SWAP

California State Wildlife Action Plan

CALIFORNIA STATE WILDLIFE ACTION PLAN

A Conservation Legacy for Californians

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DRAFT

California State Wildlife Action Plan 2025 Update

A Conservation Legacy for Californians

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Acronyms and Abbreviations

ABAG	Association of Bay Area Governments
ACE	Areas of Conservation Emphasis
ACEC	Areas of Critical Environmental Concern
AF	Acre Feet
AFB	Air Force Base
AFRP	Anadromous Fish Restoration Program
AFWA	Association of Fish and Wildlife Agencies
AML	Appropriate Management Levels
AUM	Animal Unit Months
BCP	Budget Change Proposal
BDCP	Bay Delta Conservation Plan
BIOS	Biogeographic Information and Observation System
BLM	U.S. Bureau of Land Management
BMP	Best Management Practices
BRBP	Blue Ridge Berryessa Partnership
BSSC	Bird Species of Special Concern
BIA	Bureau of Indian Affairs
CAL FIRE	California Department of Forestry and Fire Protection
CAL FIRE FRAP	CAL FIRE Fire and Resource Assessment Program
CalEMA	California Emergency Management Agency
CalEPA	California Environmental Protection Agency
CalNASP	California National Archery in the Schools Program
CalSTA	California State Transportation Agency
CalTIP	Californians Turn in Poachers and Polluters
Caltrans	California Department of Transportation
CAMP	Campaign Against Marijuana Planting
CAPP	Conceptual Area Protection Plan

CBC	California Biodiversity Council
CCAS	California Climate Adaptation Strategy
CCWCN	Coastal Cactus Wren Conservation Network
CDFA	California Department of Food and Agriculture
CDFG	California Department of Fish and Game
CDFW	California Department of Fish and Wildlife
CDNPA	California Desert Native Plants Act
CDOC	California Department of Conservation
CDOF	California Department of Finance
CDPR	California Department of Parks and Recreation
CDTFA	California Department of Tax and Fee Administration
CEC	California Energy Commission
CEQA	California Environmental Quality Act
CERES	California Environmental Resources Evaluation System
CESA	California Endangered Species Act
CFA	Code of Federal Regulations
CHAT	Crucial Habitat Assessment Tool
CIB	California Interregional Blueprint
CISAC	California Invasive Species Advisory Committee
CISR	Center for Invasive Species Research
CLNWS	China Lake Naval Weapons Station
CNDDB	California Natural Diversity Database
CNPS	California Native Plant Society
CNRA	California Natural Resources Agency
Commission	Fish and Game Commission
CTP	California Transportation Plan
CVFPP	Central Valley Flood Protection Plan
CVP	California Central Valley Project
CVPIA	Central Valley Improvement Protection Act
CWA	Clean Water Act

CWHR	California Wildlife Habitat Relationships
DBW	Division of Boating and Waterways
Delta Reform Act	Sacramento-San Joaquin Delta Reform Act of 2009
Delta	Sacramento-San Joaquin Delta
DMG	Deserts Managers Group
DOD	U.S. Department of Defense
DOI	U.S. Department of Interior
DOW	Defenders of Wildlife
DRECP	Desert Renewable Energy Conservation Plan
DSC	Delta Stewardship Council
DPS	Distinct Population Segment
DWR	California Department of Water Resources
EBM	Ecosystem Biodiversity Monitoring
EGPR	Environmental Goals and Policy Report
ELI	Environmental Law Institute
ELRT	Eagle Lake rainbow trout
ELRTCS	Eagle Lake Rainbow Trout Conservation Strategy
ENSO	El Niño-Southern Oscillation
EPA	U.S. Environmental Protection Agency
ERP	Ecosystem Restoration Program
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
FGC	Fish and Game Code
FPR	Forest Practice Regulation
FRAP	Fire and Resource Assessment Program
FRGP	Fisheries Restoration Grants Program
FRPA	Fish Restoration Program Agreement
GGRF	Greenhouse Gas Reduction Fund
GHG	Greenhouse Gas
GIS	Geographic Information Systems

HCP	Habitat Conservation Plan
HCPB	Habitat Conservation Planning Branch
HUC	Hydrologic Unit Code
IEP	Interagency Ecological Program
IID	Imperial Irrigation District
INRMP	Integrated Natural Resource Management Plan
IPCC	Intergovernmental Panel on Climate Change
ISCC	Invasive Species Council of California
KEA	Key Ecological Attribute
LAE	Land Acquisition Evaluation
LCC	Landscape Conservation Cooperative
LED	Law Enforcement Division
LMP	Land Management Plan
LSA	Lake and Streambed Alteration
MAST	Management, Analysis and Synthesis Team
MBTA	Migratory Bird Treaty Act
MCU	Marine Conservation Unit
MCS	Marijuana Cultivation Site
MLPA	Marine Life Protection Act
MMA	Marine Managed Area
MMBF	Million Board Feet
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
MPA	Marine Protected Area
MSCP	Multiple Species Conservation Program
MSHCP	Multiple Species Habitat Conservation Plan
MSSC	Mammal Species of Special Concern
NASP	National Archery in the Schools Program
NCCP	Natural Community Conservation Plan
NEPA	National Environmental Policy Act

NERRS	National Estuarine Research Reserve System
NGO	Non-Governmental Organization
NISC	National Invasive Species Council
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPPA	Native Plant Protection Act
NPS	National Park Service
NRCS	National Resource Conservation Service
NZMS	New Zealand mud snails
OEHHA	Office of Environmental Health Hazard Assessment
OHV	Off-Highway Vehicle
OPC	California Ocean Protection Council
OPR	Governor's Office of Planning and Research
OSPR	Office of Spill Prevention and Response
OTD	Office of Training and Development
PAD	Passage Assessment Database
PDO	Pacific decadal oscillation
PLM	Private Lands Management
PORTS	Parks On-line Resources for Teachers and Students
PUC	Public Utilities Commission
QSA	Quantification Settlement Agreement
RAMP	Regional Advance Mitigation Planning
RCD	Resource Conservation District
RDM	Residual Dry Matter
REAT	Renewable Energy Action Team
ROW	Right-Of-Way
RWQCB	Regional Water Quality Control Board
SCP	Scientific Collector's Permit
SGCN	Species of Greatest Conservation Need

SHA	Safe Harbor Agreement
SHARE	Shared Habitat Alliance for Recreational Enhancement
SI	CDFW's Science Institute
Sierra Framework	Sierra Nevada Framework for Conservation and Collaboration
SJRRP	San Joaquin River Restoration Program
SMART	Specific, Measurable, Attainable, Relevant, and Time-Bound
SMCA	State Marine Conservation Area
SMR	State Marine Reserve
SMRMA	State Marine Recreational Management Area
SNEP	Sierra Nevada Ecosystem Project
SNFPA	Sierra Nevada Forest Plan Amendment
SRWP	Sacramento River Watershed Program
SSC	Species of Special Concern
SVRA	State Vehicular Recreation Area
SWAP	State Wildlife Action Plan
SWG	State and Tribal Wildlife Grants
SWP	State Water Project
SWRCB	State Water Resources Control Board
TA	Technical Assistance
TAC	Technical Advisory Committee
TCP	Timberland Conservation Program
TMDL	Total maximum daily load
TNC	The Nature Conservancy
USBR	U.S. Bureau of Reclamation
USDA	U.S. Department of Agriculture
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
USNVC	U.S. National Vegetation Classification
UTS	Unarmored Threespine Stickleback

VegCAMP	Vegetation Classification and Mapping Program
WCB	Wildlife Conservation Board
WCGA	West Coast Governors Alliance
WET	Watershed Enforcement Team
WHL	Wildlife Health Laboratory
WFL	Wildlife Forensic Laboratory

Executive Summary

Congress created the State and Tribal Wildlife Grants (SWG) program in 2000, recognizing the need to fund programs for the conservation of wildlife diversity. Congress mandated each state and territory to develop by 2005 a State Wildlife Action Plan (SWAP) that provided a comprehensive wildlife conservation strategy to continue receiving federal funds through the SWG program. California's first SWAP was completed by California Department of Fish and Game (now the California Department of Fish and Wildlife [CDFW]) and approved by the U.S. Fish and Wildlife Service (USFWS) in 2005. CDFW has received approximately $71 million in federal support for the state's wildlife conservation activities through the SWG program from 2005 through 2024. The SWG program requires SWAP updates at least every 10 years. CDFW completed its first comprehensive review and major SWAP update in 2015. CDFW has now prepared SWAP 2025, which is the comprehensive update of SWAP 2015.

Vision for Wildlife Conservation

In SWAP 2025, CDFW focuses on conservation of the wildlife resources of the nation's most biologically diverse state. SWAP 2025 is a flexible, but scientifically grounded plan. Employing an ecosystem approach to conserve and manage diverse habitats and species, SWAP 2025 provides a blueprint for actions necessary to address the highest priorities for conserving California's aquatic, marine, and terrestrial resources. Its implementation relies on making important and helpful conservation information more accessible to resource managers and the public, and on developing lasting partnerships with a broad array of governments, agencies, organizations, businesses, and citizens.

For SWAP 2025 to be successful, it will need to be supported and adopted internally at the highest levels and by staff of CDFW, as well as externally by partners. Internally, priorities will be articulated, and direction given to integrate and implement SWAP goals, strategies, and actions into programs and ongoing activities. Externally, CDFW will advocate for adoption and integration of SWAP goals, strategies, and actions into other planning efforts and coordinate and collaborate with its conservation partners to leverage human and financial capacity to achieve success.

CDFW's vision for conserving the state's wildlife is to sustain the floral and faunal biodiversity of California over the next decade, and to establish a solid conservation framework for the decades that follow. Through SWAP 2025 and together with diverse partners, CDFW seeks to:

- Maintain and enhance the integrity of ecosystems by conserving key natural processes and functions, habitat qualities, and sustainable native species population levels, so that California's ecosystems are resilient to shifting environmental conditions resulting from climate change and other causes
- Promote partnerships with federal, state, and local agencies, California Native Americans, and non-governmental organizations with aligned conservation goals to leverage efficient use of funding and other public resources
- Inspire greater understanding and recognition of critical needs for conserving wildlife and their habitats by lawmakers, land use planners, private landowners, California Native American tribes, and others who have influence in developing and implementing conservation actions
- Allocate sufficient water and manage water resources to maintain healthy ecosystems and fish and wildlife populations when considering state and regional water supply needs
- Provide resources and coordinate efforts with partners to eradicate or control invasive species and prevent new introductions

- Promote hunting and fishing as a conservation tool to use when working to eradicate or control invasive or non-native game species
- Sustain the quality of California's natural resources and biodiversity in harmony with predicted economic growth and human population increases
- Continue to prioritize protection of key habitat linkages, sensitive habitats, and specialized habitats for SGCN
- Integrate wildlife conservation with working landscapes and environments, recognizing both the economic and ecological values of agriculture, rangeland, forestry, and fisheries
- Support conservation programs that benefit native species, habitats, and ecosystems through broad-based public funding from federal, state, special district, and local government sources
- Seek and encourage collaborative relationships with California Native American tribes, including for the co-management of resources and the incorporation of Traditional Ecological Knowledge and practices (TEK)
- Engage in research and resource assessment practices, including data collection, storage and analysis, to inform environmental conservation and management
- Educate the public about wildlife conservation issues, including hunting and fishing as conservation tool, and inspire a conservation ethic in present and future generations through public outreach
- Enhance conservation capacity by clearly articulating conservation purposes, implementing strategies more effectively, applying adaptive management principles, and effectively using staff and financial resources

Statewide Goals

Three statewide goals to enhance California ecosystems have been identified for SWAP 2025. These overarching goals, with their associated sub-goals, represent the desired ecological outcomes of SWAP 2025 implementation.

Goal 1 – Abundance and Richness: Maintain and increase ecosystem and native species distributions in California, while sustaining and enhancing species abundance and richness

- Goal 1.1 (Ecosystem Distribution): Maintain and increase ecosystem distributions
- Goal 1.2 (Native Species Range and Distribution): Maintain and increase native species ranges and distributions
- Goal 1.3 (Native Species Abundance and Richness): Sustain and enhance native species abundance and diversity, including genetic diversity
- Goal 1.4 (Ecosystem Richness): Sustain and enhance ecosystem diversity

Goal 2 - Enhance Ecosystem Conditions: Maintain and improve ecological conditions vital for sustaining ecosystems in California

- Goal 2.1 (Connectivity): Maintain and improve connectivity vital for sustaining ecosystems (including those relevant to vegetation, wildlife corridors, genetic permeability, water flow, floodplains [longitudinal and lateral], and groundwater)
- Goal 2.2 (Community Structure and Composition): Maintain and improve community structure and composition vital for sustaining ecosystems (including age structure, structural heterogeneity, habitat richness, and native and key species population levels)
- Goal 2.3 (Water Quality, Quantity, and Availability): Maintain and improve water quality (including temperature, chemistry, and pollutant/nutrient concentrations and dynamics) and water quantity and availability vital for sustaining ecosystems and their attributes (including ocean, lakes, rivers, streams, groundwater, and snowpack)
- Goal 2.4 (Soil and Sediment Quality): Maintain and improve soil and sediment quality vital for sustaining ecosystems (including soil moisture, chemistry, and pollutant/nutrient concentrations and dynamics)

Goal 3 - Enhance Ecosystem Functions and Processes: Maintain and improve ecosystem functions and processes vital for sustaining ecosystems in California

- Goal 3.1 (Successional Dynamics): Maintain or improve successional dynamics vital for sustaining ecosystems
- Goal 3.2 (Disturbance Regime): Maintain or improve disturbance regimes vital for sustaining ecosystems (including fire, flooding and grazing regimes)
- Goal 3.3 (Hydrological Regime): Maintain or improve hydrological regimes vital for sustaining ecosystems (including riverine, lacustrine, and estuarine hydrodynamics)
- Goal 3.4 (Sediment Deposition Regime): Maintain or improve sediment deposition regimes vital for sustaining ecosystems (including hydro-geomorphic processes, wind-driven processes, and soil stability)

Ecosystem Approach

A multi-species ecosystem approach was used as the guiding framework for developing SWAP 2025. An ecosystem approach to conservation involves maintaining and enhancing the ecosystem processes, structure, and conditions, recognizing that all components are interrelated in a dynamically changing system. Large-scale landscape approaches are generally the most reliable and preferred method to conserve ecological integrity, including biological diversity. The approach benefits both game and non-game wildlife species, and creates many co-benefits related to both ecological values (such as enhanced water quality, soil conservation, or resilience to the effects of climate change) and societal values (such as open space, scenic quality, or outdoor recreation opportunities).

Species of Greatest Conservation Need

A key element of updating the SWAP is identifying and compiling information on the species of wildlife that are indicative of the state's biological diversity and have the greatest need for conservation. These species are referred to as Species of Greatest

Conservation Need (SGCN). For SWAP 2025, CDFW subject matter experts developed criteria and evaluated species, resulting in a list of over 1,000 species of invertebrates, amphibians, reptiles, fish, birds, mammals, plants, and algae that are considered SGCN. Because of the large number of species, applying a species-based conservation approach to develop SWAP 2025 was not feasible; however, it is recognized that an ecosystem approach may present limitations that must be balanced with species-specific efforts when needed to effectively address conservation of species.

SWAP 2025 used three criteria to determine the list of SGCN:

- Species listed at threatened, endangered, or candidate species in California under the federal Endangered Species Act or the California Endangered Species Act
- Species for which there is a conservation concern (generally equivalent to California Species of Special Concern and Fully Protected Species)
- Species identified by CDFW as being highly vulnerable to climate change, experiencing population decline, or being highly vulnerable to other stressors (e.g., pesticides, disease, habitat loss, etc.)

Consideration of Climate Change

Significant climate-related changes to California's environment have been documented in the last decade, including sea level rise, natural community shifts, increased prevalence of invasive species, increased number and intensity of wildfires, and prolonged drought (California Natural Resources Agency [CNRA] 2024). Climate-induced effects on wildlife, in combination with other pressures, have the potential to greatly diminish vulnerable wildlife populations and habitats and must be considered when developing management strategies. Climate change considerations have been given great weight during development of SWAP 2025 in the following ways:

- Adopting climate vulnerability as a criterion for selecting SGCN
- Incorporating climate forecasts when assessing the ecological conditions of conservation targets
- Identifying how the SWAP conservation strategies align with California's Climate Change Adaptation Strategy (CNRA 2024) and the National Fish, Wildlife, and Plants Climate Adaptation Strategy (Pellicciotto et al. 2012), thus achieving important climate adaptation co-benefits through SWAP implementation

Prioritizing Conservation Targets

The SWAP elements required by USFWS, and the basis of developing multi-species conservation strategies, are based on broad resource categories of natural resources in California. SWAP 2025 recognizes that some conservation strategies apply to specific geographic regions while other conservation strategies are more broadly relevant across multiple regions or possibly statewide. To assess conservation strategies at appropriate scales, SWAP 2025 grouped resource categories into 'conservation units' using the following established geographic units:

- Terrestrial resources were grouped by ecoregions based on the U.S. Forest Service Ecoregion Classification.
- Freshwater aquatic resources were grouped by hydrologic units based on the four digit hydrologic unit codes (HUC) identified by the U.S. Geologic Survey.
- The San Francisco Bay Delta (Figure 1.5-5) area consists of the entire San Francisco Bay and portions of the San Francisco Bay HUC (HUC 1805), Sacramento River HUC (HUC 1802), and San Joaquin River HUC (HUC 1804). The Bay Delta boundary includes areas of tidal influence, areas of salt marsh vegetation, and lowland elevations behind dikes/levees.
- Marine Conservation Unit was identified under the Marine Life Protection Act [(Fish and Game Code [FGC] §§ 2850-2863]). The SWAP Marine Province is a single Marine Conservation Unit (MCU) and is divided into three Marine Bioregions (bioregions).
- Anadromous fish, which span the above-defined geographic scales. Anadromous fish strategies are based on the geographic scale defined by their migratory life cycle.

The conservation units, with the exception of anadromous fish, were grouped into seven major geographic provinces to facilitate discussion of ecosystems, natural communities, and species at a scale appropriate for regional conservation planning. The seven provinces are:

- North Coast and Klamath
- Cascades and Modoc Plateau
- Central Valley and Sierra Nevada
- Bay Delta and Central Coast
- South Coast
- Deserts
- Marine

For each conservation unit in California, SWAP 2025 developed at least one conservation target, consisting of a set of conservation strategies to improve conditions of a conservation target. The focus of SWAP 2025 is on species deemed to be most rare, imperiled, and in need of conservation. Habitat types with high levels of species richness, high counts of rare and endemic species, and high counts of vulnerable species (including declining and at-risk species and SGCN), were prioritized for selection as potential terrestrial conservation targets. Expert opinion and knowledge were employed to identify the highest priority freshwater aquatic targets for each hydrologic unit. Marine ecosystem targets were based on priorities identified through work recently completed as part of the Marine Life Protection Act (MLPA). Anadromous fish conservation targets are key species, species guilds, habitat types, or ecological processes essential to the future conservation of anadromous species. They have been prioritized by CDFW to adequately encapsulate their evolutionary and ecological significance.

Development of Conservation Strategies

SWAP 2025 provides an ecosystem approach for conserving California's fish and wildlife resources by identifying strategies intended to improve conditions of SGCN and the ecosystems upon which they depend (Figure 1). Regional conservation strategies have been developed in SWAP 2025 for terrestrial, freshwater aquatic, and marine resources.

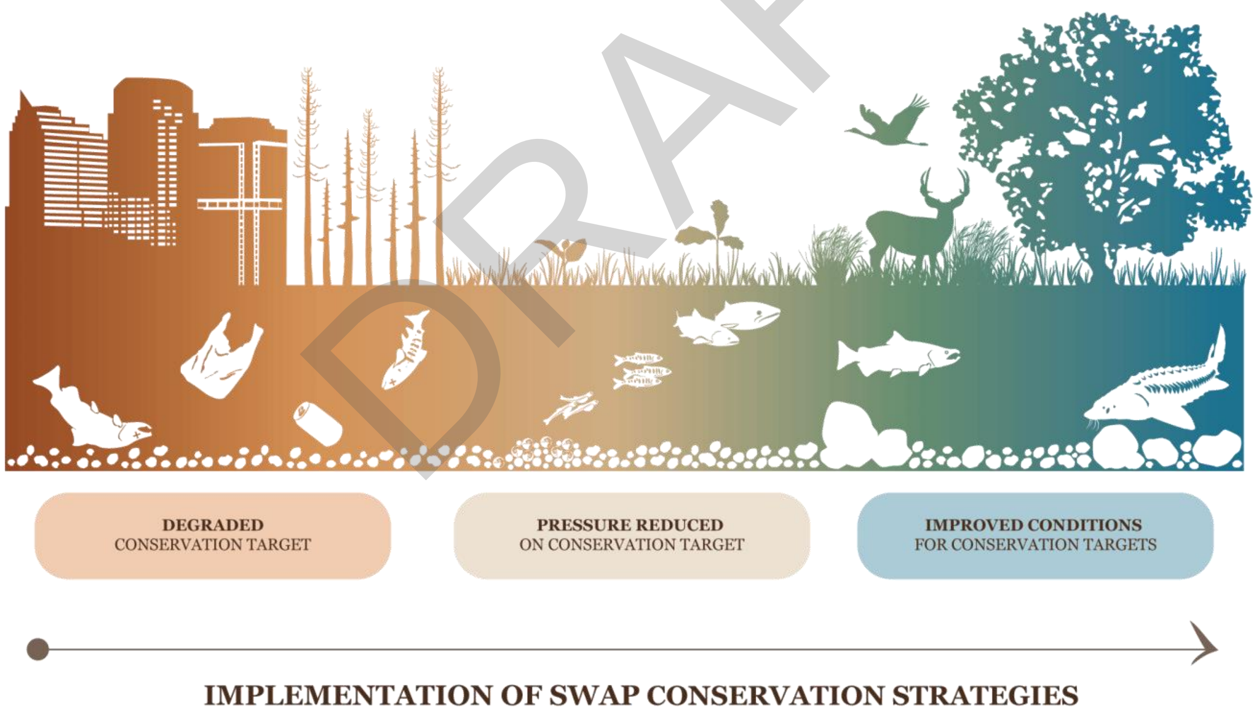


Figure 1 Ecosystem Condition Before and After SWAP 2025 Implementation

Specific conservation strategies were developed for each conservation target using a systematic approach. First, for each conservation target, key ecological attributes (KEAs) were identified. These attributes are the ecological qualities on which the viability of the conservation target most depends. Stresses, the degraded conditions of the ecological attributes, were then identified followed by the identification of the sources of the degradation called pressures, which consist of anthropogenic (human-induced) or natural drivers that have strong influences on the ecological conditions of the target. If applicable, underlying socio-economic causes for the pressures were also recognized. After illustrating the interrelationship of KEAs, stresses and pressures, conservation strategies were developed that would either directly or indirectly alleviate negative impacts of pressures or stresses, or to improve or maintain the ecological viability of conservation targets by conserving KEAs. Strategies reduce pressures directly and stresses indirectly or act directly on stresses or the target. How all these components work together to achieve SWAP 2025 goals is conceptualized below.

Definitions Important to SWAP 2025

Conservation Target: An element of biodiversity at a project site, which can be a species, habitat/ecological system, or ecological process on which a project has chosen to focus.

Goal: A formal statement detailing a desired outcome of a conservation project, such as a desired future status of a target.

Key Ecological Attribute (KEA): Aspects of a target's biology or ecology that, if present, define a healthy target and, if missing or altered, would lead to the outright loss or extreme degradation of the target over time.

Objective: A formal statement detailing a desired outcome of a conservation project, such as reducing the negative impacts of a critical pressure (defined below). The scope of an objective is broader than that of a goal because it may address positive impacts not related to ecological entities (such as getting better ecological data or developing conservation plans) that would be important for the project. The set of objectives developed for a conservation project are intended, as a whole, to lead to the achievement of a goal or goals, that is, improvements of key ecological attributes.

Pressure: An anthropogenic (human-induced) or natural driver that could result in changing the ecological conditions of the target. Pressures can be positive or negative depending on intensity, timing, and duration. Negative or positive, the influence of a pressure to the target is likely to be significant.

Species of Greatest Conservation Need (SGCN): All state and federally listed and candidate species; species for which there is a conservation concern (i.e., Species of Special Concern and Fully Protected Species); species identified as being highly vulnerable to climate change, experiencing population declines, or highly vulnerable to stressors; and species whose take is expressly prohibited by NOAA-NMFS or CDFW, a federal rebuilding plan, or considered overfished. Invertebrates with NatureServe ranks of S1 and S1S2 are also included.

Strategy: A group of actions with a common focus that work together to reduce pressures, capitalize on opportunities, or restore natural systems. A set of strategies identified under a project is intended, as a whole, to achieve goals, objectives, and other key results addressed under the project.

Stress: A degraded ecological condition of a target that resulted directly or indirectly from negative impacts of pressures (e.g., habitat fragmentation).

Statewide Summary of Key Ecological Attributes, Stresses, Pressures, and Conservation Strategies

Key Ecological Attributes (KEAs) are aspects of a target's biology or ecology that, if present, define a healthy target and, if missing or altered, would lead to the outright loss or extreme degradation of the target over time.

Most Commonly Identified KEAs

- Area and extent of community
- Community structure and composition
- Connectivity among communities and ecosystems
- Fire regime
- Hydrological regime
- Nutrient concentration and dynamics
- Pollutant concentrations and dynamics
- Soil quality and sediment deposition regime
- Successional dynamics
- Surface water flow regime
- Water level fluctuations
- Water quality
- Water temperatures and chemistry
- Weather regime

KEAs of the Marine Province

- Area or extent of the ecosystem communities
- Relative abundance of key species populations as indicated by metrics
- Species age or size class heterogeneity
- Diversity in species composition inside and outside of MPA
- Relative abundance of native versus invasive or non-native species
- Changes in abiotic parameters over time
- Changes in human use patterns over time

A stress is an attribute of a conservation target's ecology that is impaired directly or indirectly by human activity (Salafsky et al. 2008). Understanding the ecological stresses experienced by California wildlife and ecosystems is critical to identify the conservation strategies needed to counteract them.

In 2015, CDFW and its partners ranked the primary stresses that affect each conservation target to compile a standardized set of stresses. The standardized set was used to identify the most important stresses to ecosystems within conservation units, provinces, and statewide. These stresses were reviewed and updated for SWAP 2025. The categories of stresses described below are interrelated and many of these stresses will be exacerbated by climate change.

Categories of SWAP 2025 Stresses

- Geophysical and disturbance regimes
- Soil and sediment characteristics
- Hydrology and water characteristics
- Ecosystem conditions and processes
- Coastal and oceanic characteristics
- Climate related factors

A pressure is an activity that influences a stress and could significantly change the ecological conditions of a community. CDFW and partners assessed the major pressures on each conservation target to compile a standardized set of pressures that are most important within conservation units, provinces, and statewide. The impact of pressures varies between provinces, and some pressures may not impact all provinces.

SWAP 2025 Pressures

- Agricultural and forestry effluents
- Airborne pollutants
- Annual and perennial non-timber crops
- Catastrophic geological events
- Climate change
- Commercial and industrial areas
- Dams and water management/use
- Fire and fire suppression
- Fishing and harvesting aquatic resources
- Garbage and solid waste
- Household sewage and urban wastewater
- Housing and urban areas
- Industrial and military effluents
- Introduced genetic material
- Invasive plants/animals
- Livestock, farming, and ranching
- Logging and wood harvesting
- Marine and freshwater aquaculture
- Military activities
- Mining and quarrying
- Other ecosystem modifications

- Parasites/pathogens/diseases
- Recreational activities
- Renewable energy
- Roads and railroads
- Shipping lanes
- Tourism and recreation areas
- Utility and service lines
- Wood and pulp plantations

CDFW identified conservation strategies using standardized terms consistent with the internationally recognized Open Standards for the Practice of Conservation (Conservation Measures Partnership 2020). The standardized use of conservation strategy terms facilitates communication among CDFW staff and with external conservation partners, whether federal, state, or local agencies; tribal governments; non-governmental organizations; or private landowners. Conservation strategies were developed to be used widely by partners and are appropriate to apply to any habitats or SGCNs in California when relevant.

SWAP 2025 Conservation Strategy Categories

- Data Collection and Analysis
- Partner Engagement
- Management Planning
- Direct Management
- Economic Incentives
- Environmental Review
- Land Acquisition, Easement, and Lease
- Land Use Planning
- Law and Policy
- Outreach and Education
- Training and Technical Assistance

Integration and Implementation

Integration and implementation are two of the most important aspects of SWAP 2025 development. Implementation of California's SWAP 2025 will involve integrating SWAP features into other resource management programs and plans led by CDFW or partners, developing more detailed SWAP implementation plans, systematically pursuing resources necessary for implementation of conservation strategies, effectively coordinating and collaborating with CDFW partners, and adaptively responding to emerging issues.

Because of California's tremendous biodiversity and the broad spectrum of actions needed to implement conservation strategies across a complex assemblage of resources, land uses, government activities, and resource-consumptive industries, CDFW determined that a more detailed coordination framework for SWAP implementation was needed. Called "companion plans," these sector-specific action plans will continue to be instrumental in the implementation of SWAP 2025. CDFW, in partnership with other state and federal agencies and organizations involved in the use, management, and conservation of California's natural resources and cultural heritage, created nine sector-specific plans. CDFW revised the Tribal Lands and Water Management plans in 2025.

Sector-Specific Companion Plans

- Agriculture
- Consumptive and Recreational Uses
- Energy Development
- Forests and Rangelands
- Land Use Planning
- Transportation Planning
- Tribal Lands
- Water Management
- Marine Resources

Companion plans support the development of well-coordinated, collaborative, multi-stakeholder efforts that leverage human and financial resources, as well as increase efficiencies for implementation of strategies, to achieve goals and objectives of SWAP 2025. These plans identified shared priorities of SWAP and CDFW partners, and mutually strengthen the conservation capabilities of CDFW and participating organizations.

Adaptive Management and Monitoring

Natural communities, ecosystems, species population dynamics, and the effects of pressures or conservation actions on the environment are inherently complex. Resource managers often need to take action to conserve species even though scientific information may be incomplete, and outcomes of the actions may be uncertain. Adaptive management is essential to implementing effective conservation programs considering these challenges. In the implementation of a conservation plan, adaptive management is a process of continually monitoring and assessing relevant environmental conditions, as well as the effects and effectiveness of conservation strategies, and adjusting the plan when improvement is needed to achieve the desired outcomes.

Monitoring is the scientific practice of taking systematic, repeated measurements of environmental conditions, using the same methods over time to make long-term comparisons. Monitoring is a critical component of managing California's rich biodiversity, particularly SGCN and the habitat on which they depend, and to evaluate project impacts, both negative and positive. Monitoring is conducted at multiple scales, depending on the research question or management issue. As such, CDFW monitors at the genetic, species, habitat, and ecosystem levels depending on project goals and priorities.

SWAP 2025 has integrated the concepts of adaptive management and monitoring into its development and implementation following the Open Standards for the Practice of Conservation.

Conclusion

California's SWAP 2025 establishes a strategic vision of the integrated conservation efforts needed to sustain the tremendous diversity of fish and wildlife resources found in the state. Although SWAP 2025 is not a specific work plan for CDFW or any other organization, it is meant to visualize, support, complement, and unite the plans of the multiple conservation and management entities within California. More detailed, operation-level plans will be needed to complete many of the strategies identified in SWAP 2025. Such plans should be developed by the appropriate entities whose interest, authority, or responsibility encompass each action and in coordination with the SWAP and its companion plans. Support provided by the SWG program will enable coordination and implementation of many projects identified in the SWAP.

SWAP 2025 is an adaptive plan that will continually be updated, revised, and improved, based on the input of all those involved in wildlife conservation. SWAP 2025 will be the first California SWAP to be web-based allowing ease of access and timely updating. Working together, Californians can shape a future with abundant wildlife, outstanding biodiversity, and healthy ecosystems that define the state and provide for the inspiration, recreation, sustenance, and livelihood of its residents and visitors for current and coming generations.

1 Introduction and Vision

"One thing is clear—to be effective, SWAPs need to serve as a catalyst for conservation, a mechanism for aggregating data that can be presented in a geospatial context, and that provides easily accessible and usable products by any and all for the purpose of conservation."

SWAP Best Practices Report (AFWA 2012)

California's State Wildlife Action Plan (SWAP) is a comprehensive, adaptable plan for conserving the state's fish and wildlife and their vital natural habitats into future generations. It is part of a nationwide effort by all 50 states and five U.S. territories to develop conservation action plans and participate in the federally authorized State Wildlife Grants (SWG) Program.

This program supports state actions that benefit wildlife and habitats, particularly those that benefit the Species of Greatest Conservation Need (SGCN), as identified by individual states in their SWAP. Each state has prepared a SWAP that assesses the health of the state's wildlife and habitats, identifies the SGCN in that state and the threats they face, and outlines strategies to conserve the SGCN over the long term. SWAPs aim to describe the steps needed to conserve fish and wildlife and their habitats before species become too rare or habitats become too costly to restore. Taken as a whole, the SWAPs present a national action blueprint for conserving the country's wildlife heritage and preventing species from becoming threatened or endangered.

The California Department of Fish and Wildlife (CDFW; formerly California Department of Fish and Game, or CDFG) developed its first SWAP in 2005 (SWAP 2005; CDFG 2005) and conducted a comprehensive review to produce SWAP 2015 (CDFW 2015) To meet requirements of the SWG Program, CDFW has now prepared SWAP 2025, the second comprehensive update of SWAP 2005.

As with earlier versions, SWAP 2025 is an adaptive management plan that will be continually updated and improved, based on the input and deliberations of partners involved in wildlife conservation. It will be a living document housed as a new website. Working together, Californians can shape a future with abundant wildlife, outstanding biodiversity, and healthy ecosystems that define the state and provide for inspiration, recreation, sustenance, and livelihood of its residents and visitors for current and coming generations.

1.1 California's Challenge – Sustaining Biodiversity

California is a state with both tremendous biodiversity and a large human population. The challenges of supporting sustainable socioeconomic activities while protecting natural heritage are, therefore, paramount. SWAP 2025 is a key component of the state's approach to meeting these challenges.

California's landscapes support the greatest biodiversity of any state in the nation and the state is recognized as one of the world's important biodiversity hotspots (NatureServe 2023). The state's rich endemic ecology make California a major global conservation priority (Myers et al. 2000). California's Mediterranean climate and varied topography, geology, soils, and hydrology produced a heterogenous landscape of deserts, mountain ranges, valleys, wetlands, woodlands, rivers, estuaries, and marine environments. These diverse and unique settings provide habitats for approximately 650 bird species, 220 mammals, 100 reptiles, 75 amphibians (CDFW 2016b), 138 freshwater fish and anadromous fish (Moyle and Davis 2000), over 30,000 species of insects (including 1,600 species of native bees), and more than 6,500 taxa of native plants (Baldwin et al. 2012) including more conifer and oak diversity than any other state. California's lands span more than 158,000 square miles with over 4,900 lakes and reservoirs, 175 major rivers and streams, and 1,100 miles of coastline. California's extraordinary biodiversity and varied landscapes sustain livelihoods and cultural well-being throughout the state.

An integrated ecosystem conservation approach is essential to maintaining healthy wildlife, plant and fish populations in such a large and diverse setting. Biodiversity is California's natural defense against the impacts of climate change, and protecting biodiversity is a critical part of California's solution to the climate crisis. Unfortunately, many natural habitats in California have disappeared or are in decline, and many species that depend on these habitats throughout the state are also in decline. California has more threatened or endangered species than any other state in the nation, with approximately 30% at risk of extinction (NatureServe 2023). Slowing the loss or decline of habitat and species is key to California's future resilience.

California is also the most populous state in the nation. Recent projections by the California Department of Finance indicate that California's population is anticipated to reach 40 million by mid-century (CDOF 2023). One of California's greatest challenges is to support a large human population while conserving the state's highly biodiverse environment and natural resources. To do this, California must address improvements in livelihoods, wellbeing, and health of both people and wildlife, together. Equally important is engaging the public in conservation to heighten interest and understanding of the state's unique habitats and species, and the plight they face. Climate change compounds this challenge. The effects of extreme climate phenomena impact people and nature alike and the state's efforts to manage for these impacts will touch nearly every sector, investment, and natural resource conservation decision.

Conserving natural resources in the midst of a growing climate and biodiversity crisis has become a critical mission of the California Natural Resource Agency (CNRA). In 2017, a group of 26 scientific experts from across the state's universities, herbaria, and conservation organizations created the "Charter to Secure the Future of California's Native Biodiversity," a call to secure and recover California's biodiversity under current and changing climate conditions. In 2018, Governor Brown launched the California Biodiversity Initiative (Executive Order B-54-18) with the goal of integrating biodiversity protection into the state's environmental and economic goals and efforts, consistent with the Convention on Biological Diversity (Convention on Biological Diversity 2025). The Biodiversity Initiative also designated September 7th as California Biodiversity Day to celebrate and encourage actions to protect the state's exceptional biodiversity.

Following the Biodiversity Initiative, in 2020 Governor Newsom issued "California 30x30" to protect 30% of California's lands and waters by 2030 (Executive Order N-82-20; PRC §71450). As of January 2025, California is nearly at its goal with 25.25% terrestrial areas conserved. California's 30x30 plan seeks to conserve and restore biodiversity, expand access to nature, and mitigate and build resilience to climate change through voluntary, collaborative actions. The initiative aligns with state commitments to advance justice, equity, and diversity and inclusion, strengthen tribal partnerships, and sustain economic prosperity, clean energy resources, and food supplies (CNRA 2022). By jumpstarting this movement, and codifying it into law, California became a global biodiversity leader in the implementation of the Kunming-Montreal Global Biodiversity Framework.

1.2 Public Trust Responsibility to Manage

CDFW has jurisdiction over the conservation, protection, and management of fish, wildlife, plants, and habitat necessary for biologically sustainable populations of those species. That jurisdiction includes the authority to manage threatened or endangered native animals and plants; enter into Conservation Easement agreements, acquire properties; and seek the designation of CDFW lands as wildlife areas, ecological reserves, marine protected areas, and other natural areas. SWAP 2025 helps CDFW fulfill its multiple responsibilities.

CDFW is the state's trustee agency for protecting fish and wildlife resources, habitat and related recreation, for the people of California, as mandated by the Fish and Game Code (FGC), legislation, and other avenues. As such, under the California Environmental Quality Act, or CEQA (Public Resources Code 21000 et seq.) when a project has a potential for resulting in either a direct physical change in the environment, or a reasonably foreseeable indirect physical change in the environment, CDFW is responsible for providing biological expertise to review and comment on environmental impact arising from development, infrastructure, and other project activities as they are considered by any public agency .

As trustee agency, CDFW responsibilities also include, but are not limited to:

- Conducting wildlife resource assessments, wildlife and habitat research and monitoring, conservation planning, and wildlife management

- Assisting with the development of, and issuing approvals for Natural Community Conservation Plans
- Regulating deposition of material into or alteration of any bed, bank, channel or flow of rivers, lakes, and streams
- Regulating the take of, reviewing and making listing determinations for, and developing recovery plans for species that have been designated as rare, threatened, endangered, or candidate by the California Fish and Game Commission
- Collecting and storing scientific data, conducting analyses, evaluating resource status, and developing regulations to provide hunting and fishing opportunities to the public
- Reviewing activities that are required by statute, provide considerable public benefit, and contribute substantially to the state's economy
- Using sound science and communication to protect, maintain, enhance, and restore California's ecosystems, including marine ecosystems, for their ecological value and their enjoyment and use by the public
- Serving as the principal state agency contact for wildlife issues in all counties and communities
- Educating the public about wildlife conservation and wildlife public safety issues
- Providing technical advice for species and habitat conservation planning efforts and evaluating land acquisitions for the benefit of wildlife resources
- Advising local governments, commissions, and working groups regarding biological, technical, and conservation issues
- Serving as the lead state agency charged with addressing human-wildlife conflict, public safety, and depredation problems (a growing challenge due to the expansion of rural communities and agricultural activities)
- Participating in the development of strategies to monitor, assess, reduce, and manage wildlife disease, as well as responding to potential and actual outbreaks of disease
- Enforcing laws related to hunting, recreational and commercial fishing, trapping, cannabis cultivation, pollution, falconry, and exotic animals
- Developing solicitations and managing grant-funded conservation projects
- Consulting with California Native American tribes on the conservation, protection, and management of the state's natural resources

1.3 Vision for State Wildlife

The guiding vision for the preparation and implementation of SWAP 2025 is stated below:

Through SWAP 2025, CDFW seeks to conserve the wildlife resources of the nation's most biologically diverse state in harmony with an increasingly overlapping large human population and in recognition of the challenges of a changing climate. SWAP 2025 is a flexible and scientifically grounded plan that presents an ecosystem approach to conserve and manage California's diverse habitats and species. SWAP 2025 creates a blueprint for conservation actions that respond to the pressures on biodiversity in California's aquatic, marine, and terrestrial communities. SWAP 2025 implementation relies on making conservation information more accessible to resource managers and the public and on continuing to develop lasting partnerships with a broad array of governments, California Native American tribes, agencies, organizations, businesses, and citizens. With guidance from SWAP 2025 and help from many partners, CDFW's vision is to sustain the floral and faunal biodiversity of California over the next decade and establish the framework for ongoing conservation for future generations in the decades that follow through the strategies described in SWAP 2025.

1.3.1 Vision Components

SWAP 2025 describes the conservation factors that are crucial to the sustainability of California ecosystems. The geographic province chapters (Chapters 5.1–5.7 and Chapter 6) provide specific conservation strategies aimed to reduce or ameliorate impacts to ecological systems or enhance the vital qualities of California's natural landscapes. While the SWAP conservation strategies are tailored to specific conservation targets and geographic provinces, several components of the strategies have benefits that apply more broadly across the state and support fundamental, desired outcomes for wildlife conservation in California. The vision for wildlife conservation developed through SWAP 2025 includes the following components:

- Maintaining and enhancing the integrity of ecosystems by conserving key natural processes and functions, habitat qualities, and sustainable native species population levels, so that California's ecosystems are resilient to shifting environmental conditions resulting from climate change
- Promoting partnerships with federal, state, and local agencies, California Native American tribes; and non-governmental organizations with aligned conservation goals to leverage efficient use of funding and other public resources
- Inspiring greater understanding and recognition of critical needs for conserving wildlife and their habitats by lawmakers, land use planners, private landowners, California Native American tribes, and others who can influence conservation actions

- Allocating sufficient water and managing water resources to maintain healthy ecosystems and fish and wildlife populations when considering state and regional water supply needs
- Providing resources and coordinating efforts with partners to eradicate or control invasive species and to prevent new introductions
- Promoting hunting and fishing as a conservation tool to use when working to eradicate or control invasive or non-native game species
- Sustaining the quality of California's natural resources and biodiversity in harmony with predicted economic growth and human population increases
- Continuing to prioritize protection of key habitat linkages, sensitive habitats, and specialized habitats for SGCN
- Integrating conservation with the productivity of working landscapes and environments, recognizing the values of agriculture, rangeland, forestry, and fisheries
- Supporting conservation programs that benefit native species, habitats, and ecosystems through broad-based public funding from federal, state, special district, and local government sources
- Educating the public about wildlife conservation issues, including hunting and fishing as a conservation tool, and inspiring a conservation ethic in present and future generations through public outreach
- Seeking and encouraging collaborative relationships with California Native American tribes, including for the co-management of resources, including the incorporation of Traditional Ecological Knowledge and practices (TEK)
- Engaging in research and resource assessment practices, including data collection, storage and analysis, to inform environmental conservation and management
- Enhancing conservation capacity by clearly articulating conservation purposes, implementing strategies more effectively, applying adaptive management techniques, and effectively using staff and financial resources

1.3.2 Relationship to the CDFW Seven Strategic Initiatives

In 2006, the CDFW Executive Team identified Seven Strategic Initiatives as key area of focus in planning for and developing CDFW's priorities and is still used today. The Strategic Initiatives provide a tool for CDFW to effectively accomplish its mission and goals. The Initiatives provide a guiding framework that attempts to anticipate the future of California's wildlife resources and describe actions to improve CDFW's organizational effectiveness over an extended period.

SWAP 2025 and the CDFW Seven Strategic Initiatives are well aligned in their emphasis on collaboration and partnership for conservation success. To advance conservation, CDFW acknowledges in the Initiatives that it must conserve wildlife in a manner that serves the residents of the state. The will of the public as expressed through lawmakers, results in laws, regulations, and land use decisions, ultimately determines the quality and quantity of wildlife habitat to be preserved for the state's natural heritage and future generations. These realities suggest a model of action for conserving wildlife that inspires collaboration and cooperation among a wide range of interested parties by placing greater emphasis on educating, motivating, and engaging the public, landowners, organizations, businesses, and other agencies.

This collaborative approach maintains reliance upon scientific data, research, and ecological principles, including TEK, in making resource management decisions. Offering cooperative arrangements and incentives for conservation can result in a more enlightened and involved public. An informed public will demand that empirically supported science remain a vital part of the decision-making process. In keeping with these principles, the themes from the CDFW Seven Strategic Initiatives guide and are wholly consistent with the underpinnings of SWAP 2025:

1. Enhance communications, education and outreach
2. Develop statewide land stewardship based upon resource needs
3. Develop strong water resource management program
4. Develop/enhance partnerships
5. Improve regulatory programs
6. Enhance organizational vitality by focusing on employees and internal systems
7. Expand scientific capacity

1.4 SWAP 2025 Approach

1.4.1 Ecosystem and Multi-Species Approach to Conservation

SWAP 2025 uses the ecosystem and multi-species approach to conservation that was developed for SWAP 2015. An ecosystem approach to conservation focuses on managing natural resources at an ecosystem level to ensure that native plants, animals, and ecosystem processes are considered together. Ecosystem management aims to maintain and enhance ecological processes, structure, and conditions, by recognizing that these components are dynamically interrelated. This approach benefits both game and non-game (or harvested and non-harvested) wildlife species, plants, and fish, and creates co-benefits related to both ecological services (such as enhanced water quality, soil retention, or resilience to the effects of climate change) and societal values (such as open space, scenic quality, or outdoor recreation opportunities).

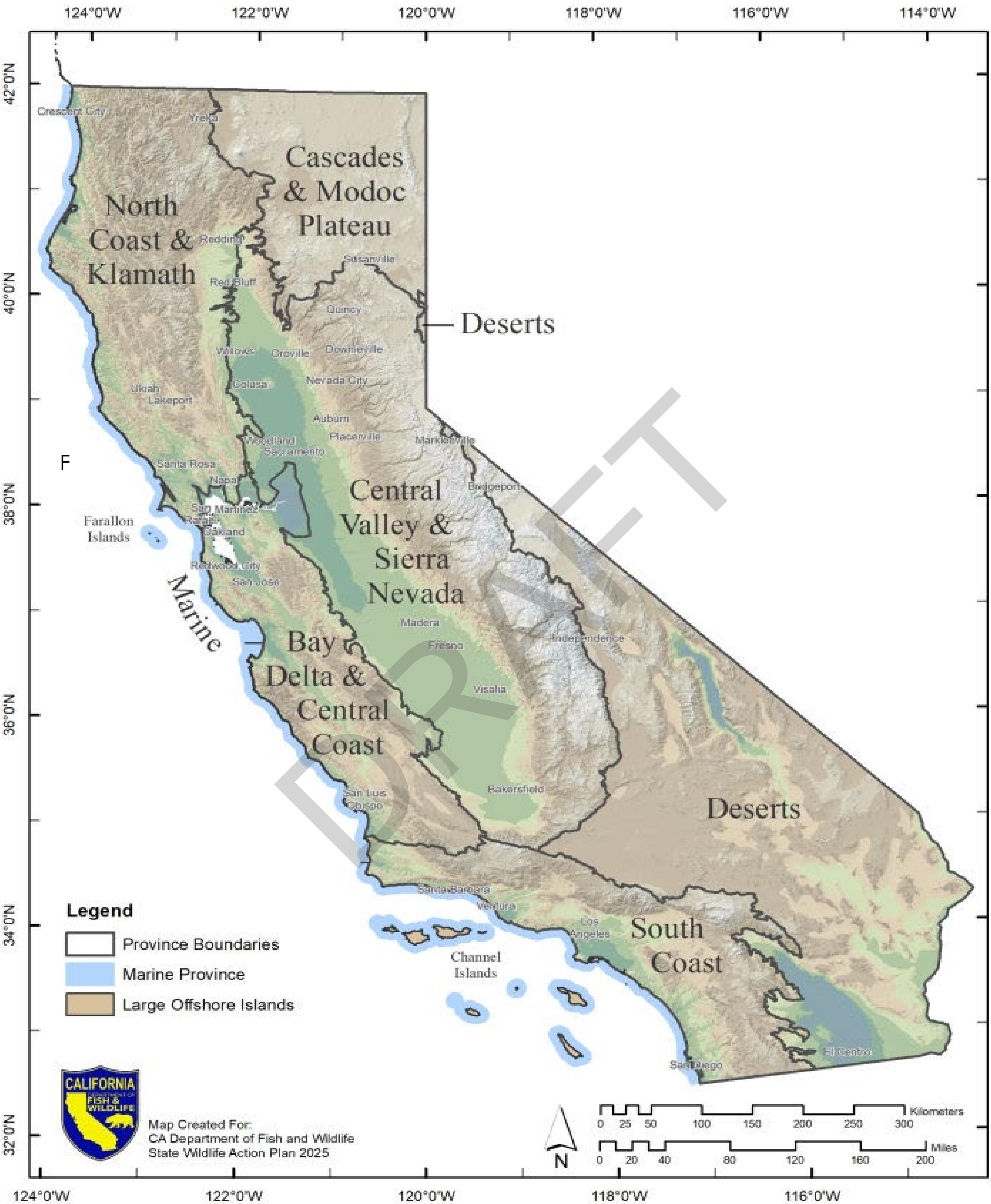
USFWS and state policy support using ecosystem-based management. The "Huffman Bill" established the policy within state government to use ecosystem-based management (FGC Section 703.3). Ecosystem-based management is defined as "an environmental management approach relying on credible science that recognizes the full array of interactions within an ecosystem, including humans, rather than considering single issues, species, or ecosystem services in isolation" (FGC Section 43).

Recognizing that individual species benefit from an ecosystem approach, SWAP 2025 identifies California's 'Species of Greatest Conservation Need' (SGCN) and proposes conservation strategies to sustain the habitats they depend on. The SGCN list consists of species deemed to be the rarest, imperiled, and/or in need of conservation, as identified by CDFW; see Chapter 2 for criteria for inclusion. A crosswalk of SGCN to habitats identified in SWAP are listed in Appendix C. Although federal SWG funding is restricted to non-game fish and wildlife species, the SWAP 2025 SGCN list includes a comprehensive range of invertebrates, fish, wildlife, and plants species considered to have the greatest conservation need in California.

Over 1,000 SGCN were identified for SWAP 2025 (Appendix C), making an assessment of threats and conservation strategies for each individual species infeasible. Instead, SWAP 2025 used an ecosystem and community-based approach to analyze and prioritize conservation threats and strategies. The conservation targets in SWAP 2025 were selected because they represent natural communities for SGCN and meet other criteria (see Appendix D). Although SGCN species and their habitats are prioritized in the SWAP, other non-SGCN species that share habitats with SGCN will benefit from implementation of the SWAP 2025 conservation strategies. The limitations presented by analyzing at the ecosystem and community level can be balanced with conservation efforts that consider species-specific actions to improve the status of SGCNs.

1.4.2 Geographic Scales

SWAP 2025 uses three geographic scales to organize California's terrestrial, freshwater aquatic, and marine ecosystems: (1) provincial scale, (2) regional conservation units, and (3) local communities/habitats. CDFW analyzed key conservation pressures on SGCN and their habitats at these three scales in order to identify conservation strategies for SGCN during their life cycles. At a broad scale, California was subdivided into seven provinces for analysis and conservation planning in SWAP 2025 (Figure 1.4-1). There are six terrestrial landscape/freshwater aquatic system provinces (grouped under the terrestrial Chapters 5.1–5.6) and one marine province (Chapter 5.7). Anadromous species were an exception (Chapter 6); CDFW developed conservation strategies at the scale of the anadromous species' migratory life cycles to account for their movement across the landscape.



Data Source: Marine Protected Area Monitoring Action Plan. California Department of Fish and Wildlife and California Ocean Protection Council, California, USA. October 2018.

Figure 1.4 - 1 SWAP Provinces

The first six provinces are described in Chapters 5.1–5.6 and are based on Bailey's provinces (Bailey 1995) from the U.S. Forest Service (USFS). These provinces use vegetation and other natural land cover types influenced by geophysical features to define boundaries. The provinces integrate the freshwater aquatic systems using the USGS hydrologic classification (HUC watersheds). Geophysical features of the state (such as a mountain ranges) and Bailey's province boundaries are primarily oriented north-south, whereas aquatic features (such as rivers) tend to have an east-west orientation; Chapters 5.1–5.6 take both geophysical and aquatic features into account. The seventh Marine Province (Chapter 5.7) consists of state-controlled, intertidal and subtidal land between the coast and a three-mile marine limit (NOAA Office of Coast Survey 2025).

SWAP 2025 uses "conservation units," and the community/habitat(s) they contain, as the scale of analysis to identify conservation targets and strategies (Figure 1.5-2). Conservation units are based on nationally recognizable organizational approaches: the USFS ecoregional classification, the USGS hydrologic classification system, and the Marine Life Protection Act (MLPA; Figure 1.5-3). Each of these classifications is flexible enough to meet unique needs of California ecosystems.

- Terrestrial "ecoregions" are defined as "sections" in the Bailey (1995) nomenclature; these are subdivisions of provinces based on major terrain features, such as a desert, plateau, valley, mountain range, or a combination thereof. SWAP 2025 uses 19 sections described in Bailey (1976) as the ecoregions for SWAP 2025 (Figure 1.4-3). The ecoregions, by definition, focus on terrestrial ecosystems, and are not well-suited for aquatic biodiversity planning, especially for fish, because rivers cross multiple ecoregions.
- Aquatic "hydrologic units" are based on the Watershed Boundary Dataset classification and mapping system of U.S. Geologic Survey (USGS), which divides and sub-divides the United States into successively smaller watersheds that are nested within each other, from the largest geographic area (i.e., regions) to the smallest geographic area (i.e., cataloging units). Each hydrologic unit is identified by a unique hydrologic unit code (HUC) consisting of two to twelve digits (in California) based on the levels within the USGS hydrologic classification system. The "subregion" level in the USGS classification system (i.e., HUC 4) is the most analogous in size and geographic configuration to the terrestrial ecoregions and were used as the hydrologic units for SWAP 2025 (Figure 1.4-4).
- The Marine Province is a single Marine Conservation Unit (MCU) and is divided into three Marine Bioregions (bioregions) for planning purposes (Figure 1.4-3). The bioregions are recognized in the CDFW and Ocean Protection Council (OPC) MPA Monitoring Action Plan and are based on data collected during baseline monitoring that identified clusters of similar biota, ecological communities, and key habitats (CDFW and OPC 2018). The bioregions include the North Coast Bioregion, from the California/Oregon border to the entrance of San Francisco Bay, the

Central Coast Bioregion, from San Francisco Bay to Point Conception, and the South Coast Bioregion, from Point Conception to the U.S./Mexico border (CDFW and OPC 2018).

There are two exceptions to the geographic scales described above:

1. For SWAP 2025, the San Francisco Bay Delta (Figure 1.5-5) consists of the entire San Francisco Bay and portions of the San Francisco Bay HUC (HUC 1805), Sacramento River HUC (HUC 1802), and San Joaquin River HUC (HUC 1804). The Bay Delta boundary includes areas of tidal influence, areas of salt marsh vegetation, and lowland elevations behind dikes/levees. In addition, the area was increased to account for climate change by including roughly a 1-meter sea level rise. This area does not correspond to the legal definition of the Delta or any CDFW organizational region; it is a unique area designed for SWAP 2025 and is called the Bay Delta conservation unit.
2. As mentioned, the analysis of anadromous species did not use the geographic conservation units described above. Anadromous fish begin life in the freshwater of rivers and streams, migrate to the ocean to grow into adults, and then return to freshwater to spawn. Because the geographic range of anadromous fishes may span multiple provinces, organization by province or conservation unit would not adequately address their conservation needs. Instead, conservation strategies for anadromous fishes were developed separately to account for all habitats within their ranges (see Chapter 6 Anadromous Fishes).

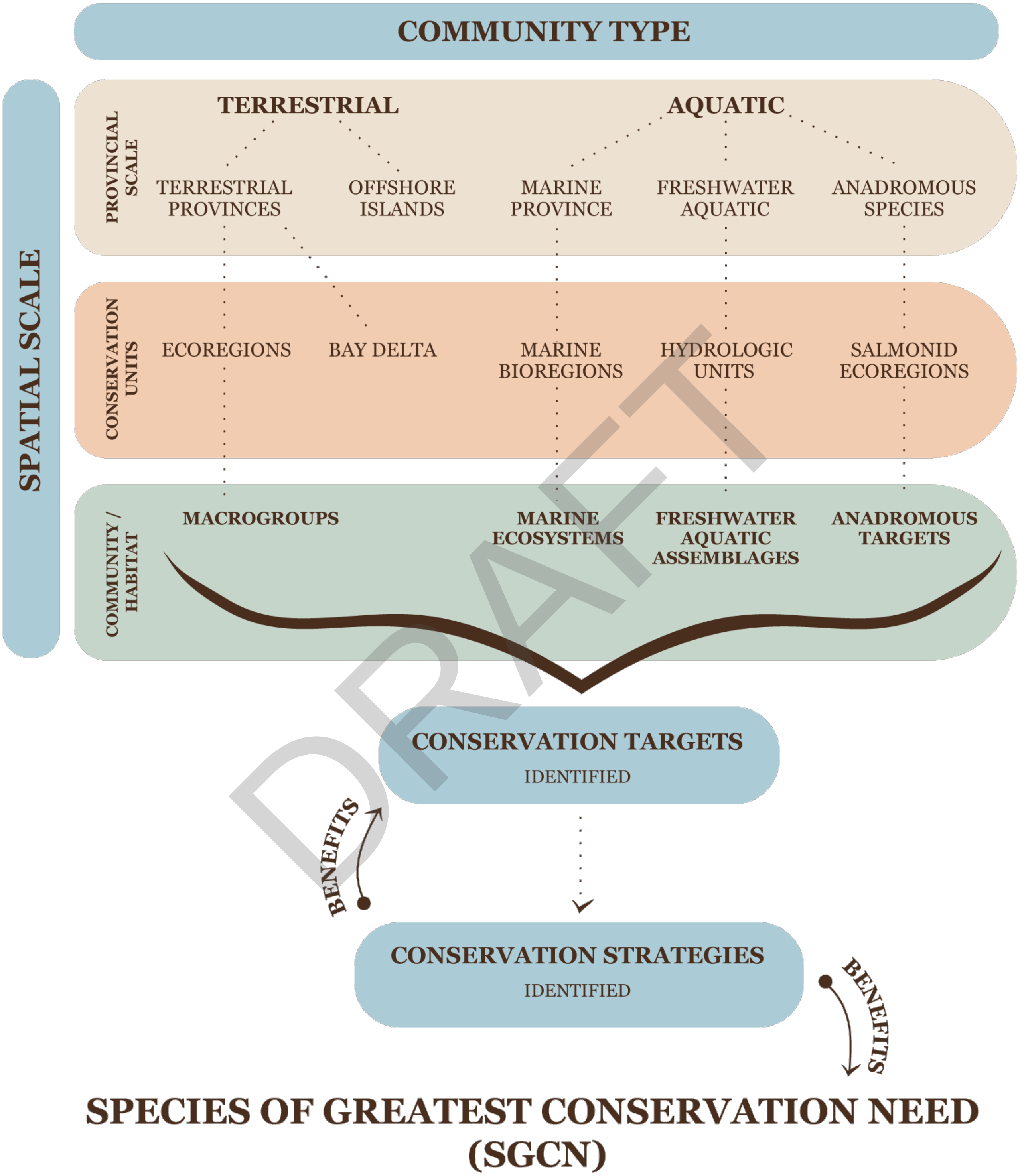
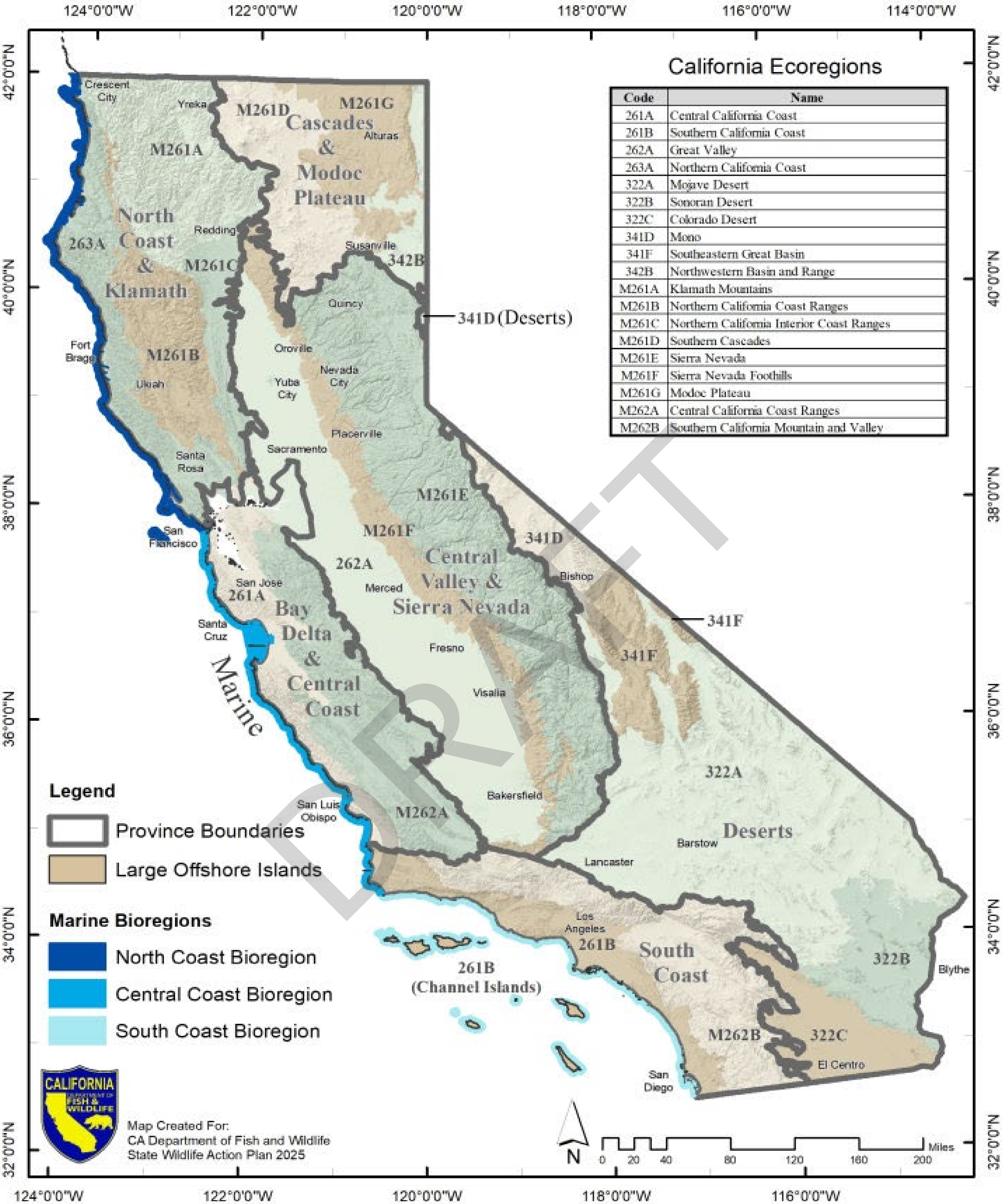
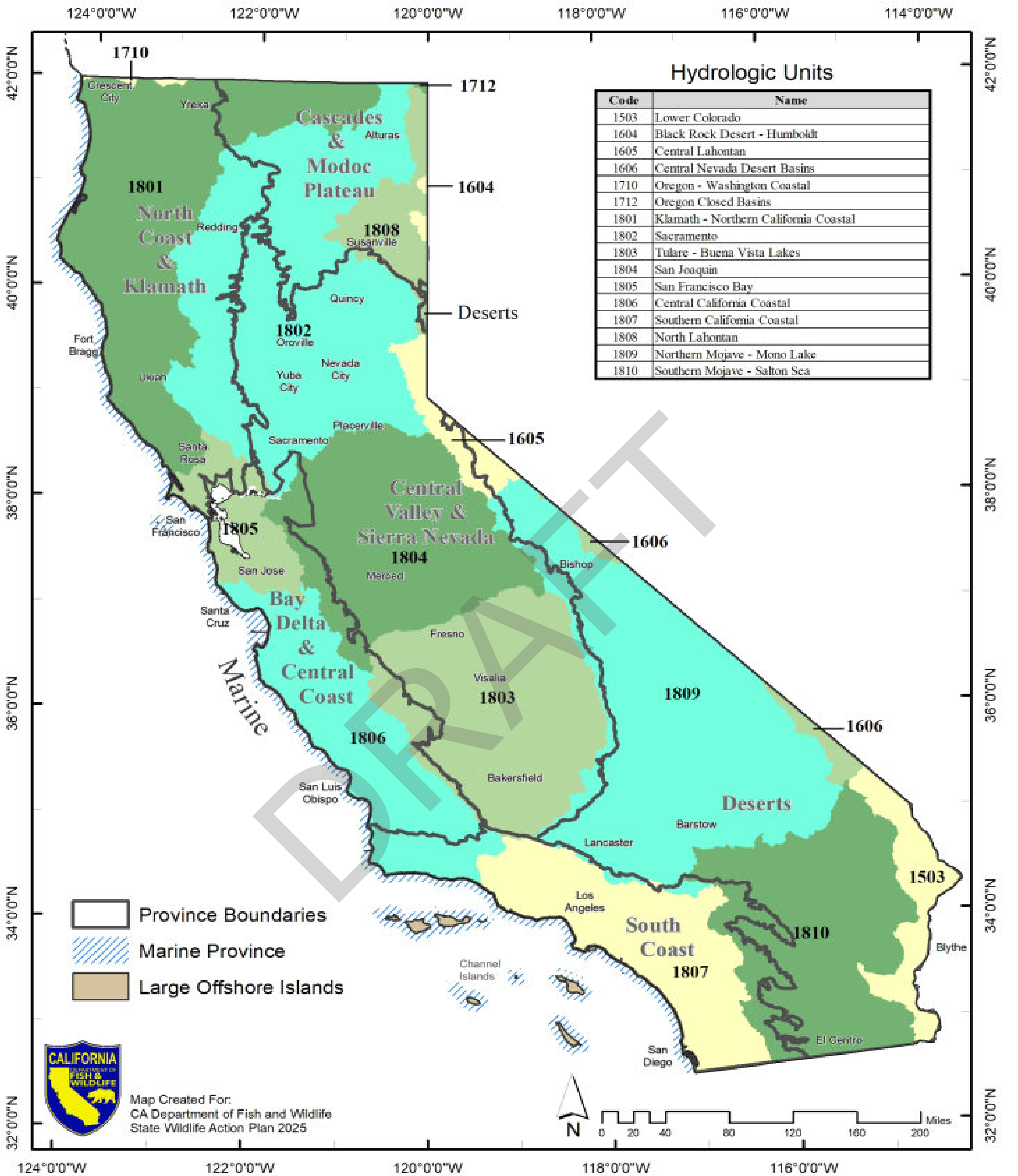


Figure 1.4 - 2 Spatial Scale of SWAP Analysis



Data Source: Marine Protected Area Monitoring Action Plan. California Department of Fish and Wildlife and California Ocean Protection Council, California, USA. October 2018.
USDA Forest Service (Ecoregion Sections); U.S. Geological Survey (hillshade)

Figure 1.4 - 3 Relationship of Ecoregions and Marine Bioregions to SWAP Provinces



Code	Name
1503	Lower Colorado
1604	Black Rock Desert - Humboldt
1605	Central Lahontan
1606	Central Nevada Desert Basins
1710	Oregon - Washington Coastal
1712	Oregon Closed Basins
1801	Klamath - Northern California Coastal
1802	Sacramento
1803	Tulare - Buena Vista Lakes
1804	San Joaquin
1805	San Francisco Bay
1806	Central California Coastal
1807	Southern California Coastal
1808	North Lahontan
1809	Northern Mojave - Mono Lake
1810	Southern Mojave - Salton Sea

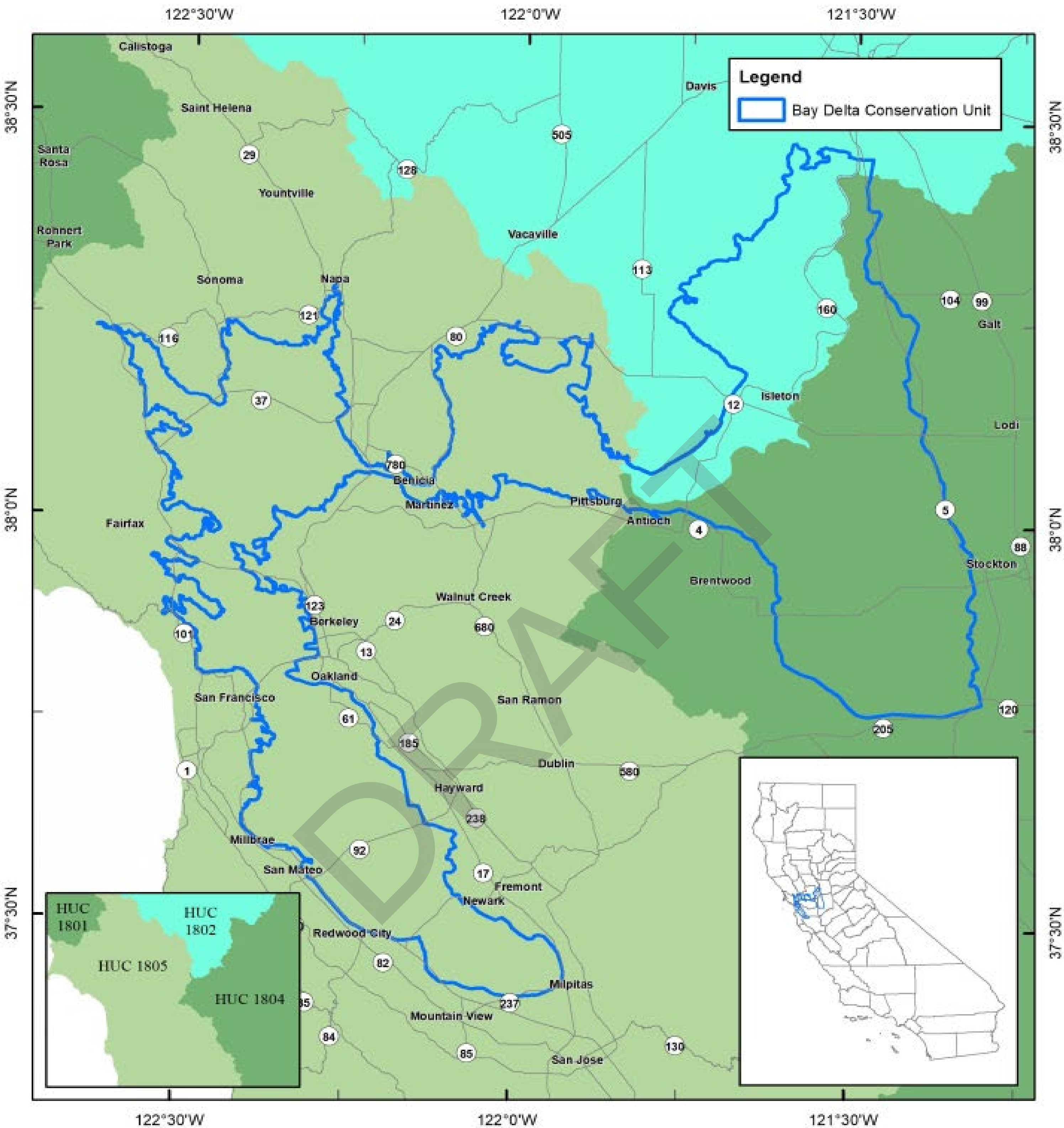
Data Source: Marine Protected Area Monitoring Action Plan. California Department of Fish and Wildlife and California Ocean Protection Council, California, USA. October 2018. National Hydrography Dataset (HUCs); USGS (hillshade)

Figure 1.4 - 4 Bay Delta Conservation Unit Boundaries for SWAP

1.4.3 Conservation Targets and Strategies – Identification and Ranking

To fulfill the required USFWS SWAP elements, SWAP 2025 identifies priority habitats/communities called "conservation targets" that have elevated levels of threats and recommends "conservation strategies" to reduce the threats on those targets and the species that use them (Salafsky et al. 2008).

A conservation target is an ecological entity chosen to be the focus of conservation actions during an environmental project. For SWAP 2025, the conservation targets are defined in terms of a natural community such as vegetation, habitat type, or a species assemblage. Conservation targets serve as a surrogate that represents the interactions between the biotic and abiotic characteristics of the larger ecosystem, including SGCN (Table 5.0; Appendix C). Using this approach, SWAP 2025 developed conservation strategies that applied to multi-species community targets within terrestrial, freshwater aquatic, and marine systems.



Map Created For:
CA Department of Fish and Wildlife
State Wildlife Action Plan 2025

Data Source: USDA Forest Service (ecoregions); US Geological Survey (hillshade), NHD (hydrologic units)

Figure 1.4 - 5 Bay Delta Conservation Unit Boundaries for SWAP

SWAP 2025 Conservation Targets

The conservation targets were selected as a subset of the following community or habitat types:

- Macrogroups are mid-level terrestrial plant communities within ecoregions that support wildlife, as defined by the National Vegetation Classification System (USNVC; See Chapter 3). The Vegetation Classification and Mapping Program (VegCAMP) develops and maintains California's expression of the USNVC. These plant communities can be considered as habitats, where a given plant or animal species is dependent on the plant community for food, cover, or reproduction at some stage, or all of its life cycle. Additional consideration of habitat elements, such as snags and logs, together with vegetation dominance or unique characteristics to which wildlife is thought to respond, allows for predictions of use based on species associations (Mayer and Laudenslayer 1988).
- Freshwater aquatic species assemblages are species that together occupy a freshwater aquatic habitat within the HUC hydrologic units and the Bay Delta conservation unit.
- Six marine ecosystems are identified in the Marine Province, and terminology is consistent with the California Marine Life Protection Act Master Plan for Marine Protected Areas (CDFW 2016a).

SWAP 2025 has two project goals for creating regional conservation projects: (1) every macrogroup occurring in California would be selected as a conservation target and 2) a conservation target would be identified in each 'conservation unit'. SWAP 2025 achieved these goals, as summarized in Appendix D.

Scientists updated the conservation targets for SWAP 2025 (Table 5.0) by assessing the status of the biodiversity, vulnerability, and degree of endemism represented by natural communities, as detailed in Appendix C. Habitat types with high levels of species richness, high counts of rare and endemic species, and high counts of vulnerable species (including declining and at-risk species and SGCN) were prioritized as terrestrial conservation targets. CDFW also used information on species geographic distributions and species habitat relationship ratings from the CWHR Program to identify targets (Mayer and Laudenslayer 1988).

For terrestrial species, an analysis was conducted of vertebrate species that rely on the habitats present within each conservation unit for feeding, cover, or reproduction. The selection was finalized by considering the conservation status of the candidate habitat types in the area. The resulting terrestrial targets are biologically rich areas with a higher risk of losing native species. Conservation strategies focused on these targets will have direct benefits to SGCN and other species that occur or otherwise depend on the habitat.

Freshwater aquatic conservation targets were prioritized based on evaluation of native fish and aquatic species assemblages within each hydrologic unit. Native fish and freshwater aquatic species assemblages are a group of species, often morphologically similar within groups, which segregate based on habitat, sub-habitat, or diet; exhibit persistence in composition through many generations; and have high resiliency (Grossman et al. 1982). In relatively undisturbed streams, species assemblages may consist of co-evolved species, which are usually tied to factors such as elevation, gradient, channel size, and shape (Moyle et al. 2003). Often imperiled because of anthropogenic habitat degradation, native species assemblages selected as targets are frequently confined to or occur totally within a single sub-hydrologic unit, such as a lake or stream. Expert opinion and knowledge were employed to identify the highest priority freshwater aquatic targets for each hydrologic unit.

CDFW Scientists identified four marine ecosystems where impacts are most likely to occur as the SWAP 2025 marine conservation targets. The marine conservation targets indicated include:

- Embayments, estuaries, and lagoons
- Intertidal zone
- Nearshore subtidal zone
- Mid-depth zone
- Deep zone
- Offshore rocks and islands

Anadromous fish conservation targets consist of species, species guilds, habitat types, or ecological processes that are vital to the survival of anadromous populations(s). The conservation targets for anadromous species occur at two scales: statewide and in four salmonid ecoregions:

- North Coast and North/Central Coast
- Klamath River
- South Coast and Southern California
- Sacramento-San Joaquin River

SWAP 2025's conservation strategies, outlined in Chapters 5 and 6, are directed at high priority conservation targets that were selected for their broad benefits to multiple species and SGCN.

The selection of conservation targets was based on the 2015 SWAP and strict target selection criteria that were applied a priori to all targets. Local experts provided additional guidance on conservation needs and imperatives. SWAP 2025 does not target some highly rated macrogroups because they are being conserved under another plan or strategy, such as a Natural Community Conservation Plan or Habitat Conservation Plan. Other lower rated macrogroups may have a greater conservation need due to pending or ongoing direct or intense pressures. For this reason, the selection or omission of any target does not necessarily reflect the prioritization of ecological goals, although all selected targets have high ecological value.

While SWAP 2025 succeeds in developing over 250 regional conservation strategies, the need for conservation planning continues to grow as California ecosystems experience novel and increasingly numerous challenges. SWAP 2025 presents conservation targets and strategies as a foundation for planning and a tool to address California's conservation needs and natural resource priorities. Implementation of the strategies outlined in SWAP 2025 will lead to measurable progress in meeting the conservation needs of the selected conservation targets and individual SGCN. As progress is made, CDFW and its partners can identify other high priority targets and define new conservation strategies, using current SWAP 2025 as a model. Using this approach, new targets will include clear objectives with strategies that are measurable, attainable, relevant, and time bound. This highlights the benefit of being web-based, which will allow the plan to evolve more efficiently.

1.4.4 Open Standards for the Practice of Conservation – Planning Framework

CDFW followed the Open Standards for the Practice of Conservation (Open Standards) (Conservation Measures Partnership 2020) for analysis of macrogroups (terrestrial plant communities), freshwater aquatic species assemblages, and marine ecosystems. Open Standards is based on a simple premise that the ecological conditions of selected targets are compromised by some negative impacts to the targets. The set of strategies developed for a given target are meant to work together to ameliorate the negative impacts to the target and to enhance the ecological conditions. Under SWAP 2025, targets are plant communities, native aquatic assemblages, anadromous fish targets, or marine ecosystems. This translates into SWAP 2025 developing a set of strategies to improve the degraded ecological conditions of selected ecosystems (Figure 1.5-6).

The Open Standards provided the framework for updating SWAP 2015 conservation units and were retained in SWAP 2025. The Open Standards will guide ongoing implementation of SWAP 2025 and future adaptive management. The steps of the Open Standards process are consistent with those needed to fulfill the eight elements required by the USFWS for SWAPs (Appendix A) (AFWA 2025), and the framework proposed by the AFWA Teaming with Wildlife Coalition for measuring the effectiveness of State Wildlife Grants (AFWA 2011).

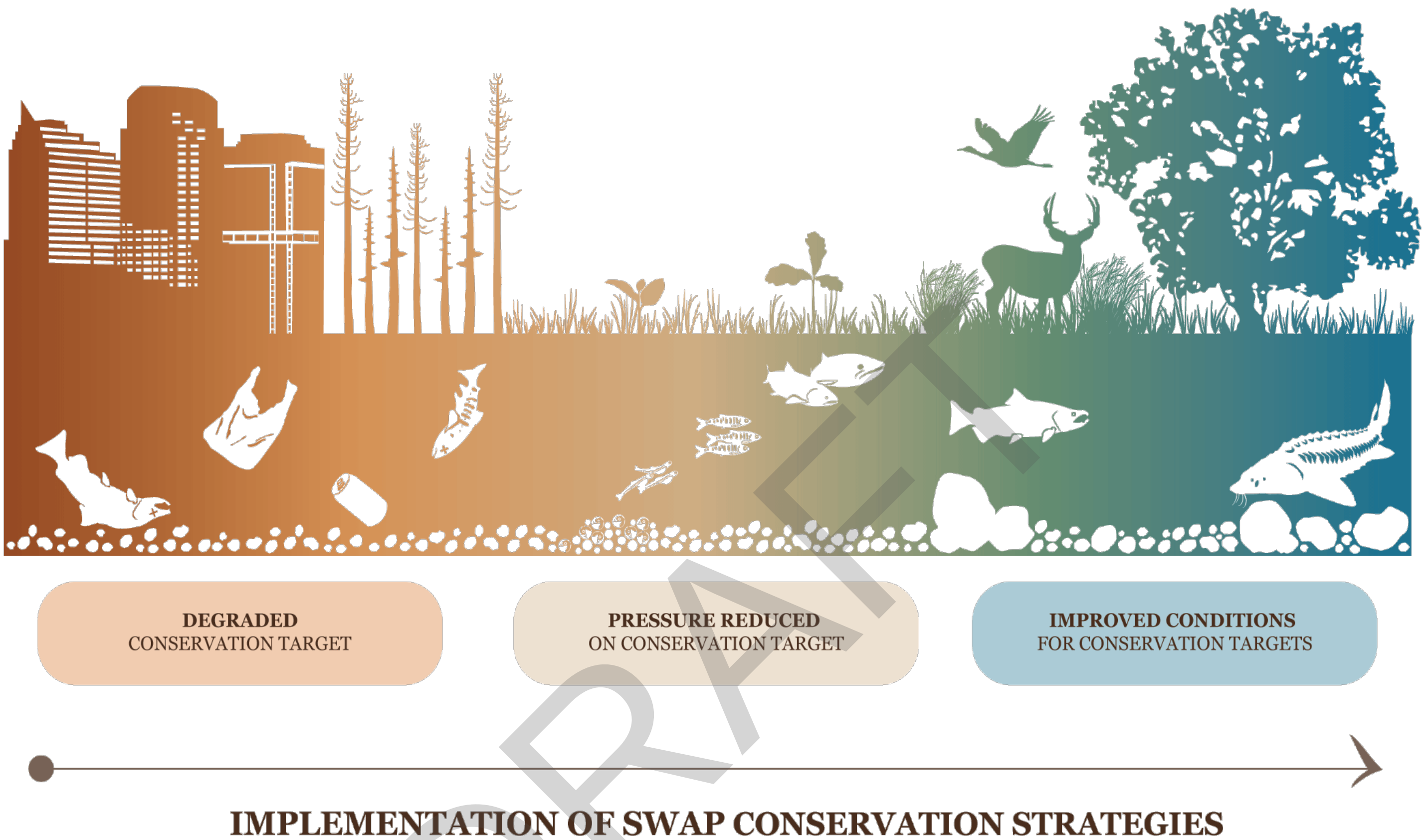


Figure1.4- 6 Ecosystem Condition Before and After SWAP Implementation

Definitions Important to SWAP 2025

Conservation Target: An element of biodiversity at a project site, which can be a species, habitat/ecological system, or ecological process on which a project has chosen to focus.

Goal: A formal statement detailing a desired outcome of a conservation project, such as a desired future status of a target.

Key Ecological Attribute (KEA): Aspects of a target's biology or ecology that, if present, define a healthy target and, if missing or altered, would lead to the outright loss or extreme degradation of the target over time.

Objective: A formal statement detailing a desired outcome of a conservation project, such as reducing the negative impacts of a critical pressure (defined below). The scope of an objective is broader than that of a goal because it may address positive impacts not related to ecological entities (such as getting better ecological data or developing conservation plans) that would be important for the project. The set of objectives developed for a conservation project are intended, as a whole, to lead to the achievement of a goal or goals, that is, improvements of key ecological attributes.

Pressure: An anthropogenic (human-induced) or natural driver that could result in changing the ecological conditions of the target. Pressures can be positive or negative depending on intensity, timing, and duration. Negative or positive, the influence of a pressure to the target is likely to be significant.

Species of Greatest Conservation Need (SGCN): All state and federally listed and candidate species; species for which there is a conservation concern (i.e., Species of Special Concern and Fully Protected Species); species identified as being highly vulnerable to climate change, experiencing population declines, or highly vulnerable to stressors; and species whose take is expressly prohibited by NOAA-NMFS or CDFW, a federal rebuilding plan, or considered overfished. Invertebrates with NatureServe ranks of S1 and S1S2 are also included.

Strategy: A group of actions with a common focus that work together to reduce pressures, capitalize on opportunities, or restore natural systems. A set of strategies identified under a project is intended, as a whole, to achieve goals, objectives, and other key results addressed under the project.

Stress: A degraded ecological condition of a target that resulted directly or indirectly from negative impacts of pressures (e.g., habitat fragmentation).

1.5 SWAP Review and Revision

USFWS directs each state to comprehensively review its SWAP at least every 10 years (Element 6; AFWA 2012). The USFWS and Association of Fish and Wildlife Agencies (AFWA) provided a Best Practices guide for SWAP revision and implementation in 2012 (AFWA 2012) and in 2017 updated the guidance on the requirements for the review and revision, including the definition of a comprehensive, major, or minor revision. All states must comprehensively review and revise, as needed, their 2015 SWAPs by October 1, 2025 (or the date specified in their approved plans) and send the updated version and summary documentation to USFWS.

SWAP 2025 is the required comprehensive review and update of SWAP 2015. The next comprehensive review and update will need to be completed no later than 2035, in accordance with Public Law 106-553 (U. S. Congress 2000). CDFW will continue to follow the USFWS/AFWA 2012 AFWA Best Practices information and the 2017 guidance, unless new information becomes available. Table 1 in the AFWA Best Practices report provides guidance regarding actions that would be helpful when conducting a review and revision to the SWAP (AFWA 2012).

Future comprehensive updates will include the summary documentation that will demonstrate the SWAP was examined and that all USFWS required elements are met (See Appendix A). If no changes are made, CDFW will document and explain why no changes were necessary and what process was used to make that determination. If changes are made, CDFW will provide a summary of the key revisions to USFWS and the public. Public participation will be a key element of future comprehensive reviews and revisions.

In addition to the statutorily required comprehensive review and update every 10 years, ongoing reviews and revisions are part of the cyclical life of any long-term resources management plan and can enhance its relevancy and implementation. CDFW intends to engage in an annual SWAP review process, and with a web-based platform, it will be efficient to ensure SWAP is a living document.

If while implementing SWAP 2025, a significant change occurs that requires revision of two or more elements of the Plan, then CDFW will initiate a major revision to the SWAP. Major revisions do not "restart" the 10-year comprehensive review timeframe. CDFW will include public participation in a major revision process and will document any revisions for both submittal to USFWS and public posting on the CDFW SWAP webpage.

A minor revision, which is defined as changes to a single element, can also be undertaken at any time in coordination with USFWS. Minor revisions are expected to involve narrow changes to the SWAP, such as technical clarifications, elaborations of existing conservation strategies, or the incorporation of new information that does not lead to substantial changes to SGCN, conservation targets, stresses, pressures, or conservation strategies. Because the revisions would be minor, a public participation process would not be needed. CDFW will email USFWS describing the minor revision and will highlight changes on the CDFW SWAP webpage.

1.5.1 SWAP 2025 Public Engagement

Element 8 of the Required Elements of a SWAP requires "provisions to ensure public participation in the development, revision, and implementation of projects and programs. Congress has affirmed that broad public participation is an essential element of this process." During the preparation of the draft SWAP 2025, two public meetings and four partner meetings were held virtually in March 2025. Over XXX people attended the meetings. Public input was sought to ensure that SWAP 2025 is adequately identifying major conservation issues in California and that the draft conservation strategies are appropriately addressing those impacts. Outreach materials discussing the various habitats included a PowerPoint presentation, a SWAP fact sheet, and summary of changes from SWAP 2015. Public comments on the draft SWAP 2025 were submitted via an online form accessible on [CDFW's SWAP website](), plus email and mail to CDFW SWAP Program.

1.6 Companion Plans

CDFW created nine 'companion plans' to serve as a framework for sector-specific conservation activities. The companion plans help focus the broad spectrum of actions needed to implement conservation strategies across California's tremendous biodiversity and array of resources, land uses (including public access), government activities, and resource-consumptive industries. The companion plans are a starting point for coordinating with stakeholders to implement SWAP in certain sectors. CDFW, in partnership with other state and federal agencies and organizations involved in use, management, and/or conservation of California's natural resources and cultural heritage, created the following nine sector-specific plans:

- Agriculture
- Consumptive and Recreational Uses
- Energy Development
- Forests and Rangelands
- Land Use Planning
- Marine Resources
- Transportation Planning
- Tribal Lands (updated in 2025)
- Water Management (updated in 2025)
- Marine Resources

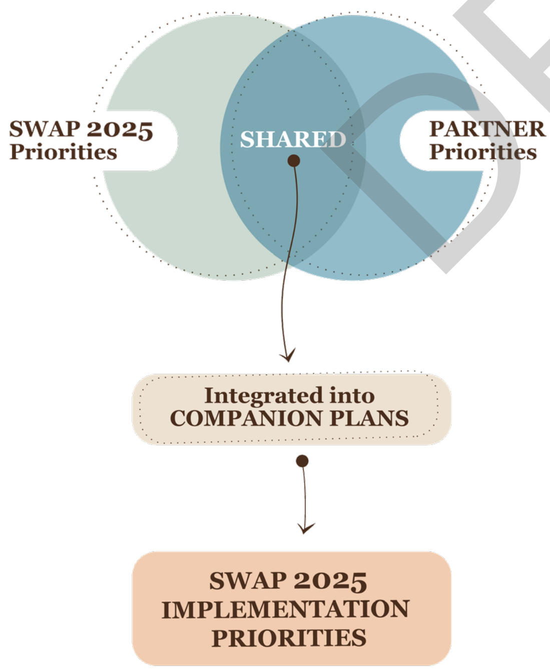


Figure 1.7 -1 SWAP and Companion Plan Priorities

Companion plans support the development of well-coordinated, collaborative, multi-stakeholder efforts that leverage human and financial resources, as well as increase efficiencies for implementation of strategies as described in SWAP 2025. These plans identify shared priorities of SWAP 2025 and CDFW partners, which could be used to mutually strengthen the capability of partners to conserve natural and cultural heritages.

The companion plans explored solutions to the complexities of collaborative conservation actions to implement SWAP 2025. These plans went beyond the basic requirements of SWAPs and strengthen implementation of SWAP 2025 by engaging partners through identification of shared conservation goals, objectives, and strategies to be highlighted as the plan's highest implementation priorities. The companion plans also fulfil AFWA's emphasis on incorporating more partner engagement as a best practice in wildlife conservation planning.

The companion plan concept stems from growing interests and needs for inter-agency and partner coordination and collaboration in the state, as indicated in the adoption of a 2013 resolution by the California Biodiversity Council (CA Biodiversity Council 2013) to promote better alignment among California and federal resource agencies for natural resource conservation priorities. The companion plan process brought agencies and partners (such as other state agencies, local and regional agencies, California Native American tribes, nongovernmental organizations, academic institutions, and industry associations) together to identify aligned priorities. Each companion plan supplements SWAP 2025 by:

- elaborating on how SWAP 2025 conservation strategies could be implemented collaboratively
- identifying sector-specific shared conservation goals, objectives, and strategies for mutual support
- outlining linkages within and among sector plans
- sharing opportunities to leverage financial or other resources for conservation actions among sectors
- identifying actions that sector partners are already taking or could take to support overall implementation of SWAP 2025
- serving as a way to engage and encourage collaboration among agencies and partners

Each companion plan:

- describes the scope of the sector
- describes goals in common with SWAP 2025 and partners' efforts
- highlights SWAP 2025 goals, objectives, and strategies that are aligned with sector priorities
- outlines the alignment of goals, objectives, and strategies with other existing plans and strategies
- describes leverage points and opportunities for implementing SWAP 2025 (e.g., key partners and potential sources of funding)
- explains a timeline and measures of success for implementing joint actions

Through cooperation and teamwork during the development, companion plans lay the groundwork for greater engagement with partners from key sectors in SWAP 2025 implementation. The companion plans are critical for determining the feasibility of conservation actions addressed in SWAP 2025 and to allocate human and financial resources to support implementing those actions. Together, SWAP 2025 and associated companion plans set a broad context and strategic direction for integrated planning and management of conservation actions.

2 California's Natural Diversity and Conservation Challenges

> "It is that range of biodiversity that we must care for – the whole thing – rather than just one or two stars."
>
> – Sir David Attenborough

California houses more native species than any other state in the U.S., including the highest concentration of endemic species, or species that occur nowhere else in the world (Stermer and CDFW 2021). California is a global biodiversity hotspot – one of only 36 worldwide – due to its remarkable variety of life and the critical threat to its unique habitats and wildlife (Myers et al. 2000).

California's biodiversity stems from the state's varied topography and climate, which has given rise to a remarkable range of habitats and a correspondingly varied array of plant and animal species. California contains an exceptional range of landscape features, latitudinal range, geological substrates and soils, and climatic conditions that have produced a wide range of ecosystems. California's alpine meadows; desert scrub; oak woodlands; diverse grasslands; vernal pool complexes; moist redwood forests; spring-fed lakes; freshwater streams, rivers, and marshes; coastal wetlands, beaches, dunes, and bluffs; giant marine kelp beds; and other habitats support a correspondingly diverse array of species.

Conservation of the state's outstanding biodiversity develops and fortifies ecosystem services, or the positive benefits that wildlife or habitats provide to people. Wildlife provides significant economic and quality of life benefits to the state through recreation, tourism, sport and commercial harvest, and ecological services, such as pest control (e.g., coyotes keep rodent populations in check and therefore reduce disease transmission risks) and pollination. Examples of ecological services provided by habitat include reduction of flood risk, improved water and air quality, and temperature moderation (e.g., shade). Many of the places where wildlife thrive are often the same as those valued for recreation and other human activities. California's residents can become active stewards by learning how to reduce pressures on the state's wildlife and reduce impacts on the state's precious natural treasure of biodiversity. By doing so, communities in California help ensure that the Golden State retains highly biodiverse wildlife populations and habitats for generations to come.

This chapter presents required Elements 1, 2, and 3 of SWAP 2025. After describing the context for biodiversity, the chapter describes the distribution and abundance of wildlife, defines the Species of Greatest Conservation Need (SGCN), and details the pressures on native habitats and SGCN in California.

2.1 Geographic and Topographic Diversity

California's natural diversity is largely due to the state's range of physical geography that is driven by regional changes in topography, geology, soils, and climate. From the Pacific Ocean to the crest of the Sierra Nevada, California's topographic variety is unparalleled. Within 80 miles of one another lie the highest and lowest points in the lower 48 states: Mount Whitney at 14,495 feet and Death Valley at 282 feet below sea level. In California's offshore waters, rocky reefs, offshore banks, and underwater canyons also create a diverse marine landscape.

Geology is a fundamental driver behind the diversity of plants and associated animals in California. The geology of California is the result of volcanic activity and upheavals from tectonic shifts that were then shaped by glaciers and erosion along the Pacific Ocean. Earth scientists divide California into 11 geomorphic provinces, recognized as naturally defined geologic regions with distinct landforms: Sierra Nevada, Cascade Range, Coast Ranges, Transverse Ranges, Peninsular Ranges, Klamath Mountains, Great Valley, Basin and Range, Modoc Plateau, Mojave Desert, and Colorado Desert (CDOC 2002). Uncommon geologic features, such as the Traverse Ranges that run east to west in southern California, contain a wide variety of vegetation types ranging from desert to subalpine that add to the high levels of biodiversity. California's geologic history of fault lines, glaciers, and erosion produced a web of complex and diverse river systems.

California's unique geological history created a range of soil types that is key to the distribution of plants and associated wildlife. California exhibits 10 of the world's 12 soil orders. Glaciation, sedimentary and volcanic deposits, movement along fault zones, the uplift of subterranean rock and sediment layers, and gradual erosion created unique topographical features and a mosaic of bedrock and soil types. Unique soil types, such as serpentine and carbonite soils derived from bedrock, are uncommon outside of California and plants have evolved specifically to survive in these soils, resulting in numerous endemic California plant species (Stermer and CDFW 2021).

California's offshore waters exhibit enormous biodiversity. Offshore waters are divided into the San Diegan zoographic province to the south and the Oregonian Province to the north (Briggs 1974). California's many islands create diverse marine habitats in the surrounding ocean. Evolution of unique island species caused by populations being isolated from mainland species has contributed to California's marine and island biodiversity.

2.2 Climatic Diversity

California's unique geography and topography create distinct climatic conditions across the state, with variations in slope, elevation, and aspect of valleys and mountains creating a range of microclimates for habitats and wildlife. California can be subdivided into five major climate types: Desert, Cool Interior, Highland, Steppe, and Mediterranean (Stermer and CDFW 2021).

However, the state is largely considered to have a Mediterranean climate, characterized by rainy winters and hot, dry summers. Along the coast, summer fog is frequent due to the influence of the Pacific Ocean. Cool Interior and Highland climates can be found on the Modoc Plateau, Klamath, Cascade, and Sierra ranges. High mountains have cooler conditions, with a deep winter snowpack in many years.

California's Desert climates vary by local topography. The Mojave Desert for example is characterized by both high-elevation mountain ranges where rain and snow are more abundant, as well as warmer, sweeping valleys below. The Steppe climate of the San Joaquin Valley is hot like a desert but averages enough moisture to also support vegetation types not commonly found in the desert.

The marine environment has a profound influence over California's terrestrial climates, particularly near the coast. Additionally, the state is known for variability in precipitation because of the El Niño-Southern Oscillation (ENSO) and the Pacific Decadal Oscillation (PDO). These oscillations are the cyclical shifting of high – and low-pressure systems, as evidenced by the wave pattern of the jet stream in the northern hemisphere. El Niño events occur when equatorial trade winds strengthen leading to warmer sea surface temperatures in the eastern Pacific Ocean, typically resulting in greater precipitation in southern California and less precipitation in northern California; La Niña events occur when waters are colder in the eastern Pacific resulting in drier than normal conditions in southern California and wetter conditions in northern California during late summer and winter. The warmer ocean temperatures associated with El Niño conditions also result in decreased upwelling in the Pacific Ocean.

2.3 Habitat and Species Diversity

California's range of geography, topography, soils, expanse of ocean waters, and climate created a variety of habitats across the state, supporting many native plant and animal species found only in California. Biological diversity is the variation of life at all levels of biological organization, including both the total of life forms across an area and the range of differences between those forms. High biodiversity can indicate small scale genetic diversity in single populations as well as landscape-scale variety of ecosystems. Greater biodiversity at the genetic, individual, species, or ecosystem level leads to greater stability (Cleland 2011); for example, species with high genetic diversity and many populations adapted to different conditions are more likely to be resilient to weather disturbances, disease, and climate change (Center for Biological Diversity 2025). CDFW's Areas of Conservation Emphasis project (ACE; See Chapter 3 for more information) synthesizes these complex data to provide measures of biodiversity that are easy to understand and readily available to the public through an interactive webmap viewer.

2.3.1 Plant Diversity

California has the highest numbers of native and endemic plant species of any state in the U.S. With approximately 6,500 species, subspecies, and varieties of plants, California contains roughly 32 percent of all vascular plants in the United States, documented in the Atlas of Biodiversity, 2nd Edition (Stermer and CDFW 2021). Nearly one-third of the state's plant species are endemic (Stein et al. 2000). Regionally, a total of 2,124 of the 3,488 species (61%) are endemic within the California Floristic Province, which encompasses the Mediterranean area of Oregon, California, and northwestern Baja (Critical Ecosystem Partnership Fund 2025).

California has been recognized as one of 36 global hotspots for plant diversity (Critical Ecosystem Partnership Fund 2025) due to the combination of the state's diversity and the threat of losing species unique to California. Nearly 300 species, subspecies, and varieties of native Californian plants are designated as rare, threatened, or endangered by state and/or federal law (CDFW 2024), and over 2,400 more plant taxa are of conservation concern.

California contains most of North America's biomes, which are geographic regions with specific climate, vegetation, and wildlife. Biomes in California include grassland, shrubland, deciduous forest, coniferous forest, tundra (alpine), mountains, deserts, rainforest (temperate), marine, estuarine, and freshwater habitats. Each biomes contains a suite of plant communities, such as redwood forests, vernal pool wetlands, or blue oak woodlands. Altogether, the state supports over 90 types of forest and woodland plant communities, over 150 shrubland plant communities, and nearly 200 herbaceous plant communities (Sawyer et al. 2009). See list of terrestrial macrogroups that were included as SWAP conservation targets in Appendix D.

Some parts of the state are particularly rich in plant species diversity. Areas of California with the greatest number of plant species include the Klamath and inner North Coast ranges, the high Sierra Nevada, the San Diego region, and the San Bernardino Mountains. Other regions with considerable plant diversity are the North and Central Coast Ranges, the Cascade Range, the Sierra Nevada foothills, and the western Transverse Range (Stermer and CDFW 2021).

The state's native flora includes many unique or unusual species. The giant sequoia, an ancient species that has survived from the Tertiary Age, is one of the most massive living organisms known. Coastal redwoods are the tallest trees in the world, reaching as high as 321 feet, taller than a 30-story building (Faber 1997). A 4,856-year-old bristlecone pine in California's White Mountains, called Methuselah, was considered the oldest living non-clonal organism (Vasek and Thorne 1988) until superseded by the discovery in 2013 of another bristlecone pine in the same area with an age of 5,064 years (Rocky Mountain Tree-Ring Research Center 2012). California is home to the smallest flowering plant in existence, the pond-dwelling water-meal, less than one-tenth of an inch across. The state also supports nine species of carnivorous plants, including sundews, butterworts, and the California pitcher plant. Numerous species have unique adaptations. Some plant species are highly restricted in their distributions, such as stands of Crucifixion-thorn, Gowen cypress, Hinds walnut, and Torrey pine. Some plants have adapted to grow on serpentine soils that are low in calcium and high in magnesium, chromium, nickel, and other heavy metals that are toxic to most plant species. Closed-cone conifer species, such as pygmy cypress and some chaparral plants have adapted to need hot fires to complete their life cycles (Faber 1997). Other Californian plant species and communities, such as mixed conifer forests, chamise chaparral, and creosote scrub, are widespread.

2.3.2 Terrestrial Wildlife Diversity

California has a large number of animal species that represent a substantial proportion of the wildlife species nationwide. The state's wildlife species include approximately 100 reptile species, 75 amphibian species, 650 bird species, and 220 mammal species (CDFW 2016). Additionally, 48 mammals, 64 birds, 72 amphibians and reptiles, and 20 freshwater fish species live in California and nowhere else (Shuford and Gardali 2008; CDFW 2016). Additionally, there are an estimated 27,000 to 100,000 terrestrial invertebrates species in California (Ballmer 1995; Kimsey 1996).

The high level of wildlife diversity derives from the range of natural communities available as habitat. Some of California's natural communities are particularly rich in wildlife species, supporting hundreds of species each. Twenty-four habitats—including valley foothill riparian, mixed conifer, freshwater wetlands, mixed chaparral, and grasslands in the state—support more than 150 terrestrial animal species each (CDFW 2025a). Oak woodlands also are among the most biological diverse communities in the state, supporting 5,000 species of insects, more than 330 species of amphibians, reptiles, birds, and mammals, and several thousand plant species (Stermer and CDFW 2021).

The state has remarkable native fauna that includes: the largest bird in North America, the California condor (Poole 2000); the Blainville's horned lizard, which squirts blood from its eyes as a defense mechanism (Stebbins 2003); the tailed frog, which is among the most primitive living frog species (Ford and Cannatella 1993); the pallid bat, which preys on scorpions but is immune to their venom (Hopp et al. 2017); five species of legless lizard, fossorial reptiles which have eyelids and detachable tails making them lizards, not snakes (Papenfuss and Parham 2013); and the once-endangered California gray whale. Wolverines had been extirpated from the state since the 1930s (Schwartz et al. 2007), but in the last two decades at least two individual wolverines have been detected in the central Sierra Nevada (Moriarty et al. 2009; Childs 2023) In addition, despite few verified sightings of the Sierra Nevada red fox (Vulpes vulpes necator) in the second half of the 20th century, the species has been detected repeatedly in the last decade in the vicinity of Lassen Peak and in the central Sierra Nevada Mountains, informing our understanding of its ecology and its current range.

A Golden Bat for the Golden State

On January 1st, 2024, the pallid bat (*Antrozous pallidus*) became the state bat of California. This golden bat now joins 14 other iconic plants and animals designated to represent California, including the golden chanterelle, the California quail, the golden trout, the California poppy, and the garibaldi (State of CA Capitol Museum 2025). The pallid bat's designation was led by a wildlife ecologist, a 12-year-old advocate, a state senator, and many wildlife enthusiasts, but was finally approved when the governor signed Senate Bill No. 732. This official designation helps recognize the importance of bats and encourages appreciation, study, and protection of these flying mammals.

Pallid bats are as diverse as Californians and can be found in all parts of the state, from the coastal redwood forests to the Sierra Nevada Mountains and from the oak woodlands to the inland deserts. Highly social creatures, pallid bats communicate with each other using a rich language of social calls which, along with the food they prefer and the places they roost, vary within and between regions.

All of California's 25 bat species eat insects, including agricultural and forests pests. Pallid bats consume a variety of invertebrates but are famous for snacking on scorpions, despite getting stung with venom. In the southern part of their range, pallid bats also consume cacti fruit and nectar, acting as pollinators and seed dispersers. Pallid bats use echolocation to navigate but often passively listen for their prey, keeping an ear out for the sound of Jerusalem crickets walking across the forest floor at night.

It is vital to protect bat roosts and bat foraging habitat to maintain healthy ecosystems in California. Bats are long-lived and have low reproductive rates, living up to 40 years but typically giving birth to just 1-2 pups per year. Bats are vulnerable to noise and light pollution, habitat loss, climate change, white-nose syndrome, and wind energy. The pallid bat is designated a California Species of Special Concern.

You can help CDFW monitor and protect bat populations by reporting your bat sightings:

Report a sick or dead bat

Report a bat colony

In 2011, an individual gray wolf became the first recorded wolf to step foot in the state since 1924. Followed by California's first recorded pack in contemporary times in 2015, the recolonization of wolves has continued steadily. California's wolf population spans across the northeastern half of the state with the majority of wolf activity occurring north of I-80 and east of I-5. In 2023, a new pack was discovered in Tulare County in the southern Sierra Mountains, documenting the most southern recolonization of wolves in the state (see "The Story of the Yowlumni Pack" below). As of mid-2024, there were a minimum of 70 wolves in seven packs documented within the state.

The Story of the Yowlumni Pack

The year 2023 was monumental for California's gray wolf population, as the number of recorded wolf packs jumped to seven across the state. One of the most surprising wolf updates was the discovery of a pack in the south Sierra, nearly 300 miles south of the next most southern recorded pack.

Initially found in the Sequoia National Forest, the pack was named "Yowlumni" in partnership with the Tule River Tribe of California after the Yowlumni band of the Tule River Yokuts Tribe. "This was described by my mother, Agnes Vera, who was born on the Tule River Indian Reservation in 1926," said Vernon Vera, a Tule River Tribal Elder. "She was the last fluent speaker of Yowlumni until her passing in 2010. She taught that the Yowlumni were speakers of the 'Wolf Tongue.'"

Genetic analysis of the Yowlumni pack's breeding adults show that the male was born from the Lassen pack and the female was from the Rogue pack, in southwestern Oregon. In 2023 the pack had six pups, who all survived into 2024, along with seven pups in the 2024 litter. The Yowlumni pack may be the most isolated pack, but at 15 wolves, it is the state's largest.

See the CDFW Wolves webpage to learn more.

Conversely, some of California's wildlife species are habitat specialists, adapted to the vegetation, forage resources, landscape features, or climate of a particular natural community and are found almost exclusively in those communities. Habitat specialists include the greater sage grouse, which feeds primarily on sagebrush; the red tree vole lives in northern California coastal fog forests and eats only the soft inner tissue of Douglas fir needles (Williams 1986); Pinyon jays seek pinyon, ponderosa, or Jeffrey pine seeds (CDFW 2025a); the chisel-toothed kangaroo rat of the northeastern Great Basin is largely dependent on one species of saltbush (CDFW 2025a); larval geometrid moths of the genus *Drepanulatrix* eat only leaves of ceanothus species (CDFW 2025a). Additionally, the valley elderberry longhorn beetle eats and reproduces only on the elderberry bushes found in Central Valley riparian habitats (USFWS 2014c). The marbled murrelet, a seabird, spends most of its life swimming and foraging in the ocean, but flies inland to nest, where it relies almost entirely on the branches of old-growth redwood and Douglas fir trees to provide wide nesting platforms (USFWS 1997). The willow flycatcher is dependent on willow thickets for feeding, cover, and reproduction (CDFW 2025a). The endangered salt marsh harvest mouse prefers pickleweed stands for cover and reproduction (CDFW 2025a). The bank swallow nests in natural riverbanks (CDFW 2025a).

In contrast, the North American beaver, an ecosystem engineer, physically constructs its preferred habitat, creating extensive wetland complexes, reconnecting waters to their floodplains, and expanding riparian habitat. The habitat created and maintained by beaver activity benefits not only aquatic species, but also terrestrial biodiversity. Beaver complexes rejuvenate and increase riparian vegetation for obligate species like the willow flycatcher, as well as create wet "green-belts" that function as firebreaks and provide wildfire refugia for numerous aquatic and terrestrial species (Fairfax and Whittle 2020; Fairfax et al. 2024).

Some species are restricted to a very small geographic range, because the species' habitat is limited in extent or has grown scarce. Geographic restriction can also occur when a new subspecies evolves after being isolated from populations of the same species by geological or climatic changes. For example, the desert slender salamander (state and federally listed as endangered) is known only by two small populations in the Santa Rosa Mountains in Riverside County. The species is a relic of cooler, moister climate regimes, but now is restricted to canyon areas that provide cliffs and rock crevices where there is continuous water seepage (CDFW 2025a). The Mount Hermon June beetle and Zayante band-winged grasshopper (both federally listed as endangered) are restricted to small outcrops of sandstone and limestone soils derived from marine sediments, known as Zayante sandhills habitat, in the Santa Cruz mountains (Rutherford 1998). The island fox, the world's smallest grey fox (state listed as threatened), occurs only on the six largest Channel Islands off the coast of Santa Barbara and Ventura counties (USFWS 2004). There are many other examples of species with very limited ranges in California, including invertebrates limited to a particular group of vernal pools and invertebrates, reptiles, and amphibians restricted to a particular desert dune, spring, or cave system.

Some wildlife species are notable for their large home ranges occupied by just one individual or family of the species. For example, the mountain lion, badger, and fisher may cover thousands of acres when hunting; large areas are required to sustain the populations of these predators (Pierce et al. 2000). Some predators exist in close proximity to urban areas and rely on remnant habitat corridors, although they face population pressures from lack of prey, inbreeding, and direct threats from urbanization, such as vehicle strikes and public safety reactions.

Many of California's wildlife species also travel substantial distances over the course of their seasonal migrations. For instance, herds of mule deer and pronghorn antelope will migrate more than 100 miles between their summer and winter ranges in northern California. The California bighorn sheep summers in the high elevations of the Sierra Nevada (up to 14,000 feet) and migrates to lower-elevation sagebrush-steppe habitat (below 5,000 – 6,000 feet) to escape deep winter snows (Zeiner et al. 1990). New data from Motus tags on hoary bats show seasonal movements in autumn from Northern California to Baja Mexico, Northern Oregon, southern Nevada, and all throughout the Central Valley. With new technology, scientists can document these wildly long-distance bat movements.

The Central Valley supports some of the greatest concentrations of migratory wintering waterbirds in the world, including millions of waterfowl and shorebirds. Birds that spend their summers in the upper mountainous elevations, such as the yellow-rumped warbler and cedar waxwing, descend tens or hundreds of miles during the wintertime to forage in the milder climates of the Central Valley or along the coast. Long-distance migrating birds, including numerous species of swallows, terns, hawks, shorebirds, and songbirds, forage or nest seasonally in California. The golden-crowned sparrow uses California as a winter home and spends summer months far to the north and the Swainson's hawk migrates between California and South America, as far south as Argentina. Other species travel from elsewhere to overwinter in California. The monarch butterfly takes multiple generations to make the migration to and from overwintering sites. Conserving the diversity of these migratory species not only conserves California's diversity, but also the diversity of species in other countries.

California's species display a variety of life histories, illustrating the many ways wildlife can adapt to a wide variety of habitats, including some unique wildlife species that are adapted to survive in harsh environments. Seasonal vernal pools in the Central Valley, coastal southern California, and elsewhere evaporate quickly in hot, dry summer conditions, leaving behind cracked and dry ground. Some invertebrates, such as fairy shrimp species, are adapted to this climate cycle, producing a tough casing that allows their eggs to remain dormant in desiccated conditions, only to emerge the following summer after winter rains refill the pools (USFWS 2005).

Pacific Flyway

The Pacific Flyway is a major north-south migratory pathway for birds in America, extending from Alaska and the Canadian Arctic through Central and South America. Every year, migratory birds travel some or all this distance in the spring and fall, following food sources, heading to breeding grounds, or travelling to overwintering sites. Each bird species travels roughly the same route every year, at almost the same time. Each year at least a billion birds migrate along the Pacific Flyway.

The birds of the Pacific Flyway depend on a diverse chain of habitats, from Arctic tundra and northwestern rainforest to tropical beaches and mangroves. California habitats provide a major component of the Pacific Flyway. Many species stop and rest in coastal and inland wetlands, such as the Salton Sea, Monterey Bay, Suisan Marsh, and Humboldt Bay, or winter in natural wetland or surrogate wetland habitats, such as flooded fields in the Central Valley. Migrating birds may gather, sometimes numbering in the millions, to feed and regain their strength before continuing their migration. Some species may remain in these rest stops for the entire season, but most stay a few days before moving on.

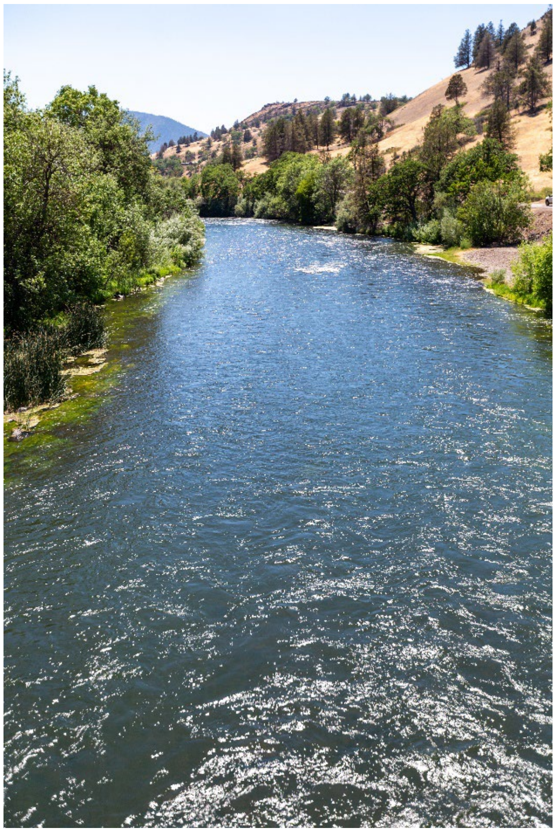
Connectivity of habitat for migratory species is essential to their conservation, especially in light of habitat loss, water shortages, diminishing food sources, and climate change.

Kangaroo rat species that inhabit the deserts, eastern Modoc plateau, coastal southern California, and southern San Joaquin Valley are all well suited for extremely dry conditions (Williams 1998). They have specialized kidneys that enable them to excrete solid urine, conserving water, and allowing them to survive for long periods without drinking. The alpine chipmunk lives in the Sierra Nevada, typically at elevations higher than 9,000 feet, where during average or wetter years the ground is covered with a 5–10-foot-deep snowpack for nearly five months of each year. The alpine chipmunk survives by storing adequate seeds and other food resources during the summer months to sustain it through the winter (CDFW 2025a).

2.3.3 Aquatic and Marine Diversity

California exhibits a wide range of aquatic habitats, from the expansive Pacific Ocean to isolated hillside seeps and desert oases that both support water-dependent species and provide essential seasonal habitat for terrestrial species. Perennial and ephemeral rivers and streams, riparian areas, vernal pools, and coastal wetlands support a diverse array of flora and fauna, including 150 animal and 52 plant species that are designated special-status species (CA SCC 2001). The California Natural Diversity Database identifies 123 different aquatic habitat-types in California, based on fauna. Of these, 78 are stream habitat-types located in seven major drainage systems: Klamath, Sacramento-San Joaquin, North/Central Coast, Lahontan, Death Valley, South Coast, and Colorado River systems (Jensen et al. 1993). Each of these drainage systems is geologically separated and contains distinctive fish and invertebrate species. California has approximately 135 distinct native resident and anadromous fish species, subspecies, DPSs, and ESUs (Moyle and Davis 2000; CDFW 2023a), and 59 of these native freshwater fishes in California are either listed, or possible candidates for listing as threatened or endangered, or are extinct (Moyle et al. 1989; Moyle et al. 2015).

From the steep creeks of the Sierra Nevada to the wide and powerful rivers of the Central Valley, California's streams and rivers support an array of invertebrates, fishes, amphibians, reptiles, birds, and mammals. The cool, steep headwater streams join with strong rivers, which (when unhindered by human activity) slow and meander, depositing fertile sediments and recharging underground aquifers in their floodplains before heading out to sea or ending in a land-locked basin. This headwater-to-sea connectivity is critical for California's anadromous fish, which rely on rivers and perennial streams for spawning habitat and safe passage to the Pacific Ocean for later life stages.

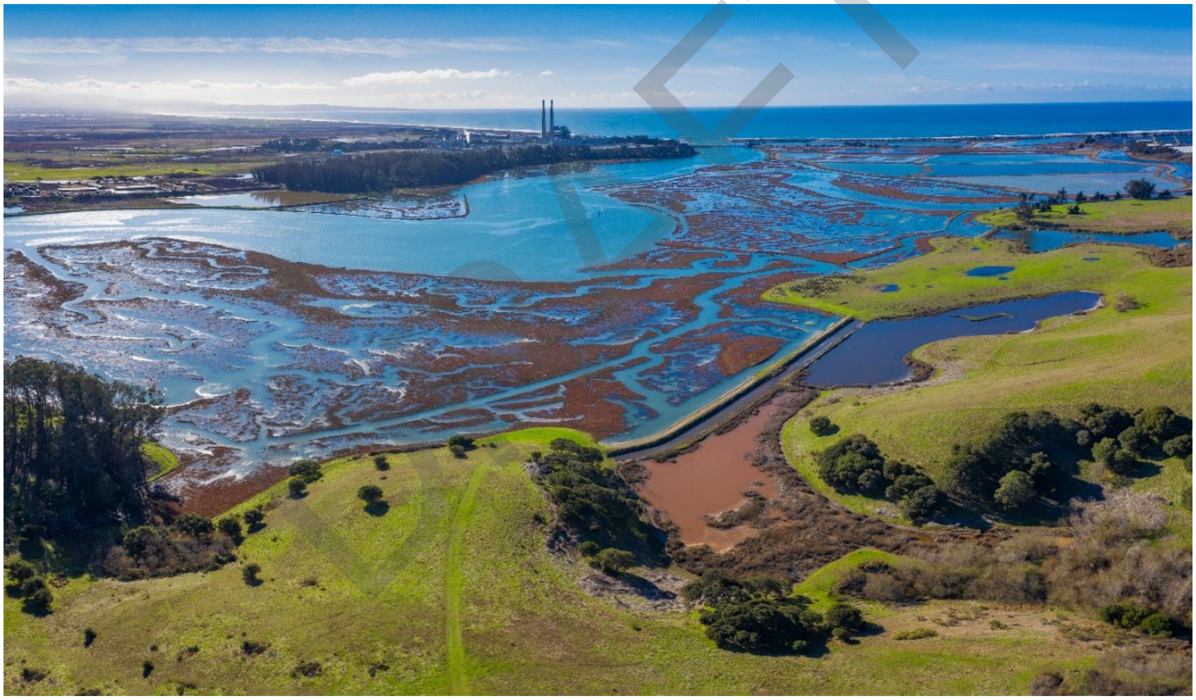


Two of the largest coastal rivers are the Klamath River, which runs for 263 miles, and the Eel River, which runs for 196 miles, both in the northern Coast Range. These coastal rivers support salmon and steelhead, and are home to aquatic mammals, such as river otters and beavers, and amphibians and birds.

Two major river systems drain and define the two parts of the Central Valley. The Sacramento River, supported by its major tributaries, the Feather River, Yuba River, and American River, flows south through the Sacramento Valley for about 450 miles. The Sacramento River carries far more water than the San Joaquin River and is second only to the Columbia River in Oregon in the amount of water it carries to the Pacific Ocean (Sacramento River Watershed Program 2025). The Sacramento River supports one of the most important salmon fisheries in California, with four separate runs of Chinook salmon (Sacramento River Watershed Program 2025). The second major river drainage is in the San Joaquin Valley where the San Joaquin River flows north for about 365 miles, supported by several tributaries, such as the Merced, Tuolumne, Stanislaus, and Mokelumne rivers. Historically, an extensive marsh system along the San Joaquin River hosted one of the largest concentrations of wintering waterfowl in the world (USFWS 2007) . Although much of this habitat has been lost, the Central Valley and the San Joaquin River continue to provide critical habitat for migrating waterfowl.

The rivers of the Central Valley converge in the Sacramento-San Joaquin Delta (Delta), a complex of fresh and brackish water wetland channels and sloughs that wind around islands mainly used for agriculture. Freshwater from the rivers mixes with saltwater from the Pacific Ocean, creating the San Francisco Bay estuary system, the West Coast's largest estuary (California Department of Water Resources [DWR] 2015). The Delta provides a rich and productive environment for more than 500 species of wildlife, including 20 endangered species, such as the salt marsh harvest mouse and the delta smelt (DWR and USBR 2015). Additionally, the Delta serves as a vital migration path for the single largest run of salmon in California. The Delta is also the hub of the state's water distribution system and provides water for two-thirds of all Californians and millions of acres of irrigated farmland.

Coastal and freshwater wetlands provide important wildlife habitat and critical ecological services, including altering and transforming pollutants in runoff water, controlling floods, moderating sediment delivery, promoting groundwater recharge, sequestering carbon, and protecting shorelines from erosion. Freshwater wetlands are not connected to saline ocean waters; they can be found along the boundaries of streams, lakes, ponds, or even large shallow holes that fill up with rainwater. They may stay wet all year long, or the water may evaporate during the dry season. The reintroduction of the North American beaver in California watersheds is a restoration tool now being used to increase the prevalence of these valuable wetland complexes and their associated ecological benefits. Through damming, beavers reconnect streams with their floodplains, improve summer baseflows, extend flows further into the dry season, and contribute valuable woody debris and habitat complexity in anadromous streams. Coastal wetlands include brackish and saltwater wetlands, including saltmarshes that are found within a variety of estuary types, including river-mouth, canyon mouth, lagoon, coastal dune-creek, bay, structural basin, and artificial drain estuaries.



California's many estuaries provide valuable habitat for birds, mammals, fish, and other wildlife. The sheltered waters of estuaries provide a haven and protective nursery for small fish, shellfish, migratory birds, and coastal shore animals. Estuaries include habitat for numerous special status or declining species of mammals (e.g., Southern California salt marsh shrew), birds (e.g., Belding's savannah sparrow), fish (e.g., tidewater goby), and insects (e.g., mudflat tiger beetle; Ferren et al. 1996). An example of this diversity is found in the Elkhorn Slough estuary near Monterey Bay, which is home to more than 100 sea otters as well as over 100 species of fish and 550 species of invertebrates (National Estuarine Research Reserves 2015).

Vernal pools are a unique type of rain-fed seasonal wetland that occur in depressions underlain by poorly drained or restrictive soil types. California vernal pools contain standing water during the winter and spring and are completely dry during the hot Mediterranean summer. As the standing water evaporates the pool and the surrounding soils can become saline, alkaline, or acidic. Many specially adapted crustaceans, amphibians, insects, and plants occur only in vernal pools (CDFW 2015a).

California's rocky offshore islands typically support a limited number of species but are nonetheless important habitats for those species that depend on them as detailed in Appendix G. The Channel Islands provide habitat for numerous endemic species, including 23 species of terrestrial wildlife. Considered the "California's Galapagos," The Channel Islands rich marine habitats sit at the confluence of the cold California Current and warm Southern California Counter-Current. Wind-driven upwelling brings nutrient rich water to the surface, creating food for a rich and diverse marine ecosystem. The Channel Islands are home to two of the three largest northern elephant seal rookeries and the largest California sea lion rookery. Twelve seabird species breed in the Channel Islands, eight of which are granted special protected status under federal or California state law: ashy storm-petrel, black storm-petrel, California brown pelican, California least tern, double-crested cormorant, rhinoceros auklet, Scripps's murrelet, and western snowy plover. To the north, the Farallon Islands host some of the largest breeding colonies of seabirds in the United States, and numerous marine mammals, including California sea lions (Farallones Marine Sanctuary Association 2014).

Rocky reefs, offshore banks, underwater canyons, coral gardens and kelp forests harbor an extraordinarily diverse number of marine species. Intertidal zones provide habitat for worms, clams, crabs, small fishes, and shorebirds, while the pelagic zone of the open ocean supports species of plankton, fish, marine birds, and marine mammals, such as whales and dolphins. Giant kelp beds within the nearshore waters off southern and central California are one of the most diverse biological communities known to exist in the world's oceans, with more than 800 marine species dependent on the kelp forests at some point in their life history. While many variations in marine fauna and habitat types exist at numerous scales, many marine species along the California coast generally occur either north or south of Point Conception (34.5° North Latitude), with warm and temperate habitat to the south in the San Diegan zoographic province and cool temperatures of the Oregonian Province to the north (Briggs 1974).

The marine biome is the major producer of plant biomass from sunlight and nutrients (primary productivity). These plants, ranging from small phytoplankton to large macro-algae, represent the basic food source for all life in the ocean, and support the extensive biodiversity of this system. In areas where northwest winds cause cold, nutrient-rich water to move towards the surface from the deep, a process known as upwelling, plankton abound attracting squid, sardines, krill, and other forage species. These species, in turn, attract predatory animals, including sharks, marine birds, and whales.

2.4 Species of Greatest Conservation Need

State Wildlife Action Plans aim to identify and focus on the Species of Greatest Conservation Need (SGCN), which are characterized by having low and declining populations and that are indicative of the diversity and health of state's wildlife (AFWA 2025). Appendix C contains the SWAP 2025 list of SGCN; the SGCN list includes 535 fish and wildlife species, 323 invertebrate species, and 537 plant species. As of the publication of SWAP 2025, SGCN plant species are not eligible for State Wildlife Grants (SWG) Program funding (AFWA 2023). CDFW has chosen to include plants on the SGCN list, so SWAP 2025 will be a comprehensive conservation planning document. Plants will benefit from implementation of SWAP 2025 strategies incidentally when occurring in habitats conserved for animal SGCN.

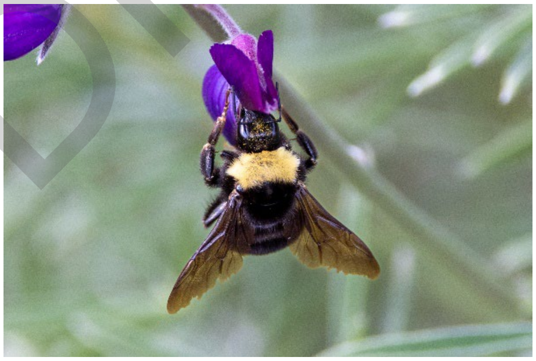
For SWAP 2025, technical teams updated the criteria that were used in 2015 to identify the SGCN; the criteria are described below. Wildlife specialists then evaluated species based on the new criteria to finalize the SGCN lists of invertebrates, amphibians, reptiles, fish, birds, mammals, algae and plants (NatureServe Explorer 2024).

2.4.1 Criteria to Select Species of Greatest Conservation Need

Criterion 1 includes species that are listed as threatened, endangered, or candidate species in California under the federal ESA or CESA. SWG Program discourages the use of funds solely on federally listed species and on species that already have dedicated funding. Although these species are included in the SGCN list, their inclusion does not imply a funding preference or prioritization.

Criterion 2 includes species for which there is a conservation concern. The species under the second criterion are identified as having either California Species of Special Concern (SSC) or Fully Protected (FP) designation. The SSC designation carries no formal legal protection; the intent of the designation is to focus attention on animals of conservation risk, stimulate research on poorly known species, and achieve conservation and recovery of these animals before they meet criteria for listing as threatened or endangered under the California Endangered Species Act. See the SSC webpage for more information, including updated lists and species accounts. Other specific conservation concern designations are described below under taxonomic group.

Criterion 3 includes species that were identified by CDFW as being highly vulnerable to climate change, experiencing population decline, and/or highly vulnerable to other stressors (e.g., pesticides, disease, habitat loss, etc.) This information was based upon expert opinion and/or as documented in published literature and reports. The methods used to identify SGCN fitting this criterion are described below for each taxonomic group.



Invertebrates

The NatureServe ranking represents a score that reflects a combination of rarity, threat, and trend factors within California's state boundaries. Rarity is weighed more heavily than the other two factors. A ranking of SX indicates a species presumed to be extirpated from the state based on extensive searches. A ranking of SH denotes a species that is possibly extirpated, but more thorough searches are needed to state this with certainty. An S1 ranking is defined as Critically Imperiled in the state because of extreme rarity (often five or fewer populations) or because of factor(s), such as very steep declines, making it especially vulnerable to extirpation from the state. A ranking of S1S2 indicates the reviewers were uncertain about some aspects of the species' status, therefore the species may be Critically Imperiled (S1) or Imperiled (S2). Detailed information about NatureServe's ranking system can be found on NatureServe Explorer. For terrestrial invertebrates, species were also included under Criterion 2 if they were petitioned for federal listing and on the 2024 federal listing workplan or were identified by the Status of Butterflies in the US Report as experiencing population declines of 50% or greater (Edwards et al. 2025). Marine invertebrates are included under Criterion 2 if take is expressly prohibited by CDFW. Invertebrates were included as highly vulnerable to climate change (Criterion 3) if they were identified by experts or in scientific literature as being at-risk from climate change.

Fish

California has approximately 70 native resident and anadromous fish species. Fishes that are state or federally listed are included under Criterion 1. Freshwater and anadromous fish species identified under Criterion 2 include SSC and species where take is expressly prohibited by CDFW or NMFS, a federal rebuilding plan, or in consideration of being overfished (NOAA Fisheries 2023; CDFW 2025b). The Fish Species of Special Concern, 3rd edition (Moyle et al. 2015) includes information on the distribution, abundance, and status of species. Climate vulnerability for fish was determined using the methods and evaluation presented in Moyle et al. (2013). The methodology uses expert opinions of the authors and literature reviews of the status and biology of the fishes to score both status of each species ("baseline vulnerability") and likely impact of climate change ("climate vulnerability"). When the total scores for baseline and climate vulnerability were combined, they produced a score that indicated the overall vulnerability to climate change. Species with a highly vulnerable or critically vulnerable score are included as SGCN under Criterion 3.

Amphibians and Reptiles

Amphibians and reptiles that are state or federally listed are included under Criterion 1. Species that have been designated as SSC (Thomson et al. 2016) are included as SGCN under Criterion 2. The Amphibian and Reptile SSC report contains species accounts and distribution maps for 45 amphibian and reptile special concern taxa (9 salamanders, 13 anurans, 3 turtles, 12 lizards, and 8 snakes). Some of these SSC also meet Criterion 1, and some have undergone taxonomic changes since publication in 2016, which are reflected in Appendix C. Under Criterion 3, a highly vulnerable status was assigned to amphibians and reptiles, if any of the following occurred:

- 90 –100 percent of the (sub)species' currently occupied localities were predicted to decline in suitability by 2050 (Warren et al. 2014)

- Greater than 40 percent of currently occupied localities and/or greater than 50 percent of the species' range were predicted to become unsuitable by 2050 (Wright et al. 2013)
- Expert opinion by the SSC Technical Advisory Committee predicted the (sub)species would be highly sensitive to climate change over the next 100 years (Thomson et al. 2016)

Birds

Birds that are state or federally listed are included under Criterion 1. CDFW updated the birds SSC (BSSC) list in 2008 and bird species from the updated list were included under Criterion 2. Species identified as Climate Priority I or Climate Priority II in A Climate Change Vulnerability Assessment of California's At-Risk Birds (Gardali et al. 2012) are included as SGCN under Criterion 3. These species were determined through an extensive climate change vulnerability assessment for birds (Gardali et al. 2012; Rosenberg et al. 2019).

Mammals

CDFW is in the process of updating the list of mammals SSC (MSSC). For this MSSC update, a team of experts used a scoring system to quantify the conservation status of all the approximately 580 native land mammal taxa (species and subspecies) in California. Scoring criteria were developed for eight conservation factors, including population size, population trend, range size, range trend, population concentration, threats, endemism, and climate change. Taxa were designated as SSC if scores surpassed an expert – derived threshold when summed across criteria, or when scored highly in the population trend, range trend, and threats criteria.

Mammals that were identified by CDFW as being highly vulnerable to climate change are included as SGCN. These species include all mammals for which all MSSC expert reviewers agreed that climate change may have or is strongly suspected to have adverse effects on population or range size (2024 MSSC climate change criterion score ≥ 3).

Plants and Algae

Plants that are state or federally listed are included under Criterion 1. Marine plant species where take is expressly prohibited by CDFW or NMFS are included under Criterion 2. Plants with a California Rare Plant Rank of 1B.1, which indicates they are rare or endangered in California and elsewhere and are seriously threatened in California, are also included as SGCN under Criterion 2. Additionally, select algae species were included based upon expert opinion under Criterion 3 (kelp, eelgrass, sea palms, and surfgrass). For reference, CDFW maintains a Special Vascular Plants, Bryophytes, and Lichens list.

2.5 Challenges in California Ecosystems

The condition of many of the state's natural communities and wildlife is impaired. This section describes common stresses and pressures across the state. The order in which they are described is not indicative of their level of importance or severity. Chapters 5.1 – 5.7 and Chapter 6 detail the conservation targets at the province level and describe conservation strategies to reduce pressures on conservation targets (which in turn, enhance SGCN populations).

2.5.1 Major Stresses

A stress is an attribute of a conservation target's ecology that is impaired directly or indirectly by human activity (Salafsky et al. 2008). Understanding the ecological stresses experienced by California wildlife and ecosystems is critical to identify the conservation strategies needed to counteract them.

In 2025, CDFW updated the ranked list of stresses from SWAP 2015 (CDFW 2015b) that affect each conservation target to compile a standardized set of stresses (Table 2-1). The standardized set was used to identify the most important stresses to ecosystems within conservation units, provinces, and statewide. Several categories of stresses described below are interrelated and many of these stresses will be exacerbated by climate change as discussed in Section 2.5.3.

Table 2-1 Major Stresses

Category of Stresses	Changes from Stresses
Geophysical and Disturbance Regimes	• Change in Sediment Erosion-Deposition Regime • Change in Natural Fire Regime • Change in Extreme Climatic Events
Soil and Sediment Characteristics	• Change in Nutrients • Change in Soil Chemistry • Change in Soil Moisture and Soil Temperature • Change in Sediment Quality
Hydrology and Water Characteristics	• Change in Runoff and River Flow • Change in Water Temperature • Change in Water Chemistry • Change in Water Levels and Hydroperiod

Category of Stresses	Changes from Stresses
	• Change in Flood Occurrence, Frequency, Intensity, and Area Flooded • Change in Groundwater Tables • Change in Nutrients • Change in Pollutants
Ecosystem Conditions and Processes	• Change in Spatial Distribution of Habitat Types • Change in Community Structure or Composition • Change in Functional Processes of Ecosystem • Change in Biotic Interactions • Habitat Fragmentation • Changes in Succession Processes and Ecosystem Development
Coastal and Oceanic Characteristics	• Change in Oceanic Inputs • Change in Oceanic Hydrodynamics • Change in Surface Area

Geophysical and Disturbance Regimes

Change in Sediment Erosion-Deposition Regime

Natural geomorphic processes (i.e., sediment deposition and transport) are very important to the quality of California's aquatic habitats. Gravels and sediments within riverine systems provide microhabitats for invertebrate species and are essential for spawning and nesting of many freshwater and anadromous fish species. Altered soil and sediment deposition in California is an important ecosystem stress primarily caused by human modification of physical river processes. Release of fine sediments from water projects, agriculture, and construction can be equally damaging. Fine sediments and silt cover natural streambeds and fill in deep pools, degrading important substrate and pool habitats for native amphibians, fishes, and invertebrates. Additionally, sediments can bind to and carry pollutants through the water column and cause increased turbidity reducing photosynthesis and interrupting the aquatic food chain (Newcombe 2003).

Historically, sediment was transported along a river and deposited at the river delta or along the river's banks by flood events, creating deep floodplain soils (Busch and Smith 1995; Poff et al. 1997). Over-bank flooding also flushed the soils of built-up salts, creating more favorable soil-nutrient conditions for vegetation growth. As a result of dams, flood control facilities, and water diversion structures, natural sediment transport has been severely diminished or blocked, and natural flooding has been reduced in frequency and magnitude in downstream river reaches. Reductions in the amount of sediment transported to the ocean can decrease beach or sandy subtidal habitat available to marine species. As an example of how altered sediment transport impacts wildlife, arroyo toad breeding sites that are created when floods deposit sediments as sandbars have been diminished by altered hydrologic regimes. Where human activities have fragmented watersheds and changed natural sediment dynamics and flow regimes, sediment deposition has been interrupted, reducing the extent of sandbars and gravel habitats necessary for this species' survival (USFWS 2014a). Similarly, habitat for the Coachella Valley fringe-toed lizard has been degraded by alterations to the sand transport processes that maintain dunes in the Coachella Valley.

Change in Natural Fire Regime

Prior to European colonization, fire events were caused by lightning and Native American cultural burning practices, both of which influenced the development of vegetation communities that are adapted to specific fire regimes. Fire-dependent vegetation types cover over half the surface area of California (Van Wagtendonk et al. 2018). Alteration of natural fire regimes is an important ecosystem stress, impacting fire-adapted vegetation communities particularly in forest and shrub-dominated habitats (Dale 2006), as well as vegetation communities that are not adapted to fire.

In the early 1900s, the nature and role of wildfire in creating and maintaining California's unique habitats was viewed as damaging to forests. As a result, state and national policy from the early 20th century onward has consisted of aggressive fire suppression, which has minimized fire on the landscape and disrupted historical fire regimes. A century of fire suppression and land management practices created an enormous buildup of forest acreage with dense tree stands and high fuel loads (Husari and McKelvey 1996) that lack habitat complexity, grasslands inundated with more

flammable non-native plant species, and mature chaparral and shrubland excluded from healthy wildfire. For example, the Sierra Nevada and northwestern California have experienced a buildup of forest fuels, leading to an increase in the intensity and heat of wildfires, which can destroy otherwise fire-adapted plants and damage soil structure (Baker and Shinneman 2004).

Over the last three decades there has been a paradigm shift in understanding the important role fire plays on the landscape and the detrimental effect that widespread fire suppression and related land management practices have had on the fire-adapted ecosystems and habitats in California. It is now recognized that fire frequency, intensity, and seasonal timing of fire on the landscape (fire regime) is an ecologically important disturbance that shapes and maintains native plant communities and wildlife habitats. Fire frequency and intensity are determined by the pattern and density of vegetation (fuel loading), landscape topography, fuel moisture, long-term weather trends, and ignition sources. In turn, fire affects ecological processes, the vegetative mosaic of the landscape, the structural diversity of habitats, the accumulation of organic material, and quality and quantity of forage available for terrestrial wildlife.

To restore native plant communities, ecologists generally agree that fire needs to return to California at intervals consistent with historical fire regimes. The 1964 federal Wilderness Act recognized the beneficial ecological role of fire and established a policy allowing natural fires to burn in wilderness areas and, under certain circumstances, in national parks. NPS has implemented prescribed fires for many years; however, most of the forests needing fire are lower in elevation than most wilderness areas. The results of prescribed fires in the Sierra have demonstrated excellent ecological benefits such as more open understory and less ladder fuel buildup. USFS policy allows prescribed fires on national forest lands (Keifer et al. 2006), but in October of 2024, the USFS announced they would be halting prescribed fires in California for the foreseeable future as a precautionary measure (Venton 2024).

Due to legacy trauma in the fire-fighting community, community concerns about runaway fire, the restrictive nature of air quality standards, and a lack of consensus in how fire should be reintroduced to the landscape, support for the practice lags with the need for policy changes supporting incorporation of healthy fire into land management plans and practices. Even with the development and implementation of California's Wildfire and Forest Resilience Action Plan (Forest Management Task Force 2021), which calls for treating 1,000,000 acres of state and federal land annually by 2025, the use of prescribed fire is currently applied to relatively few forested acres of the state. Additionally, the expansion of residential communities into fire-dependent ecosystems creates a conflict between maintaining ecological integrity and protecting property. The expansion of new development into fire-dependent ecosystems can be partially mitigated through the application of smart growth principles that concentrate new development near existing communities.

Change in Extreme Climatic Events

The change in the type, frequency, intensity, or length of climatic extreme events in California is closely related to the effects of climate change. Climate change may alter the frequency and/or intensity of extreme weather events such as severe storms, winds, droughts, and frosts. For example:

- In southern California, any increase in Santa Ana wind conditions, combined with warmer, drier summers, could escalate economic and environmental loss to wildfires in California.
- An increase in the number or intensity of thunderstorms, which form over land and pick up more acids and other pollutants than Pacific frontal storms, may mean more acid rain and increased murkiness in Sierra lakes from nutrient enrichment.
- Pests, such as pine bark beetles, could become more prominent or more destructive, if shifts in climate conditions stress trees.
- El Niño warming may encourage toxic algal blooms in bays and estuaries and depress offshore ocean productivity.
- On shore, heavier, and/or more frequent rains induced by El Niño could increase the frequency of the rodent population booms that precede hantavirus outbreaks (Field et al. 1999).

More information regarding climate change is presented in Section 2.5.3.

Hydrology and Water Characteristics

Streams and rivers in Mediterranean-climate regions such as California are characterized by particularly high seasonal and interannual variability with high fluctuation between wet and dry years due to a small number of winter storms providing most of the state's precipitation (Zimmerman et al. 2017) . This results in a distinct flow regime, which represents the characteristic pattern of a river's flow quantity, timing, and variability and is the dominant variable in determining the form and function of a river (Poff et al. 1997; Annear et al. 2004).

California native species depend on flow regimes that provide both seasonal and annual variation in flow. These naturally variable regimes are characterized by functional flow components that sustain ecological, geomorphic, and biogeochemical functions, and that support the specific life history and habitat needs of native aquatic species (Yarnell et al. 2015). The life histories of many California native species have adapted to naturally occurring seasonal flow regimes (Annear et al. 2004). For example, foothill yellow-legged frogs reproduce when flows start to recede at the beginning of spring to minimize egg loss due to winter storms and to maximize growth in summer low flows (Yarnell et al. 2015).

Human caused changes that affect hydrology can alter the structure of riverine communities, eventually resulting in vastly different species assemblages if flow regimes are permanently changed (Annear et al. 2004). Operations of water infrastructure and human use of water to support agriculture, municipal, and industrial uses have reduced the natural variability of flows for many of California's rivers and streams. Alteration to natural streamflow patterns, intensified by the effects of drought, has been documented to have negative effects on California's aquatic biota, and there is evidence that retaining key functional flow components can support native species and their habitat (Zimmerman et al. 2017; Grantham et al. 2020).

Change in Runoff and River Flow

Rivers, lakes, streams, and estuaries in California have been substantially modified and controlled since the Gold Rush. As a result, the natural hydrologic processes of the state's aquatic systems have also been substantially altered, which has created significant ecosystem stress on native aquatic species, as well as on the terrestrial plant and animal species that depend on these systems. Land development, construction of dams, flood control structures, diversions of water, and groundwater withdrawal all change the volume, timing, hydraulics, sediment load, and temperatures of water that runs off the landscape into the ground and/or streams. These impacts are exacerbated by drought conditions and climate change. For example, warmer air temperatures can cause more precipitation to fall as rain rather than snow, affecting the timing and amount of runoff. These changes affect aquatic habitats necessary for species survival.

As a result of these alterations to runoff and river flow, natural riverine habitat is lost, and fish migration routes are disrupted. In many regions of the state, diversions and groundwater pumping deplete river basins to the point where river reaches regularly dry up or are diminished to such low flows that native species cannot survive. As examples, this has occurred in the Carmel River on the Central Coast (CDFG 1996), the Colorado River in the Colorado Desert (Pitt 2001), the Mojave River in the Mojave Desert (CDFG 2004), and the Scott and Shasta rivers in the North Coast-Klamath Region (CDFG and Commission 2004) . The impacts of river diversions and groundwater depletion become much more pronounced during drought conditions.

Change in Water Temperature

Water temperatures can be affected by many variables including drought, the presence or absence of riparian vegetation, stream diversions, the temperature of discharged water from reservoirs, and other factors. Many aquatic species are cold-blooded and are easily affected by changes in temperature. A change in water temperature of 5°C (9°F) can be harmful to fish species and a difference of only 2°C (3.6°F) can mean the success or failure of an egg hatch (Poff et al. 2002). In most cases, changes in temperature resulting from human activities trend upward, an exception would be the release of cold bottom water from a reservoir. The drop in water temperature from such a release can impact a warm water fishery for miles downstream. In general, most other activities will raise the temperature of receiving waters resulting in reduced dissolved oxygen content of the water, increased metabolism and oxygen demand for aquatic species, higher solubility of toxic substances, increased algae growth and eutrophication, and ultimately (if temperature maximums are exceeded) death (Poff et al. 2002).

Change in Water Chemistry

As discussed above, increases in water temperature can reduce the amount of dissolved oxygen in water and increase the solubility of toxins. Water chemistry can also be altered by the consistency of wastewater discharges, contaminated or acidic surface runoff, excessive evaporation during dry periods, or saltwater intrusion. Increases in salinity and contaminants, or changes in water pH have direct impacts on aquatic species which are typically adapted to a narrow range of conditions. Additionally, heavy metals such as cadmium, lead, and chromium dissolve more easily in acidic water, leading to bioaccumulation and toxicity issues higher in the food chain. In extreme cases, the chemistry of a water body can be altered to the extent that is no longer suitable as a water source for terrestrial wildlife (such as in the case of streams effected by acid mine drainage).

Change in Water Levels and Hydroperiod

Hydroperiod refers to the length of time that a wetland, lake, or pond holds water. Hydroperiod can vary from as short as a few weeks for some seasonal wetlands, to very long or permanent for lakes and ponds. The hydroperiod of a wetland is critical for determining which amphibian species can successfully breed in the wetland. Hydroperiod determines the length of time amphibian larvae have to develop to the stage that they can leave water for land as well as determining the predators to which they are exposed. If a pond or wetland remains dry during the breeding and egg laying season for any amphibian species, it will likely not provide breeding habitat for those amphibians that year, regardless of whether conditions change later in the season (Tarr and Babbitt 2012). Extending the hydroperiod, such as through the discharge of urban runoff into seasonal wetlands and vernal pools, allows perennial species to gain a foothold, and results in a shift from seasonal to perennial wetland habitat, which can be no longer suitable for the unique flora and fauna that have adapted to the seasonal nature of these features.

Change in Flood Occurrence, Frequency, Intensity, and Area Flooded

The shallow and nutrient dense waters of flooded areas provide excellent habitat for immature fish and other aquatic species. Many bird species rely on floodplains to provide wintering habitat or a stop-over aquatic food source during migrations. Changes in the season of flooding can affect the availability of food sources, including lower trophic animals and seed for migrating birds. Unseasonably high flows from hydroelectric projects, or urban runoff, can flush amphibian and fish spawning sites, or deposit sediment on egg masses, while the restriction of seasonal high flows to conserve water and electricity storage can interrupt the regeneration of riparian habitats that rely on flood events and lead to unsuitably elevated water temperatures.

Altered hydrologic regime has also resulted in unnatural changes in vegetation communities that are adapted to flooded areas along rivers and estuaries. Documented changes include transitions from high quality habitat dominated by native cottonwoods and willows to invasive tamarisk, which can withstand drier conditions and saltier soils (Poff et al. 1997; Briggs and Cornelius 1998).

Change in Groundwater Tables

Fluctuations in the groundwater table alter the seasonality or flow rates of spring and seeps. Springs are locations where groundwater naturally emerges from the Earth's surface in a defined flow. Springs can form seasonal or perennial pools, support wetlands, or form the headwaters of streams. A seep is a moist or wet area where groundwater reaches the surface but does not pond. Groundwater withdrawals in an area can reduce the pressure in an aquifer, causing groundwater levels to drop and decreasing flows from springs and seeps. Fractured bedrock aquifers found in mountainous areas typically have smaller watersheds and water storage capacity than deep alluvial aquifers found in valley areas. These smaller groundwater resources are more easily affected by periods of drought or groundwater withdrawal but also rebound quickly in wet years. Groundwater decline can result in reduced habitat or loss of water sources for plant and wildlife species. This can be a critical issue in the case of isolated springs and seeps, where wildlife species may be unable to relocate or may have to travel long distances to reach the next available water source.

Change in Nutrients

The amount of nutrients in a stream or lake is a function of the geology and vegetation within its watershed, and the amount of sediment that has been deposited. Newly formed lakes typically have rocky bottoms and very limited fertility. As a lake ages, nutrient rich sediments are washed into the bottom of the lake, increasing its fertility. Although this is a natural process, it can be accelerated by man-made nutrient sources such as runoff from urban and agricultural areas. As the nutrient level of a water body increases, so does the productivity of algae and aquatic plants. This increase in productivity is accompanied by increases in decomposition which uses up oxygen. In small or shallow lakes, the entire lake can become oxygen starved, resulting in the death of fish and other aquatic species.

Change in Pollutants

California's waters have been exposed to pollutants from urban and agricultural sources, industrial activity, mining, and other human activities (Masoner et al. 2019). Some pollutants can be toxic to wildlife and can affect the food chain. The concentration of some pollutants can accumulate in tissues of species that are exposed over a long period of time, a process referred to as bioaccumulation, or toxic chemicals may also be amplified in the tissues of predator species as they are passed from prey to predator in a process known as biomagnification. An example of this would be mercury concentrations in water, sediments, and aquatic invertebrates accumulating in the tissue of certain fish species. The use of anticoagulant rodenticides in farming, particularly cannabis, has led to detection of toxic chemicals in wildlife and killed forest-dwelling carnivores (Gabriel et al. 2012; Gabriel et al. 2018).

Soil and Sediment Characteristics

Soils act as water reservoirs and filters, provide nutrient cycling for the plant community, and offer habitat to an incredible diversity of microorganisms, insects, and burrowing animals. The soil and above ground communities are inextricably linked and changes in one have repercussions in the other. Soil organisms depend on aboveground vegetation for the sugars and carbohydrates produced during photosynthesis, and plant growth is dependent on the microbial community's ability to convert and release mineral nutrients so that they are available for plant uptake. The soil community metabolizes organic and inorganic pollutants, releasing them as carbon dioxide and water and preventing contamination of water sources. Maintaining the biodiversity of the soil ecosystem is a crucial factor ensuring the success of these processes.

Change in Nutrients

The nutrient availability within a soil ecosystem is tied directly to organic matter inputs from the plant and wildlife community and the biodiversity of the soil community. Nutrient availability is cyclical, and the amount of nutrients released for use by the above ground community must be balanced by organic matter inputs. As native ecosystems are converted for other uses, the soils community undergoes a series of changes related to nutrient cycling. Soils disturbed for agricultural use experience accelerated rates of organic matter decomposition, gradually depleting the soils nutrient reserves. Additionally, soil compaction reduces the available habitat for the microbial community and can slow nutrient processing. In areas where native plant species are removed or replaced, their symbiotic fungi are cut off from their primary food source and disappear from disturbed sites. These fungi are critical in obtaining nutrients for their host plants and their loss can make re-establishment of native species difficult even after other habitat conditions have been restored. These stresses on the soil ecosystem ultimately result in reduced quantity and quality of food and habitat for wildlife species, for example, by reducing plant cover and species richness or by simplifying community structure.

Change in Pollutants

California's soils have been exposed to pollutants because of intensive agriculture, industrial activity, mining, and other human activities. Some pollutants can be toxic to members of the soil community, which can affect the food chain. Additionally, when a soil contains high concentrations of heavy metals such as lead, zinc, and copper, or constituents such as mercury, arsenic, hydrocarbons or pesticides, these contaminants can be mobilized by the soil community and can accumulate in plant and animal tissues (Smical et al. 2008). The concentration of some pollutants can be amplified as they are passed from prey to predator in a process known as biomagnification. An example is when lead concentrations in soil accumulate in earthworms and is then transferred to moles and shrews through the food chain (Pierzynski et al. 2000).

Change in Soil Chemistry

Changes in soil pH have a strong effect on the relative availability of nutrients and minerals. Acidification of soils can lead to excessive availability of some minerals, including aluminum, which can be toxic to plants at high levels. Soil chemistry is also highly dependent on the presence of very small soil colloid particles which are found in clay minerals and soil organic matter. These colloids hold a static electrical charge which allows the soil to bond with and retain excess nutrients and pollutants that are carried into the soil. As soil organic matter is depleted through erosion, ground disturbance, vegetation removal, or lowering of the water table, the soil loses its ability to filter out pollutants which can lead to impacts on surface and groundwater quality (Pierzynski et al. 2000).

Change in Soil Moisture and Soil Temperature

The availability of soil moisture has a direct impact on the number of soil animals that a given area can sustain. This is evident in the relative abundance of biological activity in mountain compared to desert soils (Hendricks 1985). Additionally, the moisture content of a soil is directly correlated to the soil temperature. Changes in moisture and temperature can affect the suitability of a soil to provide habitat for burrowing animals (Kumar and Pasahan 1993).

Change in Sediment Quality

Sediment quality has a strong influence on the environment, because it often characterizes the quality of the substrate where vegetation occurs. Sediment-enriched soils directly contribute to enhanced biodiversity. Riverine systems experiencing diminished or altered hydrodynamics suffer from the lack of disturbance and sediment input, which contributes to the degradation of biological diversity and habitat variability.

Sediments not only influence the environment, but in some cases, they define the environment. Sand dunes are made of rocky sediment worn down and transported by wind. The dune systems found in the desert regions are the results of this sand transport/deposited regime. The establishment of invasive species on dunes upsets the deposition/active movement equilibrium by over-stabilizing the active sand, thereby affecting sediment quality and dune specialists that require active sand, such as Coachella Valley fringe-toed lizard (Coachella Valley Association of Governments 2016).

Ecosystem Conditions and Processes

Change in Spatial Distribution of Habitat Types

Habitat loss, through permanent or temporary conversion, is another important stress that occurs throughout California. Habitat loss is often the result of land development, infrastructure projects, and agricultural activities. Habitat loss can result in the elimination of individuals or populations from the area that is converted. Habitat loss is typically permanent when it is the result of development. However, habitat loss caused by agricultural use, pollution, and invasive species sometimes replaces the existing habitat with a different seral stage or habitat type that still retains habitat value; this change can also sometimes be reversed. Rangeland conversion in California between 1984 and 2008 was analyzed using time series Geographic Information Systems (GIS) data and classified resulting land uses with aerial imagery (Cameron et al. 2014). In total, over 195,000 hectares (480,000 acres) of rangeland habitats, or about three percent of available rangelands were converted during this 24-year period. Residential and associated commercial development was the primary reason (49 percent of conversions), but agricultural intensification was also a major cause (40 percent).

Much of California's wetland habitat loss was from the conversion of wetlands for agriculture during the late 19th and early 20th century (Garone 2020). More recently, urban and suburban development has resulted in the loss of additional upland and aquatic habitat. Some habitat types have been reduced to a small fraction of their historic extent. For example, vernal pool habitats, which are the home of many endemic species, including the delta green ground beetle, conservancy fairy shrimp, Burke's goldfields, Sonoma sunshine, Butte County meadowfoam, and many species of Orcutt grasses, have been reduced to less than five percent of their historic area (USFWS 2005). Estuaries in the San Francisco Bay system have been reduced to about 15 percent (CalEPA 2015) and coastal sage scrub to about 18 percent (Pollak 2001) of historic extent. An estimated 90 percent of the historic acreage of all wetland types has been lost (Dahl and Johnson 1991).

Populations of species that depend upon these habitats have declined significantly. Development throughout the historic range for Swainson's hawk has reduced available foraging and breeding habitat, and the loss of marsh habitat has led to a dramatic reduction in tricolored blackbird populations resulted in a reevaluation of the species' listing status.

Change in Community Structure or Composition; Change in Functional Processes of Ecosystem

Degraded terrestrial habitat quality is one of the state's most widespread stresses. It can occur in many forms, such as loss of community structure and composition or changes to ecosystem processes. It can result in diminished ecosystem functions, such as food, water, or cover, which are critical to species survival. Examples of common pressures resulting in habitat degradation include pollution, invasive species introduction, livestock grazing, intensive recreation, or soil erosion. Natural phenomena that are altered or intensified by human activities, such as droughts, flooding, or wildfire, can also result in habitat degradation.

Degradation of aquatic habitat quality is also a major stress in California. Land reclamation and water projects have fundamentally altered the historic connection between land and water in California. The reduced hydrologic connectivity between primary aquatic habitats and areas that were periodically flooded by tides and spring flows has decreased the abundance of key habitats for native aquatic species, simplified edge conditions that supported diversity, and diminished important habitat gradients. Installation of dams and diversions on major rivers has cut off historic fish migration routes. However, recent restoration projects along the Klamath River, in the Central Valley, and along coastal streams seek to restore fish passage and habitat for anadromous species.

Marine habitat degradation is also a widespread stress in the state. Degradation can occur from stormwater runoff and other non-point source pollution; contamination from pesticides, trash, heavy metals, or pathogens; or alteration of adjacent lands, such as alterations to estuaries or flow regimes. Invasive species can also cause marine habitat degradation and are easily transported into California waters in the ballast water of out-of-state or international ships.

Development adjacent to freshwater waterways and riparian corridors has limited natural river processes and meander by reducing floodplains and riparian and adjacent upland vegetation. The reduced riparian and adjacent upland vegetation are less effective in buffering waterways from urban runoff, providing essential vegetative structure for shading streams, and supporting upland activities of amphibians, reptiles, birds and mammals that use riparian habitat for nesting, foraging, roosting, or basking. Even in areas with no direct development or apparent human influence, upstream activities from dam or culvert installation, water diversion, or loss of abutting riparian or upland habitat can degrade aquatic habitats. Also, changes in the volume, character, and hydrograph of stormwater flows or dam releases within streams that have otherwise natural features can lead to unfavorable water temperatures and reduction in foraging, spawning, and rearing habitat quality.

Loss of physical community structure and vegetation composition has been documented to directly reduce animal species diversity. In areas with heavy recreational use, construction of rock dams, deposition of trash and human waste, or trampling lead to habitat degradation and increased stresses on native species. Upland habitat degradation can occur from off-highway activities, loss of natural disturbance regimes (such as fire), or invasive plant and animal species. Feral domestic dogs and cats harass and prey upon wildlife near residential neighborhoods or outdoor recreation areas. Ornamental plants in urban edge areas change the vegetation composition and result in the loss of necessary host plants for specialized species and pollinators, as well as increased vulnerability to other stresses (e.g., fire, disruption of successional dynamics, and increased exposure to existing or novel diseases).

Change in Biotic Interactions and Habitat Fragmentation

The stress of habitat fragmentation is a secondary effect of habitat loss and a process where natural areas are divided into smaller, isolated remnants by the loss of plant communities or change in ecosystem processes. This can occur through degradation or removal of a portion of originally connected habitats or construction of linear features that divide habitats. Habitat fragmentation in California occurred in pre-history from natural climatic or geological processes that transformed the landscape, such as glacial advances, volcanic activity, geologic faulting and tectonic movement, and mass land slumping. Significant habitat fragmentation in historic times was almost entirely because of direct or indirect human pressures, including alterations of water regime, conversion of land for development, mining, agriculture, and construction of linear projects, such as highways or canals.

Habitat fragmentation often decreases biodiversity and impairs ecosystem functions. Fragmentation reduces the amount of functional habitat in an area and can isolate species into subpopulations that are more susceptible to extinction from other causes, including natural disasters, disease, invasive species, or climate change.

Habitat fragmentation inhibits the movement of individuals travelling between separate populations. This reduced movement leads to inbreeding, which reduces genetic diversity and a population's ability to adapt to environmental changes. In the case of plants, habitat fragmentation can reduce the movement of animals that carry pollen or propagules and prevent plant communities from moving over time in response to climate change. For some species with relatively small ranges, especially reptiles, plants, and small mammals, the lack of connectivity to movement corridors threatens survival of many populations. Maintaining connectivity allows these limited-home-range species to shift habitats to adjacent areas if populations experience habitat loss or degradation. For species with larger home ranges, habitat connectivity may be required across a much larger swath of the landscape. Because resources for these species are dispersed across a broader area, habitat fragmentation may result in the loss of a necessary constituent for survival (e.g., sufficient breeding or foraging habitats).

Examples of habitat fragmentation in California include the conversion of native grasslands to agricultural uses in the Central Valley, which fragmented once continuous grasslands into remnant patches surrounded by other vegetation types. In southern California habitat fragmentation has occurred as historic movement corridors between mountain ranges were urbanized.

Changes in Succession Processes and Ecosystem Development

Ecological succession is the typically predictable change in species composition of a community over time. Ecological succession follows either the creation of new unoccupied habitat, such as after a lava flow or severe landslide, or the disturbance of an existing vegetation community by natural or human-induced actions, such as fire, timber harvesting, landscape grading, or grazing. It is characterized by early rapid changes in community composition shortly after a disturbance, which is typically dominated by fast-growing or pioneering species, followed by a slower rate of changes that gradually leads to a stable climax community composition in late succession.

Disruption of succession is an important stress. It can occur either because natural succession is inhibited or because repeated disturbances by human activities take place. The lack of ongoing disturbance over time, such as an ecologically isolated habitat that is not allowed to burn because of human safety concerns, prevents the regeneration of those early successional, pioneering species. Agriculture, timber harvest, and heavy recreational uses can interrupt the establishment of late successional or climax species, which are typically less tolerant of disturbance and require a longer time to become established.

Changes in Coastal and Oceanic Characteristics

Change in Oceanic Inputs

Ocean waters may flow into semi-enclosed basins, such as embayments, estuaries, and lagoons, occurring at the watershed-ocean interface when these basins are connected to the ocean. The amount of ocean flow depends upon the tidal range and river flows, the coastal exposure and shoreline gradient, the sediment deposition regime, and the morphology of the basin. The mixing that occurs between these ocean waters and the waters from the terrestrial drainage (usually freshwater) results in salinity and density gradients that vary both horizontally (front to back of system) and vertically (surface to bottom). These gradients provide the driving force (thermohaline) for circulation.

Change in Oceanic Hydrodynamics

Both large-scale and local processes affect the ocean dynamics off the coast of California. For much of the year, the California Current brings colder northern waters southward along the shore as far as Baja California, while the Southern California Countercurrent flows into the Santa Barbara Channel. Seasonal changes in wind direction commonly create seasonal patterns for this large-scale ocean current. For example, beginning around March, northwesterly winds combine with the rotation of the Earth to drive surface waters offshore. This movement of water draws cold, nutrient-rich water from the depths (upwelling). When these northwesterly winds die down in the fall each year, a surface current, known as the Davidson Current, develops and flows in a northerly direction north of Point Conception and inside the California Current. The Davidson Current usually persists through February.

Laid over this pattern are both short-term and long-term changes. Local winds, topography, tidal processes, and discharge from rivers generate currents close to shore that can persist for hours, days, weeks or months. Local winds and storms generate waves that break upon the shoreline. These winds and currents also mix the surface waters, dispersing nutrients and oxygen in this upper mixed layer. Multi-year oscillations in the atmospheric pressure in the South Equatorial Pacific can result in El Niño conditions offshore of California (warmer waters, suppressed upwelling, and occasionally severe storms) or La Niña conditions (colder waters, enhanced upwelling, and less precipitation). Oscillations in the atmospheric pressure in the North Pacific control low-frequency upwelling and along-shore currents, resulting in consistently cooler or warmer waters off the California coast, with each phase persisting for several decades.

Change in Surface Area

The surface area of embayments, estuaries, and lagoons can vary through increased terrestrial drainage and freshwater input from higher rainfall amounts and from sea level rise and greater ocean in-flow. Coastal storms with accompanying decreases in atmospheric pressure create a slowing of outgoing tidal exchange along with an increase in oceanic storm surge entering an estuary or embayment. Higher water levels within these basins can cause flooding of habitats, such as salt marshes and riparian areas, and infrastructure. This variation in ocean and freshwater inflow will cause salinity fluctuations, tidal mixing, vertical stratification in salinity, variation in oxygen levels, and variation in connectivity throughout the estuary. In addition, oceanic upwelling increases hypoxia and acidification in the coastal ocean, which affects the biota inhabiting both nearshore areas and estuaries.

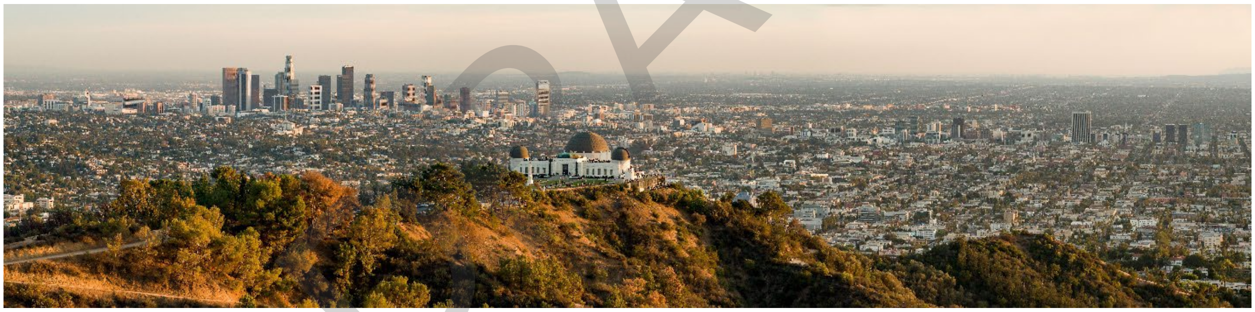
2.5.2 Major Pressures on Ecosystems

A pressure is an activity that influences a stress and could significantly change the ecological conditions of a community. As recognized in the state's demographic projections, California's population is projected to reach 40 million residents by mid-century (CDOF 2023). The state's large population leads to an array of human-induced pressures that challenge California's ability to support a large human population while conserving the state's highly biodiverse environment (See Appendix H).

CDFW and partners assessed the major pressures on each conservation target to compile a standardized set of pressures that are most important within conservation units, provinces, and statewide. The impact of pressures varies between provinces, and some pressures may not impact all provinces. Information on how each pressure impacts a province is found in the individual province sections. Pressures include:

- Agricultural and forestry effluents
- Airborne pollutants
- Annual and perennial non-timber crops
- Catastrophic geological events, including Volcano eruption, earthquake, tsunami, avalanche, landslide, and subsidence
- Climate change
- Commercial and industrial areas, including shoreline development
- Dams and water management/use
- Fire and fire suppression
- Fishing and harvesting aquatic resources
- Garbage and solid waste
- Household sewage and urban wastewater, including urban runoff (e.g., landscape watering) and point discharges

- Housing and urban areas, including shoreline development
- Industrial and military effluents, including hazardous spills and point discharges
- Introduced genetic material
- Invasive plants/animals
- Livestock, farming, and ranching
- Logging and wood harvesting
- Marine and freshwater aquaculture
- Military activities
- Mining and quarrying
- Other ecosystem modifications, including modification of mouths/channels, ocean/estuary water diversion/controls, and artificial structures
- Parasites/pathogens/diseases
- Recreational activities
- Renewable energy
- Roads and railroads
- Shipping lanes, including ballast water
- Tourism and recreation areas
- Utility and service lines
- Wood and pulp plantations



Housing and Urban Areas; Commercial and Industrial Areas

Economic and population growth increases the need for housing, commercial development, services, transportation, and other infrastructure. These activities all put pressure on the state's land, water, and other natural resources. California's population grew by 2.3 million, or six percent, between the 2010 census and the 2020 census (CDOF 2020). This is a decrease in the rate of growth from the 2000 to 2010, when over 3 million residents were added (CDOF 2025a). The rate of change is projected to slow over time until 2050 (CDOF 2025b).

Growth and development, including urban, commercial, and industrial development, can contribute to all of the major stresses described in Section 2.5.1. Conservation strategies need to take into account the pressures of continuing development demand. Progressive conservation planning on state, federal, and local levels has tempered the ecological effects of growth through conservation and mitigation requirements, such as policies requiring no net loss of California wetlands and the creation of reserves for species and habitats. Smart growth principles have incentivized infill projects, higher urban density, and transit-oriented development where the ecological impact is typically less than exurban locations. These smart growth principles are being integrated into regional land use and transportation planning through the creation of required sustainable communities' strategies, such as the Plan Bay Area.

Additionally, demographic shifts are predicted to result in a decreased demand in traditional single-family homes and an increased demand for transit-oriented or walkable multifamily-density communities. Large public works and infrastructure projects focused on repair of existing roads, and implementation of additional transit options are expected, including a state-sponsored high speed rail system, beginning in the Central Valley and ultimately extending from San Francisco and Sacramento to San Diego. Additional urban and infrastructure development will continue to lead to habitat loss, fragmentation, and decrease in the quality of remaining natural areas.

Intensified artificial light and sound pollution associated with human growth and development are increasingly recognized as having negative effects on humans (Falchi et al. 2019; Murphy and King 2022). Ecological light pollution is artificial light that alters natural light regimes in terrestrial and aquatic ecosystems and includes chronic or periodically increased illumination, unexpected changes in illumination, and direct glare. Wildlife may experience increased orientation or disorientation from additional illumination and may be attracted to or repulsed by light and glare, which may affect survival, foraging, reproduction, communication, and other critical behaviors (Longcore and Rich 2004). The effects of anthropogenic noise on wildlife are no less detrimental to wildlife or ecosystems (Shannon et al. 2016).

Garbage and Solid Waste; Household Sewage and Urban Wastewater; Industrial and Military Effluents; Airborne Pollutants

Along with growth and development come pressures from excess waste and pollutants from point and nonpoint sources. Garbage and solid waste may directly entangle wildlife. Runoff from residential and commercial areas, landscaped yards, roads and parking lots, and domesticated animal feces include pollutants and pathogens. Urban stormwater can contain contaminants like oils, pesticides, and heavy metals and can significantly deteriorate surface water quality (SWRCB 2024). Particulates, pollutants, and pathogens deposited from the air can degrade aquatic and terrestrial ecosystems and marine habitats. Discharges from power plants, sewage plants, and other industrial facilities are high in pollutants and pathogens.

Roads and Railroads; Utility and Service Lines; Shipping Lanes

Existing transportation infrastructure, such as roads and highways, can fragment the landscape and create barriers to wildlife movement, be a conduit for invasive species, increase accidental ignition points for wildfire, and cause mortality to wildlife due to collisions. Continued development increases the demand for transportation facilities for urban, regional, intercity, and long-distance travel. Caltrans estimates that the capacity of existing rail, air, and highway transportation systems will need to be increased (Caltrans 2016). The California Transportation Plan calls for an increase in intermodal transportation systems, including increased freeway reliability, express and high occupancy vehicle lanes, and increased connectivity between transportation types and across modes of transportation (Caltrans 2016). Most of these connections will occur along existing transportation corridors and increase mobility between existing modes of transportation including intercity bus and rail (Caltrans 2016). The focus on improvements to existing corridors and connections between travel modes should minimize new habitat fragmentation from state highways. However, local roadways and other infrastructure have the potential to create additional habitat fragmentation.

In addition to habitat fragmentation, roads, railways, utility and service lines, and waterways create a network of human activity that can increase other pressures, such as human-wildlife conflict, and synergism between invasive species and wildfire. Invasive plants and animals can be unintentionally transported to new areas by way of tire tread, ballast water, etc., and wildfires have ignited from sparks and flames originating from roads (e.g., collisions, discarded cigarettes), railways, and utility and service lines. Transportation infrastructure can also cause direct mortality of wildlife. In most cases, an animal that has been hit by a vehicle dies immediately or shortly after a collision. Many different wildlife species representing a wide variety of species groups have been observed as roadkill, sometimes in massive numbers. According to Caltrans and California Highway Patrol statistics, there are about 5,000 reported accidents each year on state highways involving deer, other wildlife, and livestock (Shilling 2015).

The development of new infrastructure and expansion of existing infrastructure can also result in direct habitat loss. The construction of California's high speed rail system, when completed, will become the largest infrastructure development project in the state's history. The first phase of a high-speed rail system to connect Sacramento, San Francisco, Los Angeles, and San Diego broke ground in January 2015 and it is eventually expected to extend from Sacramento to San Diego, totaling 800 miles. In addition, the High-Speed Rail Authority (Authority) is working with regional partners to implement a statewide rail modernization plan to upgrade local and regional rail lines. Like many large-scale transportation projects, without proper planning and

University of California Davis Road Ecology Center and Interactive Roadkill Map

The University of California (UC) Davis Road Ecology Center brings together researchers and policy makers from ecology and transportation to design sustainable transportation systems based on an understanding of the impact of roads on natural landscapes and human communities. Researchers at UC Davis have developed a statewide monitoring system for wildlife-vehicle collisions. The data could help state highway planners take measures to protect both drivers and wildlife.

The California Roadkill Observation System, a volunteer-submitted database of instances where wildlife and vehicles collided over the past five years, features more than 30,000 observations of over 400 species (U.C. Davis Road Ecology Center 2025). The data can be seen in detail through the system's interactive map, which assigns different colored dots for various sizes of species. The public can submit entries, including photographs, to add to the map.

Using the roadkill data, the Road Ecology Center has mapped stretches of highway that are likely to be hotspots for wildlife-vehicle collisions (Shilling 2015).

Major hot spots include:

- Bay Area: I-80 and U.S. Highway 101 run alongside the bay, where high numbers of wading birds and water birds are killed. Large animals are more likely to be hit on I-280 and State Route 17, particularly near areas of parks and open spaces.
- Southern California: Many areas along State Route 94 in San Diego County have high rates of collisions where the highway runs through wildlife habitat.
- Sierra: State Route 70 in Plumas County and near Portola have high rates of roadkill, particularly deer.
- North Coast: Both U.S. Highway 101 and State Route 20 show high rates of collision between Willits and Lake Mendocino.

consideration during the design phase to anticipate species and habitat needs, these rail projects may result in devastating impacts to biological resources, including loss or degradation of habitat for threatened and endangered species and wetlands through land conversion, loss of habitat connectivity, and construction related impacts (CA High Speed Rail Authority 2005).

California has numerous shipping lanes along its coast connecting ports to the rest of the world. In recent years, a record number of whales have been hit and killed by ships sailing along the California coast. Changes have been made to the mile-wide shipping lanes that funnel traffic into the San Francisco Bay and to the ports in Los Angeles and Long Beach. Some modifications have been made specifically to reduce the presence of ships in areas whales are known to frequent (Perlman 2014). In addition to direct mortality on species, shipping lanes introduce pollutants, pathogens, and invasive species to California marine ecosystems.

In addition, secondary roads are built and maintained on public lands. Land management agencies, such as U.S. Forest Service (USFS) and U.S. Bureau of Land Management (BLM), have Resource Management Plans that determine management of secondary road systems within their jurisdiction.

Wildlife Health

Historically, the term wildlife health has often been defined by pursuit of the absence of pathogens, parasites, and disease. A more appropriate understanding of this phrase is broader, as proposed by Craig Stephens (Stephen 2014): "1) health is the result of interacting biologic, social, and environmental determinants that interact to affect capacity to cope with change; 2) health cannot be measured solely by what is absent but rather by characteristics of the animals and their ecosystem that affect their vulnerability and resilience; and 3) wildlife health is not a biologic state but rather a dynamic social construct based on human expectations and knowledge." This updated definition is in line with the increasing popularity in multiple disciplines of a "One Health" approach recognizing the interconnectedness of human, animal, and environmental health.

Habitat degradation, geographic restriction, reliable forage and water availability, non-native competition, genetic diversity, habitat fragmentation and/or degradation, climate change and other anthropogenic stressors – these all influence how vulnerable or resilient an individual or population is to a pathogen. The conservation strategies in SWAP 2025 promote functioning ecosystems, enhancing wildlife habitats, and addressing multiple pressures and stresses to protect the health of California's wildlife.

Parasites, Pathogens, and Disease

Human growth and development can have serious and sometimes unintended consequences for wildlife species and ecosystems. Greater contact between humans, domestic animals, and wildlife – particularly in the context of degraded or disrupted ecosystems – can result in novel exposure or transmission of pathogens. These may be direct or indirect due to human activities.

Exposure to a pathogen may or may not result in disease, which may or may not affect the species' population. In some cases, response to pathogen exposure can be catastrophic, resulting in populations at the risk of extirpation from the state or extinction, which could occur with Franklin's and western bumble bees. Other stressors such as climate change and invasive plants/animals can interact to intensify the pressures on species or expand pathogen distribution.

Options for response to disease in a wildlife population are limited. Treatment, particularly at a population level, is not often possible but may be possible in certain cases, e.g., San Joaquin kit fox mange. Vaccination is available in rare instances (e.g., riparian brush rabbit vaccination against Rabbit Hemorrhagic Disease Virus-2). Minimizing the spread of disease may be possible through habitat manipulation or selective culling. These require significant and often repeated resources to protect populations and may not garner public approval. Prevention of disease introduction (e.g., minimizing bighorn sheep and domestic sheep and goat contact risk) and promotion of health resilience of wildlife is key.

Funding for ecological studies of disease has increased over the past decade due, in part, to greater recognition of a One Health framework and the human health risks of increasing emerging and re-emerging zoonotic disease, i.e., disease that can be transmitted between humans and animals. These risks have been highlighted with high pathogenic avian influenza, severe acute respiratory syndrome (SARS), and hantavirus among others. However, the needs and costs associated with this work have vastly outstripped available resources given the scale and complexity of concerns. Disease surveillance, monitoring, management, and research of wildlife health provide understanding of and help maintain healthy populations of wildlife, humans, and ecosystems.

Dams and Water Management/Use

Water resource management in California causes numerous stresses on rivers, the Delta, wetlands, estuaries, aquifers, and their associated habitats across the state.

Resource agencies manage limited water resources to meet water and power supply needs of urban communities and agricultural production. Water management activities include the operation of dams and diversions, development and operation of irrigation canal systems, extraction of groundwater, and construction of flood-control projects such as levees and channelization. Stormwater conveyances are managed to convey urban runoff and floodwater.

In all regions of the state, aquatic, wetland, and riparian habitats support rich biological communities, including many special status species. Degradation of these habitats represents a serious threat to the state's biological heritage. Water management activities can reduce the amount of water available for fish and wildlife, obstruct fish passage, and result in numerous other habitat alterations. Dams, diversions, and groundwater pumping reduce the amount of water in rivers and change the timing of seasonal high- and low flows. In shallow waters, temperatures can rise to levels unsuitable for aquatic species and important habitat features such as deep pools may be eliminated. Stormwater management can also alter hydrologic processes such as sediment deposition, water filtration, support of riparian vegetation, and wildlife movement corridors. Coastal lagoons and rivers suffer from the historic and ongoing conversion of tributary waterways into constructed stormwater infrastructure.

Increasing pressures from development and agriculture, as well as the expectation of longer droughts resulting from climate change, have exacerbated California's water shortages.

Where groundwater pumping exceeds recharge, a lowering of groundwater levels can result in depletions of surface water, including reductions of cold-water seepage that provide critical temperature refugia for rearing listed anadromous fish. Much like surface water diversions, depletion of surface water by groundwater pumping has the potential to impact aquatic ecosystems by decreasing the water body's overall thermal mass, depths, and flow velocities, resulting in reductions of physical habitat availability. Overdraft can also deprive terrestrial groundwater dependent ecosystems such as wetlands, riparian areas, and deep-rooted vegetation, of needed access to groundwater.

Additionally, climate change is expected to result in more precipitation falling as rain rather than snow, which could lead to severe flooding and further straining our aging water management infrastructure. Reduction in snowpack storage, due to climate change, affects water supply reliability, hydropower, and the amount of runoff during extreme precipitation that leads to flooding. Increased flooding potentially causes more damage to the levee system and other infrastructure (DWR 2023). It is anticipated that additional water conservation, water recycling, watershed management, managed wetland water supply, conveyance infrastructure, desalination, water transfers, and groundwater and surface storage will be necessary.

Conservation strategies in the state's aquatic ecosystems are greatly influenced by water management efforts. Much of California's water supply and flood protection infrastructure are no longer functioning properly or have exceeded their life cycles. This aging infrastructure has led to declines in species and ecosystems. California Water Plan 2023 Update identified strategies for establishing reliable water supplies and restoring ecologically sensitive areas (DWR 2023).

The U.S. Bureau of Reclamation (USBR), in coordination with DWR and other local agencies, is conducting planning for three large surface water storage projects (i.e., raising Shasta Dam, the proposed Temperance Flat Reservoir, and the expansion of the San Luis Reservoir), along with off-stream storage in the Sacramento River watershed, such as Sites Reservoir.

Extended Drought – A California Reality

From 2020–2022, California experienced its most recent drought. The state is no stranger to long periods of drought. Droughts are a natural feature of California's climate and are becoming drier due to human-induced warming. Stream flow reconstructions based on tree-ring data show that far more severe and long-lasting droughts have occurred in California prior to historic record keeping, albeit with 30 million fewer people. Although the severity of droughts varies across the state, no area remains unaffected.

Drought-related wildlife effects begin with decreased vegetation growth, or in food-chain terms, reduced primary plant productivity for wildlife food that decreases ecological energy flow. As grasses and other wildlife food plants are less productive, food availability diminishes for herbivorous species. Exemplary of the interconnected food web, reduced vegetative food energy ripples up trophic levels as a stress of insufficient nutritional energy available to insects, small mammals, reptiles, and carnivorous predators, as well. Undernourished animals with fat must draw from these reserves, which can lead to weakened health and ultimately starvation. During a recent drought, CDFW's Wildlife Investigations Lab discovered poor body condition, emaciation, and secondary infections in young red-tailed hawk carcasses in central and southern California (Batter 2014).

As the drought lingers, water-associated and more deeply rooted plants are affected. Gradually, water sources and availability shrink or disappear completely. Some plant species will go dormant in response to lack of water; others will simply die and depend on seed banks to support later regeneration. The lack of water reduces a plant's ability to resist insect infestations and disease, leading to additional mortality. An increase in dormant and dead vegetation sets the stage for more frequent and overly severe wildfires, followed by accelerated wind and water erosion.

As water bodies shrink, their wildlife inhabitants and migratory visitors are forced into concentrated areas. Migrating ducks, geese, and swans that reside or spend the winter on California's ponds, wetlands, and lakes must cope with smaller water areas. Lack of precipitation reduces the amount of habitat available for migratory and resident waterfowl and shorebirds, forcing them to become concentrated in the smaller water bodies and wetlands. Large numbers of confined waterfowl make infection by a bacterial disease, such as avian cholera, easier, so it can spread rapidly, and potentially cause the death of thousands of birds.

Rising water temperatures in the state's aquatic systems also occur because of greater warming of smaller water bodies or the lack of cold-water reserves in reservoirs from reduced snowpack. Cold water fisheries can lose their eggs, fry, or fingerling fish, as the low flows in streams are heated to near-fatal temperatures. Warm water species are not immune. The combination of warmer water and concentrated nutrients can lead to algal blooms, stressing the fish because of decreased dissolved oxygen resulting in the potential for suffocating fish.

It is important to remember that drought as a stress, by itself, is a part of California's history and ecological processes—a natural phenomenon. Native plant and animal species have survived droughts for centuries with adaptation strategies for times of drought stress and the opportunity for rapid recovery when the water regime improves.

The challenge for wildlife conservation is when drought stress exacerbates other occurring pressures, causing extirpation or, in the extreme, extinction. The potential for the imminent extinction of the endangered delta smelt (*Hypomesus transpacificus*) has been recognized, because the recent droughts have worsened the negative impacts of pressures that have led to the species' endangerment, such as competition and predation by non-native species, altered food supply, contaminants, and water exports (Moyle 2015). Although this is a high-profile example at the heart of often intense debates about water allocation and aquatic habitat management decisions in California, it is emblematic of the difficulties experienced by a number of fish and wildlife species in drought-affected habitats where the natural drought stress combines with other existing pressures on wildlife.

SWAP 2025 provides strategies that address water management and maintenance of the quality of aquatic habitats and terrestrial habitats that are affected by drought stress. CDFW has been pursuing many urgent actions to protect fish and wildlife species and habitats that face these challenges. Actions include fish rescues, anadromous fish migration assistance, wildlife rescue and relocation from wildland-urban interfaces, well installations and improved water systems for CDFW Wildlife Areas, agreements with water users to reduce surface water diversions, consultation with state and federal water agencies about water system operations to protect aquatic habitat and species, habitat restoration projects, and more extensive monitoring of fish and wildlife conditions. Funding for drought responses such as these will continue to be one of the important fiscal strategies for fish and wildlife conservation employed by CDFW in times of extended drought.

Fire and Fire Suppression

Many of California's ecosystems are fire-adapted; however, many semi-arid forests and grasslands are not experiencing fire as frequently as needed to maintain their ecological structure and function. Other ecosystems, such as coastal sage scrub and chaparral, are experiencing fires too frequently, resulting in changes to their ecology (Sugihara 2006).

Fuel load buildup, compounded with reoccurring periods of drought exacerbated by increasing temperatures due to climate change, and increased development in the wildlife urban interface (WUI), has altered fire regimes throughout the state to the point that California wildfires are increasing in frequency, acreage, intensity, and severity in almost all habitats, with forests and shrubland being most affected. Now referred to as "megafires", wildfires that burn more than ~99,000 acres, these fires have significantly increased in frequency, size, intensity, and severity since the early 2010s. Eight of the 10 largest wildfires in California's history have occurred in the last five years, with 2020 and 2021 accounting for 58% of the total area burned in California from 2012 to 2021. This is an increase of more than 10 times larger than the historical average, with 89% of the burned area being burned at a high severity (Ayars et al. 2023).

While the frequency of intentionally set fire (i.e., prescribed burning) and annual acreage burned throughout the state remains lower than pre-colonization levels in many areas, human-caused fires have resulted in unnaturally high fire frequencies in some vegetation communities, especially along roads and near the urban-wildland interface, interrupting the natural successional dynamics of these habitats. Increases in fire frequency that fall outside of the range of variation of a fire regime can decrease the quality of aquatic habitats by reducing shading and woody debris and damaging terrestrial habitats.

California's fish, wildlife, and habitats have not evolved with this unprecedented level of wildfire size and severity, and a corresponding lack of research and knowledge gap on the short and long-term effects from such fires needs to be addressed. Higher severity fires burn longer and hotter, essentially sterilize the soil, which eliminates the seed bank and leaves little remaining habitat for wildlife species to reoccupy. Recovery of severely burned areas is further hampered by subsequent rains that can wash away soil and retained wildlife habitat elements if not stabilized and preserved in a timely manner prior to rains.

The adaptations to wildfire differ among ecological communities. In sage scrub and chaparral systems some plant species have evolved seeds that germinate post-fire; however, if plants are not able to mature and set seed, the seed bank cannot be sustained in an environment with an altered more frequent fire regime. The increased fire frequencies in sage-scrub vegetation communities favor Mediterranean grasses that were introduced with the arrival of European colonization and livestock. Once established, non-native grasses grow in a dense-thatch pattern that chokes out native vegetation, lowers habitat quality for wildlife, and provides additional fuel for the cycle of frequent burning (Keeley 2009).

In some cases, altered fire regimes have caused dramatic changes in regional habitats. For instance, because of altered historical fire regimes, the densities of white fir and incense cedar have increased at the expense of live and black oaks, which are very important to many wildlife species including acorn woodpecker, band-tailed pigeon, black bear, and dusky-footed woodrat. Areas where fire was relatively rare, such as the high desert, have experienced an increase in fire frequency because of changes in more flammable non-native vegetation. Increased fuel loads associated with invasive species have resulted in an increase in the number of fires (Brooks 1999). Drought-stressed forests may already be more prone to fire because of tree deaths from pests, which are in turn made even more vulnerable to fire because of an increased buildup of fuels and competition from higher densities of trees from altered fire regimes. This new severe fire regime is exacerbated by climate change, particularly under drought-stressed conditions.

In addition to the challenges that come with altered fire regimes, the remedy of fire management activities can affect species and their habitats. Fire suppression activities, such as creating firebreaks, application of fire retardant, water drafting (i.e., use of suction to move water from a lake or stream), and back burning, can damage vegetation communities, aquatic environments, and sensitive wildlife habitats. Fuel reduction activities, including mechanical and manual removal of vegetation, prescribed herbivory, prescribed burning, and application of herbicides, are currently being implemented throughout the state to reduce fuels and restore ecosystem health and processes.

Fire risk reduction and suppression activities can have variable effects on wildlife, depending on the specific management actions and environment in which the actions occur. For example, in some areas bird and mammal diversity and abundance can increase with moderate levels of forest thinning for fire fuel management but decline with heavier levels of thinning (Verschuyl et al. 2011), and some native plant species are adapted to ground disturbance and can benefit from these human-induced disturbances (Potts and Stephens 2009), yet the establishment of fire breaks and mechanical fuel reduction without planning can damage small populations of rare plants, as well as introduce invasive species into new areas which can negatively affect native species (Merriam et al. 2006).

Control of invasive plants is another fire risk reduction action. For instance, red brome (*Bromus madritensis ssp. rubens*) and other invasive annual grasses increase fire frequencies in the western Mojave Desert in California, and cheatgrass has been part of the fuel in sagebrush fires in the Owens Valley (Lambert et al. 2010). In a study of fires over a decade in the Great Basin, which includes parts of California, cheatgrass fueled the majority of the largest fires and influenced 39 of the largest 50 fires (Balch et al. 2013). In cheatgrass grasslands, the average size and frequency of fire is greater compared to other vegetation types. The authors conclude that cheatgrass is creating a novel grass-fire cycle that makes future fires more likely (Balch et al. 2013).

Post-fire restoration projects including planting of trees and other native vegetation, and the site preparation and management required to achieve and maintain project goals, are also being implemented where funding is available in areas that are at a high risk of type conversion. While fuel reduction and post-fire restoration projects have the potential to negatively impact species and their habitats, they also undergo environmental review and permitting processes which help to avoid, minimize, or mitigate these potential impacts. Post-fire remediation activities, such as debris cleanup and removal, cleanup of hazardous chemicals, erosion control, and cleanup and stabilization of waterways can also damage vegetation communities, aquatic environments, and sensitive wildlife habitats if they are not implemented with appropriate best management practices and avoidance and minimization measures.

Annual and Perennial Non-Timber Crops; Livestock, Farming, and Ranching; Agricultural and Forestry Effluents

Agriculture is an essential component of California's economy. The state is a major producer in the fruit, vegetable, tree nut, and dairy sectors (USDA 2014; CDFA 2023; Cole et al. 2024). Historic conversions of native habitat to agriculture in California have been significant. Today the majority of the Central Valley is used for agriculture, with most of this land conversion occurring prior to the 1970s (USGS 2016, 2025). While agricultural lands no longer represent native vegetation types, they can provide important habitat for wildlife species, such as flooded rice fields of the Central Valley that provide waterfowl habitat. Habitat loss and/or degradation can occur through land conversion from one type of agriculture to another, including conversion of field and row crops or grazing lands to orchards or vineyards. Deep ripping of fields to create subsurface conditions conducive to orchards and vineyards can destroy wetlands as well as essential upland habitat for sensitive species such as California tiger salamander, and lead to habitat fragmentation. Diversion of water for irrigation can contribute to altered hydrologic regimes, and nutrient laden runoff can degrade aquatic habitat. Other impacts from agricultural practices include the use of chemical fertilizers, pesticides, adjuvants, and other chemicals that can affect non-target species and degrade water quality. Illegal cannabis groves (discussed below), particularly in the northern portions of the state, have similar but more pronounced local impacts than other agriculture, because of their location in remote and otherwise undisturbed areas and lack of regulatory oversight.

Ongoing agricultural practices can have a range of direct and indirect ecosystem consequences, positive or negative, based on timing, duration, and intensity. In addition, different cropping systems (e.g. organic versus conventional farming, or highly diversified fields versus large monocultures) can have different levels of impacts to natural ecosystems across the landscape. Many on-farm practices for conservation can reduce impacts/benefit ecosystems. The location of certain cropping systems and crop types are important factors in moving toward a long-term sustainable agricultural system.

Field crops can provide foraging habitat for raptors, such as Swainson's hawk, and rice fields and stock ponds can provide foraging and aquatic habitat for reptiles such as giant garter snake (federal and state threatened), amphibians, bats, and birds, such as tricolor blackbird. Agriculture and forestry can harm those same species through chemical treatments, removal of nesting habitat, or direct mortality from harvesting and maintenance activities. Agricultural runoff containing fertilizers and pesticides can also pollute and degrade aquatic and marine habitat. Agricultural impacts go beyond effluents and include drift and even on-field exposure to pollinators or other species that use farm fields for forage or habitat. Conversely, crop damage from wildlife can cause substantial economic loss and public health risks necessitating enhanced measures to control access to crops by wildlife.

Legislation, public policies, and landowner conservation practices have helped slow impacts of agricultural practices to species and habitats. For example, farmers can apply for subsidies to avoid disruption of tricolored blackbird nesting, to restore wetlands and other waters, to implement best management practices for grazing, and to manage field crops for the benefit of wildlife (e.g., rice field management to provide habitat for giant garter snake and migratory birds; USDA 2015).

Studies overwhelmingly show that livestock grazing negatively affects water quality and seasonal quantity, stream channel morphology, hydrology, riparian zone soils, instream and streambank vegetation, and aquatic and riparian wildlife (Belsky et al. 1999). Other researchers have found benefits from grazing and have advocated for grazing as a useful and necessary conservation tool to manage exotic annual grasses, particularly around vernal pool grasslands (Marty 2005).

Good grazing practices are much preferred, compared to poor grazing practices, and both are preferred to residential development or habitat conversion and loss. Central Valley agriculture contributes to the conservation of numerous species of waterfowl and shorebird along the Pacific Flyway, and significantly in the maintenance of winter habitat for the greater sandhill crane, a California-listed threatened species. In the absence of native habitats, grain crop fields provide essential winter flooded roost habitat for sandhill cranes, ameliorating the effects of ongoing conversion of farmlands to incompatible crops such as orchards and vineyards (Ivey et al. 2016). There is clearly a balance that can be achieved through incentive based, non-regulatory collaboration and partnerships with conscientious ranchers and farmers. SWAP 2025, as well as the California Climate Adaptation Strategy, relies upon fostering this balance as much as possible, but will require a concerted effort to sustain a dialog with farmers, ranchers, land managers, agency staff, and the public about the benefits of working together for the benefit of fish and wildlife.

Grazing, an Essential Conservation Tool

SWAP 2025 recognizes the importance and application of appropriate, well-managed grazing practices and the benefit to many of California's plant and animal communities. Livestock grazing confers many direct benefits upon wildlife and wildlife habitat, as well as many indirect benefits, such as less frequent catastrophic wildfire through the reduction of invasive plants and fuels, as well as source habitat for wild bee pollinators of agricultural crops (Chaplin-Kramer et al. 2011).

There are many instances where well-managed ranching activities directly benefit species identified as SGCN. For example, stock ponds maintained for livestock watering have proven to provide highly suitable habitat for tiger salamander and red-legged frogs (USFWS 2002), two species listed as SGCN in the SWAP 2025. Vernal pool complexes become over-run by invasive species reducing species richness and pool inundation period without needed disturbance. In the absence of native herbivores, cattle provide this benefit (Marty 2005).

Additionally, cattlemen in northeastern California have been instrumental in restoring habitat for sage grouse. Improved grazing practices together with voluntary habitat restoration and conservation efforts by ranchers to protect the Modoc sucker have contributed to the proposed delisting of that species from the Federal Endangered Species Act (USFWS 2014b). These are a few of the many examples where grazing activities and proactive ranch-management strategies have conferred direct benefits upon California wildlife.

The vast majority of cattle ranchers throughout California are responsible and conscientious stewards of the land, water, and wildlife resources of the state and are employing practices firmly rooted in the best available science. Ranchers strive to conserve our natural resources not only because it makes environmental sense, but because it makes sense from a succession-planning perspective. Ranching is a family business, and many of California's cattlemen are fourth- or fifth-generation ranchers. If California's ranchers hope to pass their livelihood on to the next generation, they know they must preserve the state's resources for their children and grandchildren, and they practice stewardship activities that will permit them to do so. Their contributions compliment their rich heritage, the natural resources, and the people of California.

Cannabis Cultivation

In 1996, Proposition 215, the Compassionate Use Act, allowed medical cannabis users to cultivate their own plants, which led to widespread cultivation. In 2016, the passage of Proposition 64, which legalized the specified personal use and cultivation of cannabis, led to expansion of cannabis cultivation through the state. Proposition 64 included provisions on regulation, licensing, and taxation of legalized use. This has led to an increase in the amount and size of cannabis cultivation, both legal and illegal. Illegal cannabis cultivation sites are found on public and private lands and management of illegal sites involves several agencies including CDFW's Law Enforcement Division.

Studies and observations have shown that illegal and non-compliant legal cannabis cultivation has resulted in a broad array of environmental impacts on aquatic and terrestrial communities, causing significant impacts to wildlife (Baker 2018). Wildlife is impacted by environmental degradation, loss and fragmentation of sensitive habitats, reduced water quality and stream flow, illness or mortality of fish and wildlife, and several other impacts (Baker 2018). Water diversions and water pollution due to illegal cannabis cultivation are of great concern and have negative impacts on the environment. The negative effects of diverting water include alterations in flow regimes; barriers to fish passage; loss of wildlife habitat; changes in water properties, such as dissolved oxygen, temperature, and pH; and the rerouting or dewatering of streams. Reduced stream flows can impact aquatic species by diminishing water quality parameters such as temperature and sedimentation, decreasing habitat availability, stranding fish, delaying migration, increasing intra and interspecific competition, decreasing food supply, and increasing the likelihood of predation.

Unlicensed activity poses a greater risk of causing environmental damage. For example, during California's dry season (June to October), when sensitive aquatic species are most vulnerable, unlicensed cultivation has been correlated with water use of up to 22 liters per plant per day (Cervantes 2006; Humboldt Growers Association 2010; Bauer et al. 2015). Unlicensed sites have been shown to illegally divert water from groundwater and streams, which can reduce instream flows and water quality (Bauer et al. 2015; Butsic and Brenner 2016). Further water quality degradation is caused by increased sedimentation from unregulated land conversions and road development (Wang et al. 2017).

The Emerald Triangle (where most cannabis cultivation occurs; Humboldt, Mendocino, and Trinity counties) is one of the least developed regions of the state and most of the cannabis-related development in the area occurs in places that were previously covered in natural vegetation (Butsic et al. 2018). These remote watersheds have high conservation value and high biodiversity, providing habitat for federally and state-listed species like northern spotted owl (*Strix occidentalis caurina*), Pacific fisher

(*Pekania pennanti*), coho salmon (*Oncorhynchus kisutch*), and steelhead trout (*O. mykiss*) (Bauer et al. 2015; Carah et al. 2015), as well as numerous other species of conservation concern.

The introduction of pesticides such as rodenticides, fertilizers, herbicides, at illegal cannabis cultivation sites directly and indirectly impact aquatic and terrestrial communities. Chemicals used during cultivation result in hazardous water quality and potential mortality of fish and wildlife. Concentrated fertilizers can leach into streams causing toxicity to amphibians, fish, or invertebrates at high concentrations or promote nutrient imbalances such as excessive algal growth, which leads to reduced oxygen levels. The excessive use of herbicides and their surfactants can also be toxic to many organisms. Pesticides and rodenticides kill target and non-target animals indiscriminately. The direct effects of pesticides on wildlife may include acute poisoning, immunotoxicity, endocrine disruption, reproductive failure, altered morphology and growth rates, and changes in behavior. Indirect impacts include decreased prey availability and secondary poisoning through contaminated water consumption or ingestion of pesticide-exposed wildlife.

Cannabis cultivation also leads to habitat loss and fragmentation, creating connectivity issues for terrestrial and aquatic species. Site development activities, including road construction, fencing, construction of ponds and artificial water sources, greenhouse construction, vegetation clearing, and forest conversion can impact wildlife movement and eliminate corridors. Cannabis cultivation causes loss in nutrient-rich topsoil and increase the risk of erosion and sedimentation of streams and burying of streams during soil preparation. Vegetation removal and forest conversion directly impact landscape ecology. Illegal cultivation sites are often in remote settings, powered by generators without secondary containment. Petroleum products that are not properly contained are often found leaching into the environment. Additional impacts at illegal cannabis cultivation sites include the introduction of fuels; noise and light pollution; improperly discarded waste, such as plastic netting, sheeting, empty pesticide containers, and spent potting soil filled with fertilizers and pesticides; increased air pollution; and poaching.

Commercial cannabis cultivation may produce significantly more anthropogenic light and noise compared to other agricultural commodities. For example, mixed-light cannabis cultivation uses artificial lights to extend the number of growing hours in a day and the number of growing days in a year. These lights are operating in areas that are predominantly rural and forested, impacting primary productivity in plants, wildlife movements and migrations, timing of phenological events, and physiological functions (Rich et al. 2020b). Noises associated with cannabis cultivation, may result from the use of irrigation pumps, diesel generators, landscaping equipment, water trucks, worker vehicles, greenhouse climate-controls (heating, ventilation, and air conditioning systems). New, sustained noises may affect habitat selection, activity patterns, phenology, and physiology of local fauna not only because they are novel, but also because they act as a constant impediment to the ability of the species to hear (Rich et al. 2020a).

Logging and Wood Harvesting; Wood and Pulp Plantations

California has approximately 99.6 million acres of land area, of which 33.2 million acres are forested. Of the total forest land in California, private landowners hold 13.0 million acres (39 percent). National forest lands account for 15.8 million acres (48 percent). Other public lands account for the remaining 13 percent or 4.2 million acres. Approximately 19.5 of the 33.2 million forested acres in California are classified as timberland. Timberland is forest land that is producing or capable of producing more than 20 cubic feet of wood per acre per year. National forests contain 9.8 million acres (51 percent) of timberland. Private landowners hold approximately 8.9 million acres (45 percent). The remaining four percent (less than 1 million acres) is held by other public landowners (Morgan et al. 2012).

U.S. Forest Service defines silviculture is the art and science of controlling the establishment, growth, composition, health, and quality of forests and woodlands to meet the diverse needs and values of landowners and society such as wildlife habitat, timber, water resources, restoration, and recreation on a sustainable basis.

California's timber harvest was 1,454 million board feet (MMBF) during 2023. Nearly 60 percent (900 MMBF) of the timber harvest came from five counties. Plumas County had the largest proportion at 16 percent (237 MMBF), followed by Humboldt County with a timber harvest of 230 MMBF (CDTFA 2025). A total of 77 primary forest products facilities operated in California during 2016. These included 32 sawmills, 23 bioenergy plants, 12 bark and mulch plants, two veneer plants, one particleboard plant, and 10 manufacturers of other primary wood products (Marcille et al. 2020).

While managed forests provide significant habitat for fish and wildlife, timber harvest can fragment forest habitat, with adverse effects on wildlife and ecosystems. Forest roads can introduce invasive plant and animal species. Poorly constructed or maintained roads and ground disturbance resulting from timber harvest can also result in soil erosion and increased surface-water runoff. While sometimes temporary in nature, these impacts can have short-term or cumulative effects when concentrated in space and time. These impacts can be more significant when salvage logging occurs on an already burned landscape (Wagenbrenner et al. 2023), a practice that is becoming much more common as severe wildfires become the norm throughout the state.

Renewable Energy; Mining and Quarrying

As of 2023, renewable resources accounted for 54% of California's in-state generation (U.S. Energy Information Administration 2024). The rapid increase in renewable energy generation represents a needed and major response by California to green-house gas emissions and the threat of global climate change (CEC 2025). In 2018, California's state legislature passed the landmark Senate Bill 100 (De Leon, Chapter 312, Statues of 2018), which set a goal to increase the electricity supplied to California consumers and state agencies from renewable energy and zero carbon energy sources to 100 percent by 2045. To achieve this target, California must develop record-setting amounts of renewable energy resources over the next 20 years. The increase in renewable energy generation is anticipated to be fulfilled largely be intensified development of solar and wind (both on and offshore) generation resources, as well as increases in biomass, geothermal, battery storage, and potentially wave and tidal energy resources (CEC 2025).

Development of new utility-scale energy generation projects, ongoing operations and maintenance of existing and future projects, and associated transmission infrastructure has the potential to result in the loss of and degradation of wildlife habitat, species displacement, as well as direct mortality. Stresses on wildlife habitat include temporary or permanent habitat loss, habitat fragmentation, risks to desert aquifers due to groundwater pumping, and indirect impacts from disturbance, such as vehicle traffic, noise, the introduction of non-native or invasive species, and predator subsidies (e.g., perching sites) that increase predation. Siting of industrial-scale solar and wind generation projects may require locations in remote areas with existing high-value habitats.

These areas are often remote agricultural or rangelands that would otherwise remain undeveloped. For example, most utility-scale solar generation projects are in California's desert and central valley regions. Remote projects often require additional electrical transmission facilities to bring generated power to load centers. The ecological impacts of large utility-scale solar plants are primarily habitat loss, degradation, and fragmentation because of the solar array fields, battery storage, and the associated transmission infrastructure. The USFWS recently identified risks to birds because of solar flux, impact trauma, and predation associated with the operation of large solar facilities in southern California (Kagan et al. 2014). In addition, a canine distemper virus outbreak that resulted in the deaths of several desert kit foxes inhabiting a solar development area raised questions regarding potential interactions between disturbance from large-scale renewable energy development, disease transmission dynamics, and disease resistance (Clifford et al. 2013). The impacts of solar and other renewable energy development are being addressed through comprehensive regional conservation planning efforts, such as the Desert Renewable Energy Conservation Plan (DRECP) and the Bureau of Land Management's Western Solar Plan. CDFW also administers several regional conservation programs, such as the Western Joshua Tree Conservation Plan, to help localities plan for and offset impacts of the development of renewables.

Biomass is energy production from wood waste, agriculture and food processing wastes, organic urban waste, waste and emissions from water treatment facilities, landfill gas and other organic waste sources and makes up about 2 percent of current energy production (U.S. Energy Information Administration 2024). The use of fuels from high fire risk areas as biomass has biomass production potential that would both reduce fire risk that damages natural lands and produce renewable energy (CA PUC 2014; CAL FIRE: FRAP 2018).

Geothermal comprised 4 percent of energy generation in the state in 2023 and has one of the lowest life-cycle emissions of any energy production source (Matek and Gawelle 2014). While geothermal typically has a smaller footprint than other energy production and therefore leads to less impact on habitats, as with other energy production resources, transmission infrastructure would be required for further geothermal development. The development of geothermal resources in the Salton Sea area, one of four pockets of generation throughout the state, is also significant. The geothermal brine produced there contains significant amounts of Lithium, a crucial element necessary for batteries that is often costly to extract by other means.

Existing and new hydroelectric projects affect fish migration, sediment and gravel transport, and hydrology, which results in habitat loss below and above dams. The alteration of natural river flows through dam release schedules that prioritize energy generation can change flow volumes and water temperatures, creating stressful or lethal conditions for aquatic species, or strand fish along stream margins.

Wind energy currently accounts for approximately 6 percent of California's total in-state electricity production in 2023 and is expected to continue to grow under renewable energy mandates, primarily though the utility-scale wind farms located in areas with annual average wind speeds of at least 13 miles per hour (U.S. Energy Information Administration 2024). Wind farms exist throughout California with major concentrations in the Burney, Solano, Altamont, Pacheco, Tehachapi, Palmdale, San Gorgonio, Kumeyaay, and Ocotillo areas (USGS Wind Turbine Database). Installation of large wind farms in these areas may lead to new pressures from energy generation developments, which can lead to direct wildlife mortality or diminishment of habitat quality. Direct mortality concerns relate primarily to the risk of avian and bat collisions with wind turbines and associated guy wires. Habitat degradation can occur from landscape alteration and fragmentation, to introduction of invasive species from access and service roads, energy infrastructure that eliminates native vegetation and modifies drainage, or increases human activity in remote areas. Large-scale wind energy facilities have the potential to alter localized micro habitats associated with areas downwind of the rotor turbulence zone. The potential impacts range from alterations in wind, surface temperatures, precipitation and evaporation levels, and soil moisture levels (Lovich and Ennen 2013).

Offshore wind is defined as the placement of either fixed-bottom or floating structures in ocean waters that take advantage of higher wind speeds available offshore to generate electricity. Due to the narrow continental shelf which quickly drops to deeper waters off California's coastline, floating turbines are the best technology available. Floating offshore wind technology is in the early stage of development and there are currently no utility scale deployments along the west coast of the United States. The area of development and range of technologies anticipated to be deployed off California include offshore turbines and substations, cables routes to shore, and port infrastructure development.

In December 2022, the Bureau of Ocean Energy Management held a lease sale for the rights to develop offshore wind resources off the coast of Eureka and Morro Bay. Based on other developments around the world and the best information available from regulators and California lease holders, a range of potential impact producing factors are being analyzed to determine best approaches to avoid, minimize, and mitigate impacts to California's tribal, cultural and natural resources (Jones et al. 2024). CDFW is actively engaged with state, federal, and California Native American tribal partners as the projects move forward. Additional offshore renewable development is anticipated for wave and tidal resources; a CEC Wave and Tidal Energy status report on these emerging technologies was recently published by the CEC (Aspen Environmental Group 2024).

Approximately 44.7 million acres of subsurface mineral estate underlies federal surface land, 2.5 million acres underlies private lands, and 592,000 acres underlies Native

American Tribal lands. There are 166 active mineral sales contracts in California and 165,000 ounces of gold produced annually (BLM 2014). Mining exploration can modify and destroy habitat, which can threaten species such as the Inyo rock daisy (CDFW 2023d).

Recreational Activities; Tourism and Recreation Areas

Outdoor recreation and exposure to nature is important to foster an appreciation of nature; however, recreation in sensitive habitats could result in habitat degradation. Recreational use of public lands in California involves many visitors, both from state residents and out-of-state tourists. Extensive areas of federal and state lands offer high-quality outdoor recreation opportunities. Visitation data (BBC Research & Consulting 2011) from federal agencies (National Park Service [NPS], USFS, BLM, USFWS, and U.S. Army Corps of Engineers) indicate that federally managed lands in California average approximately 90 million visitor days per year. The California State Parks System averages approximately 78 million visitor days per year.

Large numbers of outdoor recreation users in sensitive areas can directly damage natural systems by reducing vegetative cover, compacting soil, disturbing biotic soil crusts (i.e., cryptogams), increasing soil destabilization and erosion, disturbing breeding and foraging areas, contaminating natural lands and waterways through inappropriate disposal of trash and human waste, and by introducing non-native species. Indirect impacts may also occur to natural areas through increased development of recreational access points and supporting infrastructure such as roads, visitor facilities, and campgrounds. Visitor litter in parks and public lands can encourage increased corvid populations (jay, crow, and raven), which contributes to greater competition with and predation upon other native wildlife.

Recreational off-highway vehicle (OHV) use can have adverse effects on soil conditions, native plant communities, and sensitive species. On public lands, authorized and unauthorized OHV trails open relatively undisturbed areas to increased use. The vehicles can disturb or run over wildlife, crush and uproot plants, spread invasive plants, and disturb soils, contributing to erosion and sedimentation of aquatic habitats. Unauthorized mountain biking trails also result in the removal of vegetation, fragmentation of habitat, and pose a threat to sensitive habitats and species such as Lime Ridge eriastrum (CDFW 2023e).

Concentrated recreational use in highly sensitive areas, such as streams, coastal habitats, and riparian zones by hikers, picnickers, mountain bikers, and equestrians can damage these systems, reducing vegetative cover and disturbing sensitive species. Concentrated fishing, especially in populated areas, can lead to localized depletion of fisheries. Illegal trampling, and collecting can deplete floral and faunal populations, reduce biodiversity, and alter trophic and community structures in frequently visited natural habitats. The negative impacts of pressures from recreation can be reduced through proactive recreation planning and public education.

North American Model of Wildlife Conservation: The Critical Role of Sports men and women in Wildlife Conservation

North America's approach for wildlife conservation has proven to be one of the most effective strategies in the world due in large part to early conservationists who – over a century ago – recognized that to protect wildlife, we must preserve their habitats. As a result of this forward thinking, wildlife and their habitats in California and throughout North American have been preserved and promoted through the application of sound science and proactive wildlife management. At the forefront of this unique strategy – known as the North American Model of Wildlife Conservation – are hunters and anglers, who serve as the primary funding source for wildlife conservation efforts in California and North America.

In 1937, hunters sought passage of legislation that self-imposed taxes on hunting and shooting sports equipment to generate funding for habitat preservation. Ninety years later, federal excise taxes placed on these goods, as well as angling equipment, have generated more than $29.9 billion towards wildlife conservation (USFWS 2025). In addition, license, stamp, and tag fees paid by hunters and anglers currently generate roughly $90 million annually in California alone, contributing to California's wildlife conservation and research efforts. These revenues, other hunter-generated dollars, and the funding and efforts of private hunter-related conservation organizations have helped purchase and maintain over 1.1 million acres of state-owned and managed wildland and protected, restored, and enhanced over 700,000 acres of wetlands – California's most threatened habitat type – in the past quarter-century alone. Hundreds of thousands of acres of additional wildlands have been preserved by private landowners with hunting as their primary motivation. Though these efforts may have been originally motivated by concern for hunted species, non-hunted species and Species of Greatest Conservation Need have also benefitted.

With no other adequate alternative conservation funding system in place or available, the future of California's wildlife and fisheries depend upon a robust future for hunting and fishing in California. The State of California recognizes the substantial benefits hunting and angling provide to all our native flora and fauna and seeks every opportunity to embrace these important traditions in SWAP 2025 and the roadmap it is intended to provide for all conservation strategies and undertakings statewide for the next decade.

Invasive Plants/Animals; Introduced Genetic Material

An invasive species is an organism introduced by humans (directly or indirectly, on purpose or accidentally) outside its native range that causes harm to the environment, economy, or human health and livelihoods. Invasive species are a critical existing pressure that is exacerbated by climate change and expected to continue. Introduction of invasive species into California has occurred since the earliest European settlements. Some of these introductions have been intentional, such as the plants imported as ornamentals for horticulture, while other introductions have been unintentional when species arrive in the state along with the movement of people and goods. As California's population and economic activity has grown to its current size, the points of origin for people and goods coming to the state now span the globe. This has led to a diverse society and economy, but also left California vulnerable to the introduction of species from all around the world.

California is particularly vulnerable to invasive species because of its diverse ecosystems and communities. This ecosystem diversity means that species from all over the world may be able to find suitable habitat somewhere in the state. When species are introduced into these habitats, they often find conditions similar to their home range that will allow for the establishment of reproducing populations. The area affected currently is only part of the equation, to prevent the spread of invasive weeds, it is also important to consider the area that could be affected in the future if a species is allowed to spread.

The quantity of potential habitat and the high volume of transportation into California from other states and countries have had the unintended effect of introducing so many invasive species into the state that management of these non-native organisms is now a high priority for resource managers. Efforts are underway to combat invasive species and prevent new introductions such as regulations on the release of ballast water in California waters, CDFA's Border Protection Stations located on the major highways entering the state, and mandatory inspections of recreational boats in some lakes. Early detection and rapid response are a broadly supported approach that puts an emphasis on immediate action to control any newly detected non-native species when the population is small and most likely to be effectively eradicated. Regular monitoring of species and habitat is essential for the early detection of these invaders. Although most of the thousands of species brought into our state cause no harm, a small percentage can thrive in California to the detriment of native plants and wildlife. The colonization by invasive species, particularly invasive grasses, is expected to increase with climate change (Sandel and Dangremond 2012).

Invasive species harm California's wildlife by disrupting native plant and animal communities. Some introduced species are voracious predators, such as introduced trout species that have significantly contributed to the decline in mountain yellow-legged frog (Hammerson 2008). Others out-compete native species for resources or degrade and destroy habitats critical to native species, some spread diseases, and some are capable of re-engineering the environment to suit their needs, changing hydrology, water quality, soil chemistry, plant-pollinator networks, and fire regimes. In addition, some are transmitting novel diseases into the state. Many also degrade recreational activities from hunting to boating, camping, and hiking. The introduction of invasive species has been an especially detrimental pressure on estuaries such as the San Francisco estuary, which is likely the most invaded estuary in the world with over 230 species of invasive species (Cohen and Carlton 1998). Though it is difficult to quantify harm from invasive species in financial terms, a conservative estimate places the cost to the United States at over $100 billion each year, including damage to agriculture and infrastructure (Pimentel 2005). In California alone, invasive plants cost the state $82 million each year (Cal-IPC 2008).

Appendix E describes major invasive species in California, state and interagency programs to address invasive species, and recommendations and strategies for invasive species management in California. Specific invasive species are called out as pressures within each of the province chapters. The pressures imposed by invasive species will continue to grow and change as new species are introduced. Invasive species program support allows CDFW to maintain current and take on new, unexpected challenges.

California Invasive Plant Council and CalWeedMapper

The California Invasive Plant Council's (Cal-IPC) mission is to protect California's lands and waters from ecologically damaging invasive plants through science, education, and policy. The Cal-IPC CalWeedMapper website provides a dynamic tool for mapping invasive plant distribution at the landscape level using expert knowledge. CalWeedMapper enables natural resource managers, scientists, and others to create maps and reports of invasive plant distribution, to identify management opportunities in a county, Weed Management Area or region, and to maintain up-to-date species distribution data statewide.

Cal-IPC is working with regional partners to set landscape-level strategies, secure implementation funding, and build a coordinated approach statewide. Each region will have a Strategic Plan and Eradication Workplan, as well as identify priority species. See Appendix F for more information.

Fishing and Harvesting Aquatic Resources; Marine and Freshwater Aquaculture

Fishing activity in California has changed over time largely due to increased regulation (to conserve resources), and due to environmental, social and economic factors. In 2023, commercial fisherman landed more than 110 million pounds of seafood at California's coastal ports. Top fisheries included market squid, Dungeness crab, northern anchovy, Pacific sardine, sablefish, red sea urchin, and a variety of groundfish (rockfish, soles, and other bottom species; CDFW 2023c).

Fishing activity varies within and among California's coastal regions as a function of the distribution of species, ocean environment, management context, port infrastructure, and market demand. In 2023, approximately 1,413 commercial fishing vessels landed catch at California ports. San Diego, Ventura, and Los Angeles counties had the greatest number of vessels with landings at their ports (CDFW 2023b).

Direct collection of marine resources for food, fish bait, or decoration can deplete populations, reduce biodiversity, and alter habitat structure. Removal of species may also result in indirect effect on other populations by disrupting the ecological balance within the ecosystem.

Aquaculture is the process of raising and harvesting plants or animals in an aquatic environment. Marine aquaculture has a long history in California, beginning with oyster culture in the late 1800s. CDFW is the lead agency for leasing and permitting of marine aquaculture on state and private water bottoms in bays and estuaries and ensures that marine resources and essential habitat are protected. In California, marine aquaculture for commercial purposes includes kelp and other algae, oysters, abalone, clams, and mussels.

Military Activities

Military bases in California include Air Force Bases, Army Bases, Coast Guard Bases, Marine Corps Bases, and Navy Bases. Though military bases can sometimes provide safe havens for native species when they include large areas of land that is restricted to human access, military operations associated with these bases may also include ground and/or aerial warfare training and testing that can be detrimental to native species.

For example, the US Navy controls two of the Channel Islands off the southern coast of California. Areas of these islands became degraded through military presence and training activities, which have endangered many endemic island species. Another example is the Edwards Air Force Base (AFB), an approximately 306,700-acre facility bordered by Kern, Los Angeles, and San Bernardino counties that has been operational since 1948 and provides military aircraft testing and training. Activities include bombing ranges, low-altitude high-speed maneuvers, radar intercept areas, and weapons testing and training.

Catastrophic Geological Events

Volcanoes

More than 500 volcanic vents have been identified in California. At least 76 of these vents have erupted, some repeatedly, during the last 10,000 years (Miller 1989). Volcanoes can have devastating effects on habitats and ecosystems. Ecosystems may be destroyed by direct impact from pyroclastic flows or buried by hot rock debris and indirect impacts from melted snow or burnt vegetation.

Earthquakes and Tsunamis

Earthquakes primarily damage structures and potentially humans; these events can also result in environmental consequences. Species and ecosystems may be damaged by the shocks and shifts in land surfaces, as well as alterations in local hydrologic systems. Coastal ecosystems may be directly damaged by tsunamis or indirectly through changes in water chemistry or the introduction of invasive species.

Avalanches, Landslides, and Subsidence (Sinkholes)

Avalanches, landslides, and sinkholes have a variety of ecological effects, and many of these effects can be amplified by other factors. Generally, avalanches and landslides bring additional sediment into river systems, degrading water quality and silting reservoirs. Timber harvests and fires that remove vegetation increase the incidence of landslides and the probability of slope failure during the wet season. Landslides create bare ground that is subject to erosion and to invasion by non-native species. Sinkholes may directly impact species and ecosystems.

Other System Modifications

Pressures grouped under "Other System Modifications" include activities that have the potential to degrade ecological conditions of targets and have not yet been incorporated by the standardized list of pressures. For example, floating and submerged artificial structures along the shoreline (including pier pilings) are included in the "Other System Modifications" category. See Marine Province 5.7.7 for more information on marine and shoreline specific examples.

2.5.3 Vulnerability to Climate Change

Global climate change is a major challenge to the conservation of California's natural resources. To address this challenge, CDFW has been at the forefront of research, policy development, and implementing actions in statewide efforts to assess the potential effects of climate change, and to assess and minimize the vulnerability of California's wildlife and habitat to these effects.

This section describes the degree to which climate change is already affecting California at statewide level and summarizes projected climatic changes for the state. This section also describes climate change-related pressures on biodiversity, and efforts by CDFW and others to develop and implement conservation strategies to minimize negative impacts to fish, wildlife, and plants.

CDFW and partners are identifying the most important climate change stresses for which each conservation target is potentially sensitive. These climate factors are being integrated into the assessment and rating of human-induced pressures (described in the previous section) to each target. As additional information becomes available, the assessment of each priority conservation target will be dynamically updated, and strategies adapted as necessary.

Observed Climate Change in California

Climate change is already measurably impacting human and natural systems in California. Observed changes in climate are described in detail in the most recent California Climate Change Indicators report (OEHHA 2022) and are summarized below.

Temperature

Annual average air temperatures in California have increased by approximately 2.5 °F between 1895 and 2022 (OEHHA 2022). Warming accelerated starting in the 1980s, and average temperatures increased across most of the state by 1°F to 2°F over the past 30 years (1986–2016), relative to temperatures observed over the past century (1901–1960) (Bedsworth et al. 2018). Eight of the ten warmest years on record occurred between 2012 and 2022, with 2014 identified as the warmest (OEHHA 2022).

Statewide minimum temperatures have risen at a faster rate than maximum temperatures (2.9°F and 1.1°F per century, respectively), indicating that the increase in average temperature across California is largely driven by increasing nighttime temperatures. Warming has not occurred uniformly across the state, although all regions have experienced warming over the past century; the greatest increases have been observed in the Sonoran Desert and South Coast regions (OEHHA 2022). Warming temperatures in the state, combined with other stressors, have already contributed to small mammal and avian range shifts, vegetation shifts upslope, species abundance, and observed changes in the timing of species migration patterns (OEHHA 2022).

Precipitation, Drought, and Hydrologic Regimes

Annual precipitation amounts in California are highly variable, and do not display a significant trend. The high variability in year-to-year precipitation is itself related to climate change. Since the 2015 SWAP was released, California experienced continued drought through 2016 and again in 2020–2022. The period from 2000 to 2021 was the driest 22-year period in California history and is being referred to as the onset of an emerging "megadrought" era (Williams et al. 2022). These periods of drought contributed to the death of an estimated 170 million trees in forest lands between 2010 and 2021 (USFS 2021), caused sharp declines in southern California vegetation (Dong et al. 2019), and negatively impacted the viability of aquatic habitat (Deitch et al. 2018), impacting fish and wildlife throughout the state that depend on these habitats.

California's dry periods have been punctuated with several extremely wet years. The year 2017 was unusually wet, and nine consecutive atmospheric rivers drenched the state in winter 2022/23. The transition from drought to heavy precipitation in 2022/23 brought California's reservoirs back to historical averages, but also brought damaging flood events and debris flows (DeFlorio et al. 2024).

Warming temperatures have also led to a greater proportion of precipitation in the state falling as rain versus snow at higher elevations, reducing total snowpack and impacting California's hydrologic regimes. Declining snowpack reduced the fraction of spring snowmelt runoff into the Sacramento and San Joaquin rivers over the past century by eight percent (OEHHA 2022) and continues to have a significant effect on California's water supply throughout the year. Along with snowpack decline, glaciers are retreating in high elevation environments. Two glaciers in the Trinity Alps of the Klamath Mountains have decreased in size by 97% since 1880, with the most accelerated decline observed during the extended 2012 – 2016 drought (Garwood et al. 2020).

Warmer air temperatures and changing streamflow regimes have led to warmer water temperatures in inland lakes and streams, affecting aquatic habitat quality and quantity. In the Sierra Nevada, the annual average surface water temperature of Lake Tahoe has increased by 1.97°F since 1968, at a rate of 0.39°F per decade; as of 2022, the highest average surface temperatures were recorded in seven of the last 10 years (OEHHA 2022; U.C. Davis Tahoe Environmental Research Center 2022).

Wildfire Risk

Warming temperatures and persistent drought conditions have coincided with a large increase in the annual area burned by wildfire across the western U.S. (Dennison et al. 2014; Abatzoglou and Williams 2016; Holden et al. 2018). In California, ten of the 20 largest wildfires since 1950 burned in 2020 and 2021; 4.2 million acres burned in 2020 alone, more than double the area burned in any other year on record (OEHHA 2022). Fire activity in 2020 – 2021 alone resulted in over 500 vertebrate species experiencing fire within their ranges (Ayars et al. 2023).

Not only has the total area burned increased dramatically in recent decades, but in western U.S. forests, the area of high severity burns has also increased due to warmer and drier fire season conditions (Parks and Abatzoglou 2020). While moderate and low-intensity fires are vital for healthy ecosystems, frequent high severity fires can negatively impact habitat and in some cases lead to conversion to a different vegetation type. Fire severity has important implications for forest ecosystem functions, including soil stability, carbon storage, and ability to provide habitat for wildlife.

Recent studies have demonstrated that anthropogenic warming, more than natural variability in climate conditions, has contributed to these changes in fire weather and subsequent increase in area burned in the state, especially in California's forests (Zhuang et al. 2021; Turco et al. 2023).

Sea Level Rise

Sea level rise is occurring in California, consistent with global trends. Sea level rise is tracked using a series of tide gauges placed along the coastline by NOAA and others (NOAA 2021); these tide gauges have measured increases in mean sea-level along the majority of the coast at a rate of approximately 0.04 to 0.08 inches per year; exceptions exist due to local land uplift resulting from shifts in the Earth's tectonic plates, specifically along the northern California coast (OEHHA 2022). For example, since 1900 mean sea level has increased by about 8 inches at La Jolla and San Francisco tide gauges (southern and central California coast, respectively), while sea level has declined by about 3 inches in Crescent City (northern coast) due to regional uplift (OEHHA 2022).

Ocean Temperature and Chemistry

Ocean temperatures along the California coast are warming. Like sea-level rise, ocean temperature is tracked using a series of stations along the coastline. These stations have detected a trend of increasing near-shore sea-surface temperatures (SSTs), most substantially off Southern California, where temperatures have increased by 0.3°F per decade (OEHHA 2022). Like sea-level rise, the increase in SST varies interannually and by region.

From 2014 – 2016 California suffered a marine heatwave, which occurs when "the difference between the sea surface temperature (SST) and the long–term mean (1971–2000) is above the 90th percentile of all values for a given location on a given day of the year" (OEHHA 2022). This marine heatwave had devastating effects on marine species and commercial fisheries (Rogers-Bennett and Catton 2019; Free et al. 2023).

Ocean acidification also impacts the marine environment; increasing carbon dioxide concentrations in the air lead to increased carbon dioxide uptake by the ocean, which decreases the pH balance of ocean waters. Declines in the oxygen concentration of ocean waters off Southern California have also been observed since the mid-1990s (OEHHA 2022).

For more detail on documented changes in climate in California, including information on extreme heat, winter chill, and other important climate indicators, please reference the California Climate Change Indicators Report (OEHHA 2022).

Climate Change Projections for California

Climate models are used to generate projections of future climate over a given spatial scale and timeframe. Climate projections for California are regularly produced and updated based on observed climatic change and advances in climate science. The 5th National Climate Assessment was released in 2023 (National Climate Assessment 2023) and a 6th Assessment Report produced by the Intergovernmental Panel on Climate Change at the global scale was completed in 2023 (Lee et al. 2023). Both documents provide insight into observed climate impacts as well as updated information on future climate-related risks across sectors.

California produces the "California Climate Change Assessment", which is focused on downscaling projections and impact assessments for greater relevance to this region. The fourth assessment was completed in 2018, and a 5th assessment is underway, due to be completed in 2025.

This section provides a brief overview of projected climatic changes for California at the statewide scale. Statewide projections offer insight into the general expected climate trends, however climate change and associated impacts will not unfold uniformly across the landscape. Local topography, latitude, proximity to oceans, and other factors will ultimately affect the pace and magnitude of climatic change that occurs across the state. For more information on regional variability, see climate change information provided at the province level in Chapters 5.1–5.7.

Temperature

Statewide, annual average maximum temperature is expected to increase roughly 5.5°F by mid-century (a 30-year period from 2035–2064) and 9°F by end-of-century (2070–2099) under a high-end emissions scenario (Pierce et al. 2018). These projected increases reflect an average across multiple climate models that projected both more and less severe results. The historical reference period is 1961–1990. The same dataset reveals annual average minimum temperature is expected to increase by roughly 5.1°F by mid-century and 8.9°F by end-of-century. These increases reflect averages across the entire state of California, but as noted above, actual increases will vary in rate of change as well as magnitude locally and regionally. In general, increases could be slightly lower near the coasts, which are more ventilated by marine air than interior regions (Pierce et al. 2018).

Precipitation, Snowpack, and Hydrologic Regimes

Precipitation in California is more difficult to project, but a modest increase of 1.7 inches by mid-century and 3.8 inches by end-century is projected on average across multiple models (Pierce et al. 2018). However, precipitation in California is extremely variable year-to-year and wholesale increases in precipitation across the state are not projected to occur; rather, northern parts of the state are more likely to see a slight increase in precipitation and southernmost California is more likely to experience a decrease. Precipitation in the state varies seasonally as well; by the end of the century, spring and fall precipitation is projected to decrease by 20% whereas winter precipitation is expected to increase by the same amount (Pierce et al. 2018).

Projections of precipitation type are clearer than projections of precipitation amount. Warming temperatures will cause a greater amount of precipitation to fall as rain instead of snow, and that the snow that does fall will melt earlier in the season. As a result, mean snow-water equivalent (a common indicator for snowpack) is projected to decline to less than two-thirds of its historical average by 2050, and to less than half the historical median by 2100 (Bedsworth et al. 2018). Greatest snow loss will occur at mid elevations (from 1500 to 3300m) during fall and spring (Shulgina et al. 2023). Changing precipitation and snowpack regimes will have serious implications for California's water supply and management, for both humans and wildlife.

Wildfire Risk

Climate is also a primary determinant of fire patterns (Halsey 2005). Risk of large wildfires is projected to increase as a result of climate change influences, most substantially in the Sierra Nevada foothills, Trinity Alps, Great Basin, and Coast Range (CNRA 2014). Considering this, climate change adds a significant variable in understanding future fire regimes and identifying fire risk management measures that can maintain a mosaic of habitats (Grissino Mayer and Swetnam 2000).

As noted above, wildfire occurrence has already increased in California due to anthropogenic climate change, and this trend is projected to continue. The average area burned by wildfire could increase by 77% by the end of the century under a high-end emissions scenario, compared to a 1961–1990 baseline (Westerling 2018). Extreme wildfires, which are fires larger than 10,000 hectares (24,710 acres), would occur 50 percent more frequently under the same scenario. The wildfire season in California is long, starting as early as spring in Southern California, and extending through the summer and into fall throughout the state. Conditions leading to late-season wildfires (October and November) have become more common over the past several decades; the number of autumn days exhibiting weather conditions associated with extreme wildfire events (95th percentile) has more than doubled (Goss et al. 2020). These extreme fire weather conditions will be amplified with climate change in both northern and southern California by the end of this century, broadening the already long fire season. These projections do not examine changes in vegetation, land management, wildfire risk reduction activities (e.g. fuels management), and other factors that can substantially influence wildfire probability and severity.

Sea Level Rise and Coastal Flooding

Along the coast, mean sea level will continue to rise. California recently updated its sea level rise projections for the next century, resulting in five plausible scenarios that encompass a range of possible futures for the state. Looking across all five scenarios, mid-century projections (2050) range from 0.5 to 1.2 feet of sea-level rise, whereas 1 to 6.6 feet of sea-level rise is expected by 2100, compared to a 2000 baseline (CA OPC 2024). Rates of sea-level rise are unlikely to be constant over time and will vary by region. Localized uplift and subsidence play a large part in affecting the rate of sea level rise in an area and the associated level of impact on coastal ecosystems or infrastructure. Interannual variability in sea level rise is also expected, driven in part by the ocean-atmosphere interactions that influence California's weather, such as the Pacific Decadal Oscillation and the El Niño Southern Oscillation.

Sea level rise brings with it an increase in coastal flooding and erosion risks. The frequency of coastal flooding events could double with every 2 – 4 inches of sea level rise, leading to annual extreme flooding events by mid-century and even more frequently by 2100 (Vitousek et al. 2017; Taherkhani et al. 2020).

Ocean Temperature and Chemistry

Climate-induced ocean trends are difficult to project due to the complexity of ocean circulation patterns, biogeochemistry, and the large range of natural variability. Generally, models project rapid future changes in ocean temperature, pH, and dissolved oxygen for the California Current System (Sievanen et al. 2018). Sea surface temperatures are projected to increase roughly 0.5–1.5C by 2040, and 2–4C by 2100 (Alexander et al. 2018). Models also indicate rapid declines in California Current pH anomaly and in open ocean dissolved oxygen concentrations as a result of increased greenhouse gas concentrations in the atmosphere (Sievanen et al. 2018). Together, these changes will likely affect coastal upwelling, an important process for ecosystem productivity in the marine environment (Xiu et al. 2018).

Climate Change Stresses and Species and Habitat Vulnerability

The climatic changes described in the previous section will affect fish, wildlife, and plants in a myriad of ways. Changes in climate variables are interrelated, and often additive or amplify stresses that may already exist due to land use change, development, or other human-induced pressures. Summarized below are the main effects of a changing climate within the biodiversity and habitat sector (not an exhaustive list), which together significantly increase the risk of biodiversity loss and species extirpation or extinction. This section also includes a high-level summary of the natural communities in California that are expected to be most vulnerable to climatic change.

Species Movement and Changing Community Composition

- In response to changing food, water, and habitat availability, or even direct thermal stress, species may need to either shift within their existing ranges and/or shift their geographic range in response to climate change. These shifts may occur towards higher latitudes, higher elevations, cooler coastal environments, or local microclimatic refuges, depending upon interactions with precipitation, topography and soils, and species behavioral and life history characteristics.
- Species movement may be impeded by natural landscape features or human development, preventing access to food or suitable habitat and thereby increasing the risk of biodiversity loss. Migratory limitations may be greater in the aquatic environment; for example, vernal pool and freshwater lake species are likely to be more susceptible to extirpation, because of the disappearance of habitats or inability to move to new aquatic environments.
- Species migration/movement and invasions, along with changes in behavior of climate-sensitive species, will alter species interactions and community dynamics; these changes may have negative effects on critical ecosystem services.

Changing Habitat Availability and Access

- Large, intense wildfires increase the risk of vegetation and habitat loss and conversion.
- Accelerating sea level rise may result in the loss of substantial areas of important habitat for a variety of coastal species. For example, coastal marshes are often constrained by deep water on one side and development on the upland side. Sea level rise could convert some of this habitat to open water, causing intertidal, salt marsh habitat to disappear, because it cannot move upslope. Additionally, sea level rise will result in increased saltwater intrusion into freshwater resources near the coast, resulting in habitat loss for some freshwater species.
- Mid- to high-elevation snow-dominated habitats and the species that depend on them are at risk, as snowpack diminishes with warmer temperatures.
- Changing streamflow patterns and rising water temperatures affect the quality and quantity of available aquatic habitat in lakes and streams.

Physiological Stress

- Temperature-sensitive terrestrial plant and animal species will be exposed to thermal stress as a result of warmer temperatures and the amount of additional warming and associated thermal stress may exceed the tolerance of some terrestrial species, particularly endemic ones.
- Warming of lake and stream temperatures will adversely affect food supply and fitness of aquatic species.
- Drought and moisture availability and increases in temperature will likely have an indirect effect on moisture availability for plants, negatively impacting plant growth.

- Changing ocean conditions, such as changes in ocean chemistry (i.e., acidification), can directly impede the growth and development of certain species at various life stages and may have broader impacts on the marine food web. Ocean acidification leads to decreased shell growth in key species such as sea urchins, mussels, oysters, abalone, and crabs, thus making the animal more susceptible to predation, as well as decreased skeleton production of deep-sea corals and hydrocorals (Largier et al. 2010).

Changing Phenology

- Changes in the timing of seasonal life-cycle events (i.e. phenology) can lead to mismatches in the timing of migration, breeding, pollination, and food availability.
- Changes in precipitation patterns will alter the timing and volume of stream flow and severely affect fish and amphibian populations during their life cycle (e.g., spawning, migration). For example, low-flow conditions and higher stream flow temperatures are particularly threatening to cold-water fish. Flooding as a result of earlier or more rapid snowmelt could also lead to increases in soil erosion, sedimentation, and pollution affecting aquatic habitats.

Spread of Invasive Species, Pests, Pathogens, and Disease

- The problem of invasive species is likely to become more challenging in the future in both aquatic and terrestrial ecosystems, as climatic changes may favor the spread of these species. Invasive species are typically more competitive than native species, especially those in damaged/degraded environments.
- Future climate conditions may also favor the spread of or abundance of diseases, pathogens, or pests. For example, bark beetle populations have decimated tree species in California forests due to a newfound ability to survive milder minimum temperatures that occur with climate change

As noted above, most of these impacts have already been observed in California, and similar trends are expected to continue in the future; terrestrial, aquatic, and marine ecosystems across the state will all be impacted. The next section sheds light on what the general impacts and stresses described above will mean for natural communities, habitat types, or individual species in California.

Vulnerability

Vulnerability to climate change can be defined as the degree to which a system is exposed to, sensitive to, and able to adapt to, the effects of change. Vulnerability assessments are an important tool for determining the relative climate risk to different species and habitats, and to ultimately inform development of appropriate adaptation strategies and actions. The degree of vulnerability of California's wildlife to climate change will vary considerably depending on many factors, such as the intrinsic sensitivity of a given species and/or its habitat to climate exposure and related stresses, the adaptive capacity of species and habitat to these effects, and other existing environmental stresses unrelated to climate change.

At the state-wide level, vulnerability assessments of vegetation can provide a proxy for the vulnerability of the terrestrial species that rely on that vegetative habitat for survival. A 2016 assessment completed by UC Davis examined the climate vulnerability of California's terrestrial vegetation at the macrogroup level, consistent with the terrestrial conservation targets identified in SWAP 2015. This study found that 16 of 29 natural vegetation community types in California are highly or nearly highly vulnerable to end-of-century projections across four different climate futures (Thorne et al. 2016). Macrogroups with the highest level of vulnerability included freshwater marsh, salt marsh meadows, great basin dwarf sagebrush scrub, great basin upland scrub, subalpine aspen forests and pine woodlands, and alpine vegetation. Please see the respective reports for full detail on the factors both included in and excluded from these analyses.

Climate exposure is one component of overall climate vulnerability and provides insight into where the climate is expected to change most drastically compared to the climate that is historically experienced by a single vegetative community. The vast majority of highly vulnerable macrogroups are also expected to experience high climate exposure; in general, most of the Sierra Nevada, large parts of the interior deserts and steppe and portions of the north coast ranges are projected to have the most variable climate conditions (Thorne et al. 2016).

Along California's coast, habitats are exposed not only to changes in temperature and precipitation, but also sea level rise. Under an estimated five feet of sea level rise, which is projected to occur by the end of the century in several climate scenarios, 55% of current habitat by area is considered highly vulnerable, including 60% of California's iconic beaches, 58% of rocky intertidal habitat (most of which is in the North Coast and Central Coast ecoregions), 58% of marshes, and 55% of tidal flats (Heady et al. 2018). Critical habitat vulnerability will impact many marine mammals, seabirds, and shorebirds, as sea level rise will further stress populations of 39 rare, threatened, or endangered species that depend on these habitat types (Heady et al. 2018).

In addition to vegetation and habitat-based vulnerability, the 2015 SWAP outlined several reports examining species vulnerability for various taxa, including birds, freshwater fish, reptiles and amphibians, marine species, and rare plants Those reports have not been wholly updated since their original publication, but the results remain highly relevant as climate change is actualized across the globe. Since 2015, many other assessments have emerged that supplement and expand upon these studies. While not an exhaustive list, examples include additional studies on marine fisheries (Rogers-Bennett and Catton 2022; McClure et al. 2023), anadromous fish (Crozier et al. 2019; Vander Vorste et al. 2020; Wang et al. 2020; McClure et al. 2023), anadromous fish

(Crozier et al. 2019; Vander Vorste et al. 2020; Wang et al. 2020), large and small mammals (Stewart et al. 2016; Riddell et al. 2021; Denryter and Fischer 2022), and other invertebrates (Sánchez-Bayo and Wyckhuys 2019; Halsch et al. 2021; Müller et al. 2024), specifically bumblebees (Jackson et al. 2022).

Climate Adaptation Strategies

Addressing climate change through adaptation and mitigation action continues to be a high priority for California. Since the 2015 SWAP was released, several ongoing and new climate initiatives have been pursued, many that are wholly or partially designed to address the impacts of climate change to California's natural landscapes. This section highlights recent climate change initiatives in the state and prevailing adaptation strategies for biodiversity and habitat.

In 2020, Governor Newsom issued Executive Order N-82-20 which established a state goal to conserve 30% of California's lands and coastal waters by 2030, for the purpose of biodiversity conservation and building resilience to climate change. The Pathways to 30x30 document describes how this goal can be met, and is a driving force for accelerating actions to conserve natural lands in California. This historic commitment is aligned with national policy and is part of an international movement to conserve 30% of terrestrial and marine habitat globally.

Additionally, California has a multi-sector, statewide climate adaptation strategy to guide it's work in the adaptation space. The first California Adaptation Strategy was released in 2009 and is required by statute to be updated every three years. Under leadership from the California Natural Resources Agency, the last completed version of this document was released in 2018 (referred to as "Safeguarding California"), and the latest iteration was drafted in 2024 and is set for finalization in 2025. The strategy outlines high level priorities and goals related to reducing negative impacts of climate change to California's built and natural systems as well as human communities. It covers topics such as public health, transportation, energy use and production, water, biodiversity and habitat, and more, and includes goals that reflect the importance of science, education, outreach, collaboration, and on-the-ground action. The latest version identifies metrics for how to measure progress towards implementing the strategy by state agencies and partners for easier tracking and accountability. This document serves as seminal guidance for the state's adaptation efforts.

Below are a few foundational adaptation strategies for fish and wildlife that are reflected in the state's adaptation strategy and inherent in other planning efforts, including the SWAP 2025 update:

- Conserve critical habitat linkages and movement corridors for species, and enhance overall landscape connectivity

- Identify and protect areas of refugia or areas relatively buffered from the impacts of climate change
- Restore degraded habitat
- Reduce existing stressors to biodiversity, such as invasive species
- Conduct and support scientific endeavors to detect and monitor the impacts of climate change and inform management approaches and conservation goals
- Integrate nature-based climate solutions into relevant infrastructure and investments
- Support outreach and education related to communicating climate change impacts to biodiversity and the importance of meaningful climate action
- Collaborate across sectors, regions, and communities

California's climate adaptation strategies are consistent with the strategic framework provided in the "Climate Adaptation Strategy for America's Fish, Wildlife, and Plants" (National Fish, Wildlife, and Plants Climate Adaptation Network 2021), which was updated in 2024 by the National Fish, Wildlife, and Plant Climate Adaptation Network (final version expected to be released in 2025). This framework is a similar effort at the national level to identify overarching strategies and priorities for this sector. The tables shown in Appendix F identify how the SWAP conservation strategies outlined in Chapter 4 align with these state and federal strategies and thus achieve important climate adaptation co-benefits.

Below is a list of other important statewide climate change planning and policy efforts with relevance to biodiversity and the SWAP.

- Natural and Working Lands Climate Smart Strategy Released in 2022, this strategy identifies priorities for areas of near-term state focus to increase climate action on California's natural and working lands. Actions are focused on building resilience of these lands while increasing carbon sequestration and storage and supporting California's commitment to achieving carbon neutrality by 2045. This document acknowledges that natural and working lands, while at risk to the impacts of climate change, are also an important part of the climate solution.
- State of California Sea Level Rise Guidance: 2024 Science & Policy Update Produced by the California Ocean Protection Council and Ocean Science Trust, this document summarizes the best available science around sea level rise projections for the state and offers guidance on how to choose the most appropriate projections for use in various climate change planning applications. The goal of the document is to inform the state's efforts to build resilience for coastal communities and ecosystems in the context of rising seas and climate-driven flooding. The 2024 document is the latest iteration of this guidance; the previous version was completed in 2018.
- Protecting Californians from Extreme Heat: A State Action Plan to Build Community Resilience Climate change is projected to increase the frequency of extreme heat

days and events, posing threats to public health and safety, economic prosperity, and communities and natural systems. Released in 2022, this plan outlines a strategic and comprehensive set of state actions to address extreme heat and serves as an update to the "Preparing California for Extreme Heat Guidance and Recommendations" report released in 2013.

- Readying California Fisheries for Climate Change this document was developed to provide scientific guidance to CDFW regarding the potential impacts of climate change on California fisheries. The goal of the document was to inform the state's process to amend the Marine Life Management Act (MLMA) Master Plan. The report was generated by the Ocean Science Trust with support from the California Ocean Protection Council in 2017.
- California Salmon Strategy for a Hotter, Drier Future: Restoring Aquatic Ecosystems in the Age of Climate Change Produced in 2024, this document acknowledges the importance of salmon in California as a keystone species, and as a central feature to religions, creation stories, the health and subsistence of Indigenous Peoples, and a multi-million-dollar fishing industry. Its purpose is to outline actions state agencies are already taking to stabilize and recover salmon populations and additional or intensified actions needed in coming years to support a healthier, thriving salmon population in California, that will benefit many additional aquatic species in the state.
- California's Wildfire and Forest Resilience Action Plan Developed in 2022 by the Governor's Forest Management Task Force, this plan provides specific actions the state can take to accelerate efforts to restore the health and resilience of California forests, grasslands, and natural places while improving the fire safety of communities and sustaining the economic vitality of rural forested areas.

These initiatives together represent strong leadership within the state to prioritize climate action, and the robust partnerships and collaboration that are required to ultimately achieve shared goals. CDFW works alongside other agencies and organizations to develop and implement these plans, and to ensure that biodiversity conservation remains an integral part of a comprehensive, holistic approach to addressing climate change in the state.

3 CDFW Conservation Tools

California has historically been a leader in the conservation of natural resources, driven in part by a recognition of the importance of protecting the state's remarkable biodiversity. Environmental conservation in California has been developed and refined within federal and state legal frameworks (see Appendix I) and is implemented by numerous state agencies and programs, including CDFW (Chapter 7 and Appendix I). This chapter outlines select CDFW programs and planning tools that have been developed for conservation and are used to implement SWAP conservation strategies (Chapter 4). Over time, CDFW has developed a range of data tools, approaches to data management, conservation plans, advanced mitigation, and grants. CDFW's diversity of tools and programs provides flexibility to plan and respond to upcoming challenges in the conservation of California's diversity of species and habitats.

3.1 Conservation Data and Tools

Accessibility and management of scientific data is critical to meet the CDFW mission of managing California's diverse fish, wildlife, and plant resources, and their habitats. Biological data analysis is particularly important in efforts to restore species at risk, including Species of Greatest Conservation Need (SGCN).

CDFW houses the research and monitoring data collected by CDFW scientists in multiple databases, depending on wildlife or natural resource of interest. CDFW also develops and maintains planning tools that allow analysts to integrate CDFW and public data to assess trends for wildlife species and ecosystems. CDFW staff use these planning tools to synthesize data and disseminate findings to inform conservation decisions made by land managers and stakeholders statewide. Data planning tools also inform CDFW landscape planning work, including public regional conservation plans and land management plans for CDFW-owned properties.

This section describes the objectives of data collection, and the CDFW data and planning tools used for the conservation of species and habitats in California, including

SGCN. The conservation planning tools described below can be used to implement specific AFWA conservation strategy categories (Conservation Measures Partnership 2016), including data collection and analysis; partner engagement; and environmental review; law and policy; outreach and education; and training and technical assistance.

3.1.1 Resource Assessment

A prime objective of CDFW data collection is to assess the distribution and abundance of fish, wildlife, native plant species, and natural communities using data analysis and scientifically informed models. CDFW assesses resources using:

- Inventories: Snapshot-in-time or initial baseline set of observations or data collected for a monitoring effort on the distribution and abundance of species and habitats (represented by vegetation types)
- Monitoring species and habitats: Data collected over time that can be used to identify or assess the status of a conservation or management objective. This includes demographic trends in species (increasing, decreasing, or static) or trends in the amount of available habitat; This data is also important for understanding the movement and dispersal of species across the landscape, and for revealing the changing spatial configurations of habitats which are important considerations for conservation and management activities

In addition to efforts by CDFW, numerous state and federal natural resources agencies, private landowners and firms, California Native American tribes, and dozens of academic and research institutions are involved in monitoring wildlife and ecosystems in the state, and each entity usually conducts field research to support its specific management needs. In addition, consulting firms conduct wildlife and natural resource surveys to support CEQA documentation for projects. See more information on monitoring in Chapter 8. Additionally, CDFW's research authorizations (Scientific Collecting Permits and CESA 2081(a) MOUs) generate a large volume of scientific reports and species data.

3.1.2 Data Sets, Decision Support Tools, and Data Management

CDFW focuses considerable effort on managing, centralizing, safeguarding, and sharing scientific data that is generated and collected by CDFW staff, including:

- managing a submittal and cataloguing system that captures individual Data Management Plans (DMPs) for each individual scientific data project, as well as capturing the data developed for that project

- publishing of the DMP data out to the CNRA Open Data Platform for public access and use, where appropriate
- designing and sharing standardized formats and protocols
- developing programs to manage databases, maps, models, and tools
- making information accessible through dashboards, reporting, and data sharing
- conducting data mining and summary tasks for specific requests by land managers, wildlife managers and researchers, private landowners, and others involved in making conservation decisions

CDFW data systems continue to evolve and grow as the scientific data profile of CDFW continues to expand into greater amounts and types of data. The use of GIS and emerging technologies is closely linked with CDFW's scientific data development programs.

CDFW utilizes Unoccupied Aircraft Systems (UAS, or drones) for a range of critical data collection initiatives. These efforts support projects such as habitat restoration mapping and monitoring, management of native and invasive vegetation, stream restoration monitoring, vegetation disease mapping, radio-tagged wildlife tracking, and oil spill response management. A centralized UAS Program oversees pilot training and ensures the safe and legal operation of UAS throughout the state.

The data development programs described below fulfill these critical functions:

- Vegetation community mapping
- Imperiled species tracking and data compilation
- Species range mapping
- Developing predictive species distribution models
- Maintaining habitat suitability information
- Developing habitat connectivity and species movement models
- Identifying locations that facilitate or impede species movements
- Mapping multifaceted patterns of biodiversity richness across the landscape
- Aggregating existing incongruent data sources and decision-support systems

The following sections describe some of CDFW's data and mapping tools. CDFW uses and contributes data and expertise to many other internal and externally sourced mapping and data tools that may not be included in this section.

Areas of Conservation Emphasis

Areas of Conservation Emphasis (ACE) is a CDFW decision support tool that provides data and maps of biodiversity, connectivity, and significant habitats to help guide and inform conservation priorities in California (Hill et al. 2015). At its core, ACE is a statewide inventory, collating species occurrence data, species habitat models, vegetation maps, climate data, and other information to develop maps of biodiversity patterns on the landscape. The data used in ACE come from CDFW staff, academic researchers, consultants, land managers, and many other collaborators across the state, which when brought together, broadens our understanding of California's biodiversity.

The ACE project synthesizes these complex data to provide measures of biodiversity that are easy to understand and readily available to the public through an interactive webmap viewer. ACE relative richness metrics tell the story of how any area across the state supports more or fewer species than another area, and provides many different ways for the user to view this information, depending on the conservation goal. ACE provides:

- Counts of all plant and vertebrate species (Native Species Richness)
- Counts of special-status species (Rarity Richness)
- Relative importance for California endemics (Irreplaceability)
- Compiled locations of significant habitat types such as Monarch overwintering areas and wetlands
- Map layers concerning ecological stressors
- Protected status of lands
- Climate resilience information
- Connectivity models which can be viewed in conjunction with ACE biodiversity data

ACE biodiversity datasets are designed in a hierarchical framework where data is aggregated and then combined at several levels. This enables ACE users to utilize data-driven metrics at the highest levels for a rapid, broad-scale, statewide view, and to drill down for greater levels of data detail for use at regional or local levels. A number of ACE data layers are used to support several explorer and decision support tools as part of the CA Nature tool suite, developed by CDFW and partners to support Executive Order N-8220 which establishes the goal of conserving 30% of California lands and coastal waters by 2030 (Pathways to 30x30).

Biogeographic Information and Observation System

CDFW's Biogeographic Information and Observation System (BIOS) enables the management and visualization of biogeographic data collected by CDFW and partner organizations. Partner organizations that provide data layers to BIOS include the U.S. Geological Survey (USGS), U.S. Bureau of Land Management (BLM), USFWS, California Coastal Conservancy, California Geological Survey, U.S. Forest Service

(USFS), and many others. BIOS facilitates the sharing of data within the BIOS community through integrating GIS, relational database management, and ESRI's web technologies to create a statewide, integrated information management tool.

California Natural Diversity Database/RareFind

The California Natural Diversity Database (CNDDB) is a program that inventories the status and locations of imperiled plants and animals in California. As the state's Natural Heritage Program, CNDDB staff evaluate and apply conservation ranks, work with partners to maintain lists of special status species, and maintain a relational database and GIS of documented areas of known occurrence. CNDDB's goal is to provide the most current information available on the state's most imperiled elements of natural diversity and to provide tools to analyze these data. The CNDDB concentrates its work on species petitioned for state or federal listing, species under legal status review, state species of special concern, and areas with active NCCP/HCPs or other land use planning efforts or development pressure. CNDDB supports land use planning and conservation efforts for a variety of federal and state agencies, and local municipalities.

CNDDB data is accessed through the website query tool RareFind. Spatial querying and visualization can be performed in the BIOS web platform and querying in either application can be handed off from one to the other. Additionally, the CNDDB GIS is available for more robust analysis, overlay, and custom data mapping and visualization in standard desktop applications like ArcMap, ArcGIS Pro, or ArcGIS Online.

CNDDB managers have initiated efforts to improve system functionality that will modernize data processing mechanisms for staff within CNDDB and streamline data submission and access for external users. The project is expected to initiate in Spring 2025, including design and testing, with implementation lasting 2 to 3 years.

California Terrestrial Habitat Connectivity Map and Regional Connectivity Analyses

The Statewide Terrestrial Connectivity map, part of the CDFW ACE project, presents a high-level view of connectivity across the state using the ACE grid (2.5-mi^2 hexagons). Each hexagon contains attributes identified across multiple studies, including the presence of mapped corridors or linkages from statewide and regional studies (see the Terrestrial Connectivity dataset factsheet for full list); the presence of large, contiguous, natural areas (Spencer et al. 2010); the relative landscape intactness score (Degagne et al. 2016); the Nature Conservancy's Omniscape (Schloss et al. 2022), and ungulate migration corridors. Hexagons are then assigned to one of five ACE connectivity classes and accompanying ranks, indicating the relative importance of each area to prioritize for conservation along with management actions to maintain and enhance ecological connectivity. At the statewide scale, the Statewide Terrestrial Habitat Connectivity map is intended to support large-scale, ecosystem based conservation plans like the SWAP and the California Climate Adaptation Strategy, and to integrate with infrastructure plans such as California Transportation Plan 2040.

California Transportation Plan 2040

The California Transportation Plan (CTP) provides a long-range policy framework to meet our future mobility needs and reduce greenhouse gas emissions. The CTP defines goals, performance-based policies, and strategies to achieve our collective vision for California's future statewide, integrated, multimodal transportation system. The plan envisions a sustainable system that improves mobility and enhances our quality of life.

The CTP 2040 is scheduled for approval by the California State Transportation Agency in December 2015. The Public Draft CTP 2014 was prepared with extensive input and collaboration between Caltrans, its regional partners, and the public. The CTP 2040 references the California Essential Habitat Connectivity Project and Regional Advance Mitigation Planning as a statewide planning tools available to align transportation development with regional wildlife connectivity planning. The CTP 2040 identifies strategies and recommendations to preserve and enhance natural resources with the early integration of environmental considerations into system planning and project scoping (Caltrans 2016).

Following recommendations from the California Essential Habitat Connectivity Project (Spencer et al. 2010), CDFW and partners have been working to develop regional, fine-scale connectivity analyses to identify important core areas and linkages for focal species. As of 2024, these regional analyses have been completed for approximately 60% of the state, including regions such as the San Francisco Bay area, California desert, Central Valley, south coast, and northern Sierra Nevada foothills.

CDFW is currently working to fill remaining data gaps to achieve a wall-to-wall map of fine-scale, climate-informed, species-specific linkage studies across the state. These products are integrated into the Statewide Terrestrial Habitat Connectivity map as they become available and can be used to inform a wide array of planning efforts, such as Regional Conservation Investment Strategies (RCIS), NCCPs and habitat conservation plans (HCPs), transportation Blueprint Plans, city and county General Plans, and land acquisition, management or restoration plans by conservancies, land trusts, and other nongovernmental organizations. These finer scale analyses can be accessed via the Habitat Connectivity Viewer. Additional information related to regional and statewide habitat connectivity datasets can be found on the Conservation Analysis Unit's Terrestrial Habitat Connectivity page and in Appendix H Wildlife Connectivity. Private landowners may want to use this information to understand how they can be a part of a regional conservation goal or engage in the discussion.

California Wildlife Habitat Relationships

The California Wildlife Habitat Relationships System (CWHR) contains life histories, geographic ranges, habitat relationships, and management information for 712 species and additional subspecies of amphibians, reptiles, birds, and mammals that occur in the state. The CWHR system is composed of several components which include:

- A complete species list of California's terrestrial vertebrates
- Life history information and geographic range data by season for 712 regularly occurring species
- A standardized habitat classification scheme for California containing 59 habitats, structural stages for most habitats, and 124 special habitat elements
- Habitat suitability tables associating more than 500 wildlife species to these standard habitats and structural stages with modeled suitability scores for reproduction, cover, and feeding
- A potential habitat map for each of the more than 500 species, applying modeled habitat suitability scores to the best available vegetation maps within the species' range

An online web application providing access to the above information, as well as the ability to conduct complex species queries based on locations, legal status, or selected habitat types, or a comparison, two-condition query in which the user may define two habitat scenarios, often used to describe pre and post treatment scenarios (e.g. logging, brush clearing), for the system output a set of species and suitability scores for both scenarios.

Climate Change Data and Support Tools

CDFW collects weather data for climate-related analyses through the Sentinel Site Network. Data is housed on Dendra.Science, a climate data management platform developed by UC Berkeley. This data can be used to track climate change at CDFW properties hosting a weather station and to detect regional and statewide climate trends in the long-term. Climate data will be applied to wildlife and habitat impact analyses to inform the CDFW's climate adaptation planning efforts.

Climate change projection data for the state of California is readily available on Cal-Adapt, an online hub for exploring, visualizing, and downloading peer-reviewed climate data. This data is crucial to understanding how future climate change will impact CDFW functions and activities such as conservation planning exercises, restoration projects, species and land management. public land access, grants, infrastructure investments, and more. Data is generated every few years through the state's climate change assessments and subsequently updated on the Cal-Adapt platform to ensure access to the best available science.

Within CDFW, the ACE tool includes data on terrestrial resilience to climate change to identify areas that may serve as climate refugia in the future, based on an assessment of predicted resiliency of vegetative communities to changes in climate throughout the state. In addition, some of the regional linkage studies mentioned above include climate-informed linkages, which identify areas important to support species movement across the landscape in response to changing climate conditions. This can be used together with information on movement barriers to identify opportunities to support improved connectivity. Climate vulnerability analyses for different taxonomic groups are another important tool for informing climate adaptation action; see CDFW's climate vulnerability webpage for a list of recent studies conducted by CDFW and partners.

Many other tools have been developed by CDFW and others to support the translation of climate science into conservation applications. See CDFW's climate change website for additional information on climate change resources and decision-support tools, such as the CDFW Adaptation Checklist for Climate-Smart Projects (CDFW and EcoAdapt 2022) and the Resist-Accept-Direct Framework (Williams 2022).

Data Portal

The CDFW Data Portal provides a point of entry to select data sources that serve the needs of CDFW staff and programs. These data are made available for reporting, querying, and (in some cases) editing via a series of dynamic web applications. Users can also easily generate and print reports or query, browse, and download data that supports CDFW's conservation mission.

Tools for data access have been grouped into topics in the Data Portal that mirror CDFW programs and initiatives. The topics include:

- Species and vegetation
- Fisheries
- Habitat conservation
- Water policy
- Wildlife

Applications available through the Data Portal include Ecosystem Restoration Program Projects, Habitat Tracking and Reporting Reports, Coho Salmon Recovery Tasks, Angling Records, CDFW Special Hunts, Wildlife Incident Reporting, Environmental Document Review, and Lake and Streambed Alterations (Project Tracking).

California Fish Passage Assessment Database

The Passage Assessment Database (PAD) can be accessed through the CDFW Data Portal. PAD is an ongoing map-based inventory of known and potential barriers to anadromous fish in California. PAD compiles data from more than 100 agencies, organizations, and landowners throughout California, and allows past and future barrier assessments to be standardized and stored in one place and enables the analysis of cumulative effects of passage barriers in the context of overall watershed health. PAD is maintained by CalFish, a California Cooperative Anadromous Fish and Habitat Data Program, involving a number of agency and organization partners including CDFW.

RADMAP

The Range and Distribution Mapping and Analysis Project (RADMAP) identifies, develops, and maintains species habitat models and range maps for use in conservation decision making, with a focus on imperiled plants and animals. To accomplish this, species occurrence data from sources across the state are being collated into a common format, a library of environmental predictor variables is being developed, existing models are being compiled into one location, and new models are being developed, to ultimately produce a library of species habitat models for California. RADMAP is building on currently available information by developing or updating existing (CWHR) ranges for imperiled taxa as needed, developing species-habitat models using state-of-the-art statistical modeling methods, and facilitating expert review of these products. RADMAP has developed a Standards and Guidelines framework for creating or updating ranges and models to ensure consistency. These products are available for CDFW staff and partners to inform conservation planning and prioritization, and will be incorporated into ACE, habitat connectivity models, and other CDFW data products.

Vegetation Classification and Mapping Program

The Vegetation Classification and Mapping Program (VegCAMP) supports the Survey of California Vegetation (SCV) by facilitating comprehensive, standardized field assessment and analyses of fine-scale vegetation communities across the state to develop California's expression of the National Vegetation Classification System (USNVC). The standardized vegetation classification, housed in the Manual of California Vegetation online, is utilized to develop fine-scale vegetation mapping to support conservation and land management planning throughout the State.

The vegetation classification system consists of an eight-tier hierarchy with the finest resolution consisting of locally appropriate floristic associations at the bottom, and the globally applicable "Class" units at the top. Among the most useful units for general habitat evaluation are several of the mid-level classification units. SWAP 2025 uses the macrogroup level as the basic unit for regional habitat description. Macrogroup concepts are familiar to most wildlife biologists. Typical macrogroup concepts for California vegetation include Chaparral, Coastal Scrub, Mojave and Sonoran Desert Scrub, and California Foothill and Valley Forests and Woodlands. These vegetation types are defined by certain floristic and structural criteria that can be repeatedly and accurately inventoried and mapped, making them useful for developing correlations with wildlife habitats. Habitat correlations vary between species and may match one or more of these units at different levels of the vegetation hierarchy.

The vegetation macrogroups are broken down floristically and structurally into progressively more discrete hierarchical "groups," "alliances," or the finest level "associations" as needed depending upon the intended application. VegCAMP surveys, defines, and maps vegetation communities to these finest levels, when possible, in order to allow for scalable application of the data as well as to identify sensitive natural communities. See Appendix C Species of Greatest Conservation Need, Appendix D Conservation Targets: Terrestrial Vegetation Communities, and Appendix H CDFW Connectivity Program for additional information.

Applications of fine-scale vegetation mapping data include:

- Regional conservation planning
- Wildland fire and fuels modeling for improved preparedness
- Identifying individual plant and animal species distributions

- Predicting the spread of invasive species
- Early scoping for transportation projects to minimize impacts
- Prioritizing land acquisitions for parks and ecological reserves
- Identifying important wildlife corridors
- Setting a baseline for monitoring impacts of global climate change

CWHR – VegCAMP Relationship

SWAP 2025 uses 'macrogroups', a category in the CA Manual of Vegetation (MCV) (Sawyer et al. 2009) to select terrestrial targets for conservation actions. Macrogroups are a mid-level category in the hierarchical National Vegetation Classification System (NVC; Federal Geographic Data Committee 2007). In order to identify the suite of species likely present in a given macrogroup, CDFW uses a crosswalk between the NVC System and the CDFW California Wildlife Habitat Relationships (CWHR) model.

The CWHR model predicts potential habitat suitability (for reproduction, cover, and feeding) for vertebrate animal species in California. Predictions are based on the relationship between animal species and the 59 CWHR habitat types, which are defined by dominant tree and shrub species and vegetation structure classes (e.g., size and percent cover).

CDFW is able to crosswalk the CWHR using the quantitative data analyses that determines MCV classifications, including field collected vegetation data that includes plant species composition, percent cover, structure, and environmental variables (i.e. slope, aspect, hydrology, soils, etc.). The resulting vegetation community type definitions can be used to develop vegetation maps that include lower levels of the hierarchy (alliance and group), macrogroup level, a crosswalk to the CWHR habitat types, and measures of vegetation structure. These vegetation maps can be used to identify the suite of species likely present in a given area based on the CWHR wildlife habitat model.

3.2 Conservation, Management, and Recovery Plans

Local project-by-project approval of new development can lead to the slow dismantling and fragmentation of important wildlife habitats, migratory corridors, and ecosystems without measures to address cumulative effects of projects over time and across the region. A development decision may appear to have negligible consequences for wildlife populations, if it is converting a small percentage of the remaining habitat or wildland in the project area to something else. Over time, the conversion of even small pieces of habitat will add up. Without the benefit of a regional conservation analysis, a land use decision may develop a small patch of land that indefinitely blocks an important regional wildlife migratory corridor or degrades a key ecosystem component important to wildlife diversity in the broader region. Accordingly, in many circumstances, it is prudent to approach species and habitat conservation at a regional scale.

Large-Scale Regional Conservation Efforts

Conservation plans are addressing conservation of over 5.3 million acres in California. These include three different types of large-scale, regional conservation plans: joint HCP/NCCPs; HCPs that are not NCCPs; and other large-scale regional conservation efforts that to date are neither HCP nor NCCP. As of July 2024, 17 HCP/NCCPs were in process of implementation and six were in various stages of planning.

The conservation planning tools described below can be used to implement SWAP conservation strategy categories including environmental review, land acquisition, easement, and lease, management planning, and land use planning.

3.2.1 Natural Community Conservation Plans and Habitat Conservation Plans

California has implemented its own voluntary multispecies regional approach to wildlife habitat conservation. A Natural Community Conservation Plan (NCCP) is a comprehensive plan that provides for species conservation and management and, at the same time, guides development towards areas that are less critical for wildlife. Species whose conservation and management are provided by the plan are called "covered" species. The NCCP Act gives CDFW the authority to permit take and/or management of any covered species (whether it is listed as threatened or endangered under CESA, or as a fully protected). Similarly, a Habitat Conservation Plans (HCPs) is a federal level, long-term agreement between USFWS and an applicant (private landowner or non-federal land manager) under Section 10 of ESA that allows USFWS and/or the NMFS may issue permits to authorize the incidental take of species under the federal ESA.

Within California, joint NCCPs and HCPs are common. Because they cover species being listed under ESA and CESA, both USFWS and CDFW participate in the review and permitting process. Many of the large-scale, multispecies HCPs are habitat-based plans that allow development to occur in certain areas, while setting up a coordinated system of protected land reserves with a landscape-level conservation strategy.

3.2.2 Marine Protected Areas (MPAs)

Marine managed areas (MMAs) are discrete geographic marine or estuarine areas designed to protect or conserve marine life and habitat (PRC 36602). Marine Protected Areas (MPAs) are a subset of MMAs. Three types of MPAs are recognized in California: state marine reserves, state marine parks, and state marine conservation areas. State marine reserves prohibit all take of living marine resources, while state marine parks and state marine conservation areas allow a range of take depending on the specific area. As required by the MLPA, CDFW prepared a Draft Master Plan for Marine Protected Areas (CDFG 2008) which provides guidance on: context for implementing the MLPA goals and objectives; background information on California's marine resources and policies; description of the process for designing alternative MPA proposals; and overviews on the design, management, enforcement, monitoring, and funding of California's MPAs. Following implementation of the MPA Network in 2012, CDFW updated the 2008 Master Plan to establish a statewide foundation for MPA management moving forward to meet the goals of the MLPA, including a ten-year management review cycle (CDFW 2016, 2018). The first comprehensive review was completed in 2022 and includes 28 adaptive management recommendations (CDFW 2022).

California covers a total of approximately 5,285 square miles of coastal state waters (excluding state waters in San Francisco Bay which represent approximately 473 square miles). The statewide coastal network of marine managed areas (including 119 MPAs and five state marine recreational management areas) covers approximately 852 square miles of state waters or about 16 percent (CDFW 2022). To effectively manage the MPA network, the state was split into three distinct bioregions, described in Chapter 5.7.

3.2.3 Land Management Plans

CDFW Lands Program acquires and manages wildlife areas, ecological reserves, and other wildlands specifically for the benefit of wildlife and important habitats. In total CDFW manages 728 properties throughout the state, as of November 1, 2024. These lands represent or support a cross section of California's remarkable natural diversity of animals, plants, habitat types, and ecosystems. Some of the state's finest-quality wildlife habitats are represented in CDFW's holdings. CDFW lands contribute to meeting the state's 30x30 goals.

Land management is multi-faceted and evolving as the mandate in the Land Management Plans changes (see Section 3.2.4). Land management entails a broad suite of responsibilities, including managing wildlife and natural resources, maintaining infrastructure, providing site security, managing public health and safety on the lands, and managing and providing for recreation and other uses, when compatible. Section 7.3.3 details the concern about lack of resources for wildlife conservation, restoration, and enforcement on public lands.

CDFW Land Management Plans (LMPs) define the primary management purpose, outline management issues and opportunities, and present goals and strategies for CDFW properties. The LMP process brings together diverse perspectives from within CDFW as well as external voices including California Native American tribes, partners, other organizations, and the public. A thoughtful, well-developed LMP for CDFW property helps CDFW managers make the best use of resources and helps prioritize workload while maximizing ecological benefits and the use and enjoyment by the public.

3.2.4 Recovery Plans

In 2018, a new state law (SB 473) gave the CDFW the authority to develop non-regulatory recovery plans for species listed under the California Endangered Species Act (CESA). Completed recovery plans will provide practical frameworks for the recovery of CESA-listed plants and animals. Each plan will be based on the best scientific information available and will, at a minimum, include:

- site-specific management actions necessary for the recovery of the species
- objective, measurable criteria that, when achieved, would result in the potential delisting of the species
- estimates of the time required and the cost to carry out those measures and to achieve intermediate steps toward recovery

3.2.5 Species of Species Concern Lists

A Species of Special Concern (SSC) is a species, subspecies, or distinct population of an animal (fish, amphibian, reptile, bird or mammal) native to California that currently satisfies one or more of the following criteria:

- Is extirpated from the State or, in the case of birds, is extirpated in its primary season or breeding role
- Is listed as Federally-, but not State-, threatened or endangered; meets the State definition of threatened or endangered but has not formally been listed
- Is experiencing, or formerly experienced, serious (noncyclical) population declines or range retractions (not reversed) that, if continued or resumed, could qualify it for State threatened or endangered status

- Has naturally small populations exhibiting high susceptibility to risk from any factor(s), that if realized, could lead to declines that would qualify it for State threatened or endangered status
- CDFW developed and maintains a separate SSC list for fish and for all other species. Elements of these lists include:
- Overview, including a description of methods, results and discussion
- Recommendations and priorities for research, management and monitoring
- Species accounts for each SSC, including data on population size and trend, range size and trend, threats, ecological considerations, management recommendations, taxonomic remarks, and life history information relevant to status
- Range and/or distribution maps for each ranked SSC
- California Responsibility List indicating endemic or nearly endemic taxa, and which of those are SSCs
- Watch List, consisting of taxa that were previously SSCs but do not meet SSC criteria, and for which there is concern and a need for additional information to clarify status

These lists directly inform the SWAP SCGN list. See more information on SGCN list criteria in Chapter 2.

3.3 Advance Mitigation

Advanced mitigation for conservation applies strategies and actions that address environmental degradation, such as habitat loss, climate change, and species extinction, through proactive measures that go beyond traditional conservation efforts. It involves a combination of scientific, technological, and policy-based interventions designed to both prevent further environmental harm and actively restore or enhance ecosystems. CDFW manages numerous advance mitigation programs and tools to help meet its conservation goals.

CDFW's advance mitigation described below allow CDFW to implement specific AFWA conservation strategy categories (Conservation Measures Partnership 2016), including management planning, economic incentives.

3.3.1 Mitigation and Conservation Banking

A conservation or mitigation bank is permanently protected land that is conserved and managed for its natural resource values. In exchange for permanently protecting, managing, and monitoring the land, the bank sponsor may sell or transfer aquatic resources and/or species/habitat credits to permittees/project proponents that need to meet compensatory requirements for environmental impacts. Bank credits must be used in advance of project impacts when the compensation cannot be achieved at the project site or would not be as environmentally beneficial. CDFW actively supports banking to provide an incentive to protect and restore larger, more functional, and longer-lasting ecological systems. Conservation and mitigation banks provide the state with regulatory efficiencies, environmental benefits, and cost reductions.

Conservation Banking

A conservation bank generally protects important habitat including habitat for threatened, endangered, or other special status species that exists, has been, or will be created. Credits are established for the specific sensitive species and habitat. Agencies that typically participate in the regulation and approval of conservation banks are CDFW, the USFWS, and National Oceanic and Atmospheric Administration – National Marine Fisheries Service (NOAA-NMFS).

Mitigation Banking

A mitigation bank is created to compensate for activities authorized pursuant to Section 404 of the federal Clean Water Act (33 U.S.C. Sec. 1344 et seq.) and protects, restores, creates, or enhances wetland habitat. Additionally, mitigation banks may also include the conservation and protection of state and/or federally listed threatened or endangered species and/or habitat. Credits are established to compensate for unavoidable impacts to aquatic resources and/or special status species and/or habitat. Mitigation banks are approved by the U.S. Army Corps of Engineers and may also be approved by the U.S. Environmental Protection Agency, CDFW, USFWS, NOAA-NMFS, and the State Water Resources Control Board.

3.3.2 Regional Conservation Investment Strategies Program

The purpose of the Regional Conservation Investment Strategies Program (RCIS Program) is to promote the voluntary conservation of natural resources and to enhance resiliency to climate change and other threats. The Program is non-regulatory and promotes science-based conservation by providing mechanisms to guide investments in conservation, infrastructure, and compensatory mitigation for impacts to natural resources, including impacts to species, natural communities, ecological processes, and wildlife connectivity. The Program's three subprograms include: Regional Conservation Assessment (RCA), Regional Conservation Investment Strategy (RCIS), and Mitigation Credit Agreement (MCA).

Mitigation Credit Agreements

A Mitigation Credit Agreement (MCA) is a flexible, advance mitigation crediting mechanism that can only be developed within an approved Regional Conservation

Investment Strategy (RCIS) boundary. MCAs are defined in FGC section 1856 and are further described in Section 5 of the RCIS Program Guidelines. Any individual or entity may develop an MCA as an MCA Sponsor. To create mitigation credits, an MCA must implement one or more conservation or habitat enhancement actions described in the RCIS. The projected ecological improvements can create credits for a variety of targeted species, habitats, and/or other sensitive resources. The MCA Sponsor can use MCA credits to offset their own project impacts, or they can sell their excess credits to other entities that need mitigation. MCAs can generate credits that will mitigate for both permanent or temporary impacts and can be established on either private or public lands.

3.3.3 Wildlife Connectivity Advance Mitigation

Senate Bill 790 became effective on January 1, 2022, and is codified as FGC section 1955 et seq., titled "Wildlife Connectivity Actions." This statute enables CDFW to approve compensatory mitigation credits for wildlife connectivity actions, like overpasses and underpasses, through CDFW's Banking program or MCAs. The Wildlife Connectivity Advance Mitigation Guidelines provide supplemental requirements and instructions for the development, review, and approval of credits for wildlife connectivity actions. The credits created from a wildlife connectivity action can be used or transferred to mitigate the impacts of target species or target habitats. More information is available in Appendix H Wildlife Connectivity.

3.4 Grants

Grants play a crucial role in helping meet conservation goals by providing the necessary financial support (i.e., economic incentives) for a wide range of conservation projects and initiatives. These funds can be directed toward protecting biodiversity, restoring ecosystems, advancing research, and implementing sustainable practices. The State and Tribal Wildlife Grant Program is highlighted here, as it is directly tied to the implementation of state SWAPs. CDFW manages numerous other grant programs that can help CDFW implement SWAP (Appendix I).

3.4.1 State Wildlife Grant Program

The SWAPs prepared by each state are a groundbreaking effort that brings together the best science available, including TEK, to conserve priority fish and wildlife and their habitats through innovative public-private partnerships. The State Wildlife Grant (SWG) Program is a primary funding source available through the U.S. Fish and Wildlife Service (USFWS) for state fish and wildlife agencies and their conservation partners to restore and actively manage the nation's declining wildlife. With no dedicated funding stream, the SWG Program has been funded at relatively modest levels averaging just over $1 million in apportioned funding annually for each state and territory. Without the SWG Program, funding for state fish and wildlife diversity programs to prevent endangered species listings would be greatly curtailed or eliminated.

Nationwide, SWAPs have identified 12,000 species that are at risk of becoming endangered and have outlined a set of conservation actions to address key pressures, providing a voluntary and non-regulatory alternative to the federal listing process. The SWG Program has had strong bi-partisan backing and is supported by over 6,300 organizations and businesses that make up the Teaming with Wildlife Coalition. The coalition represents millions of bird watchers, hikers, hunters, anglers, and other nature enthusiasts and their businesses. The coalition was founded in the mid-1990s to specifically advocate for the creation of the SWG Program and remains strong and committed today to ensure this successful program continues. More information about the Tribal Wildlife Grants can be found in Chapter 7.3.4.

CDFW SWG Program is co-managed by Fisheries and Wildlife Branch staff. An estimated ~$3 million/year is allocated to California to implement its SWAP through the SWG Program. To implement SWAP's strategies, while maximizing available public funds, the CDFW awards grants to nonprofit organizations, local government agencies, colleges and universities, and state departments.

3.4.2 Section 6 Grants

CDFW also receives grant funds from the USFWS Cooperative Endangered Species Conservation Fund (authorized through Section 6 of the ESA) to support conservation actions designed to further the recovery of species listed as threatened or endangered under the federal ESA. CDFW staff, alone, or in collaboration with partner organizations, develop research and management projects to compete for this funding through the state's Endangered Species Conservation and Recovery Program. The primary objective of these grants is to support the development and implementation of state projects to conserve and recover federally threatened and endangered inland fish and wildlife species through:

- introduction of federally listed species into suitable habitats within their historic range
- enhancement or restoration of federally listed species habitat
- surveys and inventories of federally listed species and their habitats
- propagation of federally listed animals and plants
- research on federally listed species to inform management actions
- monitoring of federal candidate, at-risk and recently recovered species

- public education and outreach

Funding priority is given to projects that have a direct impact on the recovery of listed species, prevent extinction of a listed species or prevent the need to list a species through implementation of tasks identified in a final or draft recovery plan, recovery outline, or similar conservation or management strategy.

3.4.3 Benefits of Grants to SWAP Implementation

Grants help achieve CDFW conservation goals and implement SWAP conservation strategies. Grants can help fund almost all SWAP conservation strategies. Some SWAP strategy categories (Chapter 4) are highlighted below, including examples of benefits.

Data Collection and Analysis

- Data Collection: Grants help fund scientific research that collects critical data on biodiversity, ecosystems, and environmental changes. This information is essential for understanding threats and guiding conservation actions. Grants can assist in advancing or developing data collection, storage processing. and distribution tools.
- Monitoring Programs: Ongoing monitoring of species, habitats, and environmental conditions is necessary to assess the effectiveness of conservation efforts. Grants support long-term monitoring programs that track progress and adapt strategies as needed.

Land Acquisition, Easement, and Lease

- Land Acquisition: Grants can be used to purchase or protect land, ensuring that critical habitats are conserved and safeguarded from development or degradation.

Direct Management

- Restoration Projects: Financial support for ecosystem restoration projects, such as reforestation, wetland restoration, or coral reef rehabilitation, helps rebuild damaged ecosystems and improve biodiversity.

Outreach and Education

- Community Engagement: Many conservation goals require the active involvement of local communities, particularly in areas where people rely on natural resources for their livelihoods. Grants can fund community-based conservation initiatives, education programs, and capacity-building efforts such as an increased CDFW Interpretive Program.

- Public Awareness: Raising awareness about conservation issues and SWAP through media campaigns, public education programs, or workshops is crucial for garnering public support and driving behavioral change. Grants may fund these outreach activities.

Training and Technical Assistance

- Education and Skill Development: Grants can help fund training programs for local conservationists, indigenous groups, or organizations. This improves local capacity for managing natural resources, conducting research, and implementing conservation measures.
- Institutional Strengthening: Grants also help strengthen the capacity of environmental organizations, governments, and other stakeholders to effectively manage and enforce conservation policies.

Law and Policy

- Influencing Policy: Grants can fund lobbying and advocacy efforts aimed at influencing environmental policy and legislation. This includes efforts to improve environmental laws, create protected areas, or integrate conservation into national or local government planning.

4 Statewide Conservation Strategies

> "The nation behaves well if it treats the natural resources as assets which it must turn over to the next generation increased and not impaired in value."
>
> Theodore Roosevelt

This chapter presents the statewide goals for SWAP 2025 and describes the conservation strategies recommended to achieve those goals. The SWAP process aims to identify actions needed to conserve wildlife, specifically Species of Greatest Conservation Need (SGCN), and their habitats before species become listed or too rare to restore. CDFW and its partners have identified actions, herein called 'conservation strategies', for specific conservation targets; these strategies support SGCN within the arena of a conservation target and enhance the viability of the ecosystem.

CDFW identified conservation strategies using categories that align with the internationally recognized Open Standards for the Practice of Conservation (Conservation Measures Partnership 2016, 2020). The standardized use of conservation strategy categories facilitates communication among CDFW staff and with external conservation partners, whether federal, state, or local agencies; tribal governments; non-governmental organizations; or private landowners. In most cases, multiple conservation strategies are needed together to achieve the desired outcomes for ecosystems.

SWAP 2025 lists the conservation strategies in these locations:

- Chapter 5: Conservation strategies specific to conservation targets in provinces
- Chapter 6: Conservation strategies specific to conservation targets for anadromous fish

4.1 Statewide Goals

SWAP 2025 identifies three statewide goals for ecological outcomes of implementing SWAP 2025. The goals include fine scale measures of species distributions and ecosystem conditions that support larger scale goals of ecosystem function and process. The principal goals of SWAP 2025 work together to enhance California ecosystems, as described below.

Goal 1 – Abundance and Richness: Maintain and increase ecosystem and native species distributions in California while sustaining and enhancing species abundance and richness

- Goal 1.1 (Ecosystem Distribution): Maintain and increase ecosystem distributions
- Goal 1.2 (Native Species Range and Distribution): Maintain and increase native species ranges and distributions
- Goal 1.3 (Native Species Abundance, and Richness): Sustain and enhance native species abundance and diversity, including genetic diversity
- Goal 1.4 (Ecosystem Richness): Sustain and enhance ecosystem diversity

Goal 2 - Enhance Ecosystem Conditions: Maintain and improve ecological conditions vital for sustaining ecosystems in California

- Goal 2.1 (Connectivity): Maintain and improve connectivity vital for sustaining ecosystems (including those relevant to vegetation, wildlife corridors, greater intact habitat, genetic permeability, water flow, floodplains [longitudinal and lateral], and groundwater)
- Goal 2.2 (Community Structure and Composition): Maintain and improve community structure and composition vital for sustaining ecosystems (including age structure, structural heterogeneity, habitat richness, and native and key species population levels)
- Goal 2.3 (Water Quality, Quantity and Availability): Maintain and improve water quality (including temperature, chemistry, and pollutant/nutrient concentrations and dynamics) and water quantity and availability vital for sustaining ecosystems and their attributes (including ocean, lakes, rivers, streams, groundwater, and snowpack)
- Goal 2.4 (Soil and Sediment Quality): Maintain and improve soil and sediment quality vital for sustaining ecosystems (including soil moisture, chemistry, and pollutant/nutrient concentrations and dynamics)

Goal 3 - Enhance Ecosystem Functions and Processes: Maintain and improve ecosystem functions and processes vital for sustaining ecosystems in California

- Goal 3.1 (Successional Dynamics): Maintain or improve successional dynamics vital for sustaining ecosystems
- Goal 3.2 (Disturbance Regime): Maintain or improve disturbance regimes vital for sustaining ecosystems (including fire, flooding and grazing regimes)
- Goal 3.3 (Hydrological Regime): Maintain or improve hydrological regimes vital for sustaining ecosystems (including riverine, lacustrine, and estuarine hydrodynamics)

- Goal 3.4 (Sediment Deposition Regime): Maintain or improve sediment deposition regimes vital for sustaining ecosystems (including hydro-geomorphic processes, wind-driven processes, and soil stability)

4.2 Categories of Conservation Strategies

This chapter describes the categories of conservation strategies that CDFW used, based on the standardized guidance (Conservation Measures Partnership 2016). The SWAP program can use these categories to aggregate and analyze information across scales and to evaluate the desired outcomes and effectiveness measures across the state. Successful implementation of SWAP 2025 will depend on initiatives and work done by partners, alliances and networks of organizations. Conservation strategies were developed to be used widely by partners and are appropriate to apply to any habitats or SGCNs in California when relevant.

SWAP 2025 strategies help to implement national and state programs for climate adaptation and invasive species management. Appendix F identifies how SWAP 2025 conservation strategies align with the federal and state climate adaptation strategies described in Section 2.5.3, so important climate adaptation co-benefits are obtained while implementing SWAP 2025 strategies. Appendix E identifies the relationship between SWAP 2025 strategies and the National Invasive Management Plan (NISC 2008) and California's strategic framework for managing invasive species (ISCC 2011).

Categories of Conservation Strategies:

- Data Collection and Analysis
- Partner Engagement
- Management Planning
- Direct Management
- Economic Incentives
- Environmental Review
- Land Acquisition, Easement, and Lease
- Land Use Planning
- Law and Policy
- Outreach and Education
- Training and Technical Assistance

4.2.1 Data Collection and Analysis

Data collection and analysis is one of the most common conservation categories used by CDFW. Data collection and analysis of the biology, habitats, and pressures affecting Species of Greatest Conservation Need (SGCN) is needed to identify appropriate conservation strategies. Robust data, including data on performance and compliance measures, coupled with thorough analyses, allow resource managers to facilitate effective implementation of conservation strategies. This category includes data compilation, management, synthesis, analysis, and reporting of spatial and non-spatial data. It includes stand-alone research conducted to fill basic knowledge gaps. Conservation strategies in this category may include actions that:

- Collect baseline and long-term data for conservation targets and SGCN to understand their viability status and trends; this includes universally applicable information on multiple species throughout the state, such as vegetation and habitat inventory and mapping for terrestrial species, water quality and seasonality data for aquatic and amphibious species, and basic census techniques
- Conduct research to design more effective conservation strategies
- Collect data on climate change, climate impacts, and climate refugia
- Analyze impacts of a particular pressure on a conservation target and explain correlations of human and abiotic effects on species distribution and demographics
- Conduct comprehensive ecological assessments on individual species, guilds, and ecosystems
- Conduct groundwater and surface water assessments
- Include performance monitoring

Steps to achieve objectives of the Data Collection and Analysis category:

1. Identify information needs in coordination with state agencies and other partners
2. Collect data to answer relevant questions
3. Convey data to the correct people in an appropriate format
4. Use data to inform more effective conservation strategies (see outcomes for other strategies)
5. Apply strategies to reduce the negative impacts of pressures and stresses on the conservation target(s)
6. Achieve improved or maintained viability of conservation target(s)
7. Achieve improved or maintained viability of conservation target(s)

4.2.2 Partner Engagement

This conservation strategy category includes engaging with state and federal agencies with natural resource responsibilities, California Native American tribes, non-governmental organizations, private landowners, and other partners to achieve shared conservation goals and objectives. Partner engagement encompasses broad coordination and collaboration across jurisdictions, geographies, or areas of interest. CDFW's Partner Engagement category includes strategies that create positive work environments through developing and sustaining partnerships that lead to the development and implementation of more effective conservation strategies. CDFW recognizes the importance of Partner Engagement to successfully manage ecosystems and their associated SGCN. As a result, Partner Engagement is one of the most common categories of conservation strategies identified in SWAP 2025. Specific conservation strategies in this category may include:

- Establish partnerships with other agencies, California Native American tribes, organizations, and private landowners
- Maintain and enhance partnerships
- Engage in the decision-making process of partner entities
- Coordinate with California Native American tribes who may be collecting and analyzing data for conservation efforts and determine if there are opportunities to collaborate or share information
- Engage with California Native American tribes to determine if there are opportunities to fill knowledge gaps, identify impacts, and collaborate efforts

Steps to achieve objectives of the Partner Engagement category:

1. Identify the outcomes that require a strategic partnership
2. Identify natural resource managers, California Native American tribes and other stakeholders for partnering
3. Engage partners
4. Develop more effective conservation strategies with partners
5. Apply strategies to reduce the negative impacts of pressures and stresses on the conservation target(s)
6. Achieve improved or maintained viability of conservation target(s)

4.2.3 Management Planning

The category of Management Planning involves creating management plans for species, habitats, and natural processes. Well-designed management plans for conservation targets lead to more effective implementation of conservation strategies in other categories. Management Planning will typically undergo a tribal and public review process and will serve as the road map of conservation strategies and implementation for the agency adopting the plan. For example, in 2018 CDFW's Marine Region revised its "California Marine Life Management Act (MLMA) Master Plan," which guides the development of Fishery Management Plans pursuant to the

MLMA (CDFW 2018). CDFW has completed plans for the pink shrimp, market squid, nearshore, Pacific herring, spiny lobster, and white seabass fisheries. A new abalone fishery recovery plan is being developed and the market squid plan has undergone a significant review and will be revised in 2025. In addition, pursuant to the master plan, CDFW has developed "Enhanced Status Reports" for 39 species and species groups, that take the place of full fishery management plans. Specific conservation strategies in this category may include:

- Develop and implement Habitat Conservation Plans (HCPs); Natural Community Conservation Plans (NCCPs); Regional Conservation Investment Strategies (RCISs); and land, aquatic, or marine resource management plans that incorporate long term management and monitoring
- Develop recovery plans that contain actions that can be implemented to meet criteria for the recovery and delisting of listed species (FGC, § 2079.1)
- Update existing management plans for listed and game species
- Engage with California Native American tribes on the development and updating of management plans to incorporate tribal input, perspectives, Traditional Ecological Knowledge (TEK) and practices, and cultural significant and importance species
- Include best management practices (BMPs) to guide conservation strategies in management plans
- Develop basin management plans to provide guidance on a watershed basis
- Integrate resource management for multiple objectives, including developing wildlife-friendly fire management, outdoor recreation management, or watershed management
- Provide meaningful input and engage with local and state agency planning and decision-making processes

Steps to achieve objectives of the Management Planning category:

1. Identify the compelling need for a management plan
2. Involve key California Native American tribes, agencies and partners to support the development of the plan
3. Develop a complete management plan
4. Consider and evaluate alternative strategies in the planning process
5. Collaborate with key tribes, agencies and partners to implement the plan and its actions, and monitor the plan's effectiveness
6. Use the plans to implement more effective conservation strategies (see outcomes for other strategies)
7. Apply strategies to reduce the negative impact of pressures and stress on the conservation target(s)
8. Achieve improved or maintained viability of conservation target(s)

4.2.4 Direct Management

The conservation category of Direct Management involves the stewardship of habitats and natural processes to maintain, increase, and/or restore species populations and ecological functions and ecological conditions. Direct Management is one of the most common and fundamental conservation categories used by CDFW to manage ecosystems and associated SGCN. Partner Engagement strategies combined with Direct Management strategies allow efforts to occur on non-CDFW lands. Engagement with California Native American tribes and the incorporation of Traditional Ecological Knowledge (TEK) and practices provide additional strategies that support the stewardship or habitats and natural processes that have been implemented since time immemorial. Before implementing a Direct Management strategy, a management plan may be needed (see Management Planning category). Management Planning informs the Direct Management strategies that should occur. Specific conservation strategies in this category may include:

- Protect, restore, and enhance habitat for SGCN
- Protect and restore floodplain function
- Manage dams and other barriers and impediments to water flow or fish movement
- Manage water, including restoration of natural flows and flow patterns, promotion of water conservation, and development of alternative water sources
- Manage invasive species
- Promote hunting and fishing as a conservation tool
- Implement BMPs
- Promote the use and implementation of TEK and practices by California Native American tribes
- Promote responsible grazing as a conservation tool
- Implement controlled burns and other fuel-reduction treatments
- Translocate or reintroduce native species
- Maintain roads and manage off-highway vehicle use
- Develop protective buffers to sensitive ecosystems

Steps to achieve objectives of the Direct Management category:

1. Implement management actions
2. Reduce the negative impact of identified pressures
3. Reduce stresses to conservation target(s). If desired pressure and/or stress reduction does not occur then adjust management actions as appropriate, based on monitoring efforts
4. Achieve improved viability of conservation target(s)

4.2.5 Economic Incentives

The Economic Incentives category includes development and delivery of economic incentives to private landowners and other partners to implement responsible stewardship of landscapes, ecological processes and conditions, and specific species. It is expected that a project team would first clearly define appropriate incentives for sound stewardship that is designed to improve the status of conservation target(s). Incentives could come in many forms, such as compensation for stewardship costs or loss of income as a result of the stewardship; assistance with efficient compliance with regulatory requirements, which allows them to save money or time; added value from responsible stewardship (e.g., obtaining certifications, attracting hunters or eco-tourists); and technical assistance, which could also help them to apply for money or other incentives programs. The incentives should provide an impetus to start or continue effective management, but the long-term goal is for partners to recognize the benefit of continuing those practices for an extended duration and to work with managers to implement these practices. Specific conservation strategies in this category may include:

- Develop and provide economic incentives and assurances
- Seek and provide funding through grants, other agencies, and other opportunities as a source for economic incentives

Steps to achieve objectives of the Economic Incentive category:

1. Convey incentives to partners for responsible stewardship
2. Use the incentive to motivate partners to continue responsible stewardship
3. Apply responsible stewardship practices to reduce the negative impacts of pressures and stresses on conservation target(s)
4. Achieve improved viability of conservation target(s)

4.2.6 Environmental Review

The Environmental Review category is fundamentally intended to avoid, minimize, or mitigate/compensate for pressures that may adversely affect conservation targets. The Environmental Review category may be supported by strategies in the Laws and Policy category that trigger reviews. This can include review during the California Environmental Quality Act (CEQA) process and non-conservation-oriented policies, projects, and plans. Under CEQA, CDFW may provide comments to a lead agency for a project either as a “responsible agency,” when CDFW has approval authority over some aspect of a project, and/or as a “trustee agency” with the legal jurisdiction to protect plants, fish, and wildlife of the state. Where significant effects on wildlife are identified, CDFW makes recommendations to avoid, minimize, and/or mitigate those significant effects. Specific conservation strategies in this category may include:

When acting as lead agency, prepare environmental documents that fully meet the requirements and intent of CEQA, including ensuring that project impacts on conservation targets are mitigated to below a level of significance, as possible, as defined in CEQA, as feasible

When acting as a responsible agency, provide input during CEQA review to lead agencies to require that project impacts on conservation targets are mitigated to below a level of significance, to the extent feasible, in the area subject to CDFW approval authority: As a responsible agency, CDFW also acts as a trustee agency with the authority to provide input on project impacts outside of its approval authority, as described below:

When acting as a trustee agency, provide input during environmental review to lead agencies to promote mitigation of project impacts on conservation targets to below a level of significance, to the extent feasible, recognizing that CDFW has a trustee responsibility for fish and wildlife resources; Conduct review of resource management planning documents, such as Groundwater Sustainability Plans (GSPs), and provide input to the responsible local agencies and state regulatory authorities to ensure such planning documents fully consider the potential impacts to, and are adequately protective of, fish and wildlife.

Steps to achieve objectives of the Environmental Review category:

1. Ensure sufficient CDFW staff capacity exists to provide input
2. Gather sufficient information for use in providing input to lead agencies
3. Provide input during environmental review to lead agencies
4. Recommend actions to help achieve conservation needs during the CEQA public comment periods
5. Require the lead agency to incorporate CDFW recommendations as conditions of project approval, if serving as a responsible agency, or promote voluntary implementation of those recommendations, if serving as a trustee agency
6. Implement the CDFW-recommended strategies intended to benefit the conservation target(s)
7. Apply the strategies to reduce the negative impacts of pressures and stresses on conservation target(s)
8. Achieve improved viability of conservation target(s)

It's also important to recognize the role of AB52 during certain CEQA documents and the requirement for lead agencies to notify California Native American tribes prior to certain determinations regarding the potential impacts of cultural resources and Tribal Cultural Resources. Although, AB52 is specific to lead agencies, additional coordination may need to occur for CDFW to ensure proper tribal notification and consultation on potential impacts to cultural and/or tribal cultural resources. Under the direction of the CDFW Tribal Communication and Consultation Policy and its Office of

Tribal Affairs, efforts may need to take place to engage with California Native American tribes in addition to AB52.

4.2.7 Land or Water Acquisition, Easement, and Lease

Obtaining land or water rights through fee-title acquisition, conservation easement, lease, contract, or related means are included in the Land Acquisition, Easement, and Lease category. Partner Engagement strategies in conjunction with these strategies allow actions to take place on non-CDFW lands. The success of the conservation strategies in the Land and Water Acquisition, Easement, or Lease category depends on securing sufficient funds for the initial transaction and then purchasing, leasing, or obtaining a conservation easement for the prioritized lands and water. Steps include developing a management and monitoring plan and allocating funds for implementation. The responsible entity then needs to implement the management and monitoring work, which would ameliorate the negative impacts of pressures to the conservation target. If the land or water is leased, over time the responsible entity will need to renew the lease or convert it to a more permanent form of protection. If the land or water is placed under conservation easement, the easement conditions must be monitored to ensure compliance. Specific conservation strategies in this category may include:

- Protect land and/or water through acquisition fee-title ownership or preferably conservation easements
- Acquire or protect, through conservation easements, habitat areas important for the conservation target
- Acquire water rights to protect aquatic habitat including use of Water Code Section 1707
- Acquire lands or protect through conservation easements, and/or water to maintain wildlife corridors to connect parcels of protected (conserved lands and/or water)
- Create refuges/protected areas
- Create and expand existing CDFW Wildlife Areas and Ecological Reserves
- Authorize acquisition or protection through conservation easements of property and/or water rights
- Acquire or protect through the co-management and stewardship with California Native American tribes
- Support and collaborate for the return of Ancestral Lands back to California Native American tribes to further conservation and protection

Steps to achieve objectives of the Land Acquisition, Easement, and Lease category:

1. Obtain sufficient funds for the initial transaction
2. Identify priority lands or water with high conservation value

3. Purchase, lease, or secure a conservation easement to protect priority lands and water
4. Support California Native American tribes with Ancestral Land Return, where feasible
5. Develop management and monitoring plans
6. Allocate funding for management and monitoring on an annual basis
7. Implement appropriate management and monitoring, and adjust management actions to reduce the negative impacts of identified pressures and stresses, as needed, based on monitoring (see Direct Management category)
8. Collaborate and engage with California Native American tribes to assist in reducing the negative impacts and implement actions to assist in these efforts
9. Apply strategies to reduce the negative impacts of pressures and stresses on conservation target(s)
10. Maintain compliance of the easement or lease on the land or water being protected in perpetuity
11. Achieve improved viability of conservation target(s)

4.2.8 Land Use Planning

The Land Use Planning category includes leading or participating in planning activities for rural, urban, agricultural, or coastal lands where conservation targets are present. It involves understanding the decision-making process and identifying a mechanism to inform planning decisions. It may also involve using data collection and analysis to identify wildlife needs and habitat priorities within the involved government jurisdictions (see Data Collection and Analysis category). These results will encourage Land Use Planning actions that are consistent with conservation needs, assuming implementation also aligns with conservation. In these circumstances, expected negative impacts of pressures and/or stresses will be minimized to help improve the viability of the conservation target(s). Specific conservation strategies in this category may include:

- Provide input on local land use plans and participate in local decision-making processes that affect conservation targets
- Develop regional HCPs and NCCPs that integrate conservation planning with local land use planning
- Develop statewide strategies for siting major infrastructure projects, such as roads, water conveyance facilities, desalination plants, and renewable energy development
- Incorporate BMPs for land use development and public infrastructure that may affect conservation targets, such as roads, transmission lines, or railroads

Steps to achieve objectives of the Land Use Planning category:

1. Identify partners and mechanisms to effectively inform decisions
2. Provide guidance for land use and development decisions identified and articulated in the plan
3. Encourage the preparation of a land use plan that is consistent with the input being provided by CDFW
4. Implement the land use plan with conservation strategies consistent with CDFW input
5. Apply the strategies to reduce the negative impacts of pressures and stresses on conservation target(s)
6. Reduce stresses
7. Make adjustments based on monitoring
8. Achieve improved viability of conservation target(s)

4.2.9 Law and Policy

The Law and Policy conservation category includes strategies to develop, change, influence, and implement legislation, regulations, policy, and voluntary standards that improve the practice of conservation of target species and habitats. This category also includes law enforcement and permitting programs to ensure legislation, regulations, policies, and voluntary standards are effectively permitted and enforced. The Law and Policy category is applicable to all SWAP conservation targets statewide, but some specific conservation strategies are provided. Example of strategies include:

- Develop and support laws, policies, and regulations to protect natural resources
- Support effective law enforcement
- Develop BMPs for activities which could harm wildlife or degrade or eliminate habitats
- Participate in the legislative and regulatory decision-making process
- Increase permitting and enforcement capacity to support compliance with environmental laws and regulations

Steps to achieve objectives of the Law and Policy category, in addition to seeking substantial political and constituent support:

1. Receive input from appropriate agencies and/or partners regarding law or policy
2. Approve law or policy that is consistent with agency and/or partner input
3. Effectively permit and enforce laws or policies that are consistent with conservation objectives
4. Improve permitting and compliance with laws and policies that lead to strategies benefiting conservation targets

5. Apply strategies to reduce the negative impacts of pressures and stresses on conservation target(s)
6. Achieve improved viability of conservation target(s)

4.2.10 Outreach and Education

The Outreach and Education category involves the social sciences and actions to reach important conservation partners, communities, resource users, California Native American tribes, policy makers, other partners, and the public with information to improve awareness, gain knowledge, and change attitudes and behaviors regarding protection of natural resources. It includes both formal (e.g., classroom or workshop) and informal education efforts (e.g., one-on-one or small group engagement, and interpretive programs). Implementing education programs to engage the public in natural resource protection involves creating accessible and engaging initiatives that raise awareness about the importance of preserving ecosystems, wildlife, and natural habitats. These programs can include workshops, community outreach events, school-based curricula, and online resources that highlight the impact of human activity on the environment and offer practical solutions for conservation. By fostering a deeper understanding of sustainability and environmental stewardship, these initiatives encourage individuals and communities to adopt responsible behaviors, participate in conservation efforts, and advocate for policies that protect natural resources.

The strategies in the Outreach and Education category focus on providing information and materials to key resource users and stakeholders to inspire the adoption of behaviors that support SGCN and habitat conservation at the same time inspiring stewardship for Californias natural world.

Specific conservation strategies in this category may include:

- Developing and implementing education, interpretation, and/or outreach programs for such management areas as wildlife-friendly fire management, outdoor recreation management, recreational and commercial fisheries management, agricultural activities, water quality, and invasive species
- Utilizing CDFW public visitor centers and outdoor sites to engage diverse audiences
- Developing and delivering K-college education programs utilizing Next Generation Science Standards and incorporating CDFW messages, to include Classroom Aquatic and Fish in the City programs
- Developing and implementing teacher workshops to build confidence and competency to facilitate natural resource education in the classroom
- Engaging California Native American tribes in the development of educational and outreach programs and material to incorporate tribal perspectives, input, and discussion around TEK practices
- Engaging urban and suburban residents about stewardship of natural resources
- Developing partnerships for joint advocacy of conservation causes

The steps to achieve the desired outcomes of the Outreach and Education category:

1. Needs assessment and goal setting
2. Audience identification
3. Content development
4. Implementation and engagement
5. Monitoring and evaluation

Key Considerations:

- Cultural diversity
- Disadvantaged communities
- Accessibility
- Sustainability

4.2.11 Training and Technical Assistance

The Training and Technical Assistance category includes providing professional scientific training to managers, scientists, California Native American tribes, key partners, or others involved in resource conservation to facilitate improved or new management activities and techniques. It includes stand-alone training efforts, workshops, collaborative technical assistance, and technical information sharing. Prior to developing and conducting the training sessions, a need and goal for the training must be determined, and specific skills to be delivered and appropriate audiences identified. To strengthen these trainings, there may be an opportunity to include California Native American tribes and the incorporation of TEK and other practices. Once trainings are defined, the curricula can be selected from existing sources or newly developed, and suitable trainers identified. After a training takes place, trainees must demonstrate learning of the new skills and then ultimately apply these skills to development and implementation of more effective conservation strategies.

Technical assistance follows a similar pattern to training but focuses more on solving immediate problems and practical skills delivery "on the ground" rather than developing capacity. First, a need and goal for technical assistance must be defined and specific skills to be delivered and audiences to receive these must be identified. Once these are determined, the method and providers of the assistance must be identified. Engagement with California Native American tribes and discussions of TEK can be identified to further assist in these efforts. Trainees or recipients of the assistance must demonstrate learning of the new skills and then ultimately apply these skills to development and implementation of more effective conservation strategies. Specific conservation strategies in this category may include:

- Develop training materials and information
- Collaborate with California Native American tribes, when applicable on the coordination of TEK and other practices
- Conduct training and technical assistance
- Provide science-based application and tools that are useful for conservation activities

Steps to achieve objectives of the Training and Technical Assistance category:

1. Identify needed skills/technical assistance and targeted audiences
2. Engage and coordinate with California Native American tribes to determine where TEK and other practices can be incorporated
3. Develop the appropriate curriculum and identify trainers or technical assistance providers
4. Assemble sufficient participants being trained or assisted
5. Educate the participants about the needed skills
6. Empower sufficiently trained people to apply the learned skills
7. Apply the learned skills to reduce the negative impacts of pressures and stresses on conservation targets
8. Achieve improved viability of conservation targets

5 Province-Specific Conservation Strategies

SWAP 2025 uses three geographic scales to organize California's terrestrial, freshwater aquatic, and marine ecosystems: provincial scale, regional conservation units, and local communities/habitats (Chapter 1). Earlier chapters discuss conservation threats (Chapter 2), current conservation programs and tools (Chapter 3), and conservation strategies (Chapter 4) that are proposed to address conservation threats. Chapters 5.1–5.7 describe the distribution and abundance of wildlife within each of the seven California provinces.

The Seven Provinces of SWAP 2025:

- North Coast and Klamath
- Cascades and Modoc Plateau
- Central Valley and Sierra Nevada
- Bay Delta and Central Coast
- South Coast
- Deserts
- Marine

Freshwater aquatic Hydrologic Unit (HUCs) boundaries are shown in Figure 1.5-4. Strategies for these HUCs are described in Chapters 5.1–5.6 under the province that contains the largest extent of the HUC area.

In contrast to the provincial organizing framework, lifecycles of anadromous species typically span many provinces. Consequently, the SWAP 2025 conservation strategies for anadromous species were developed at a statewide scale or as defined by that species community. Chapter 6 covers the conservation strategies for anadromous fish. Additionally, offshore islands are separately described in Appendix G. These chapters and appendix describe conservation targets, and the conservation strategies aimed at decreasing pressures on those targets.

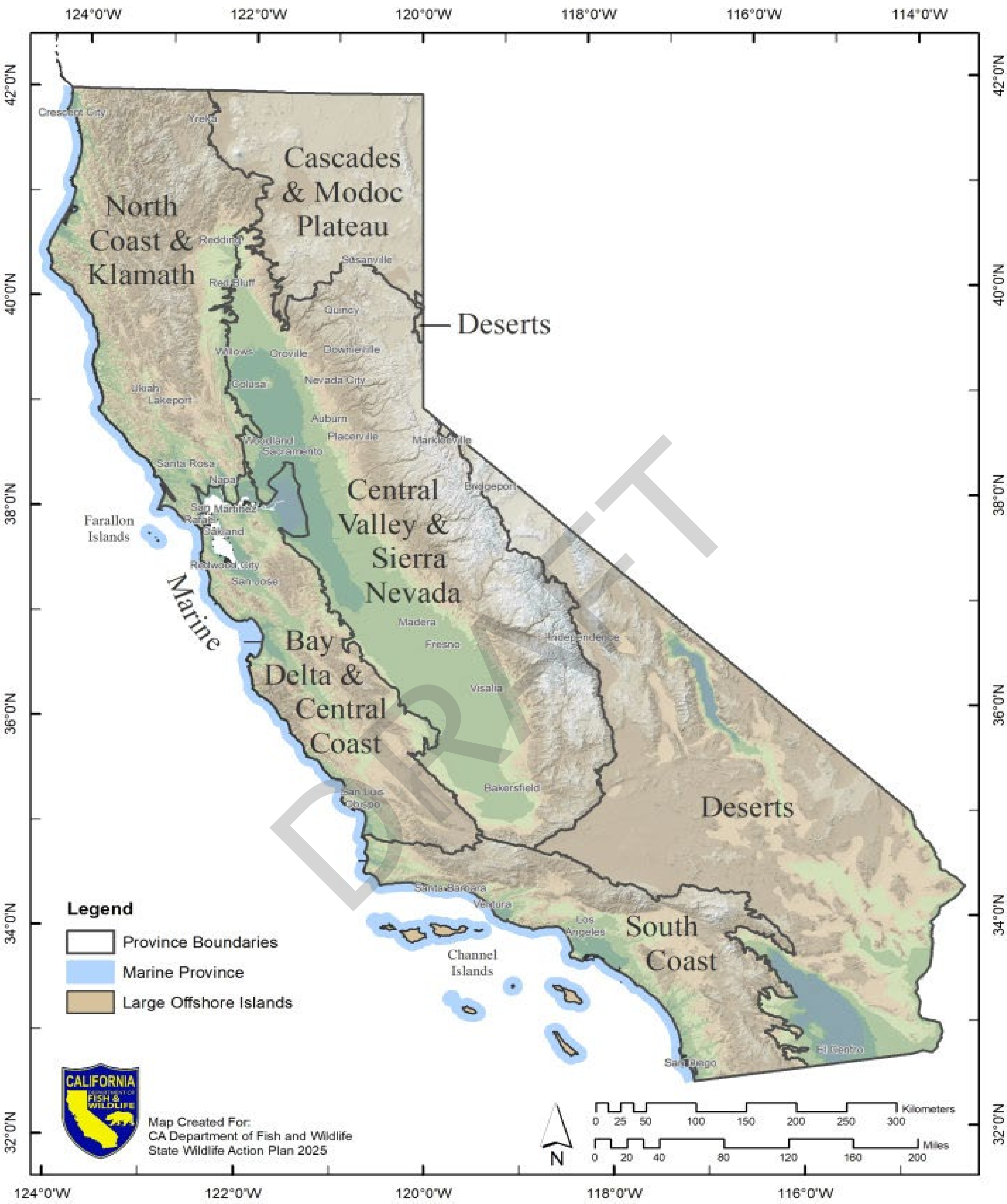
Table 5.0 Summary of Conservation Targets by Province (page 5-4) is a master table of conservation targets and conservation strategy categories for each of the provinces. Table 5.0 also contains key ecological attributes, and the California Wildlife Habitat Relationship (CWHR) classification related to each conservation target (macrogroups).

Each subchapter in Chapter 5 contains information on the province, conservation targets, and prioritized conservation strategies for select targets. In each subchapter the physical landscape, major natural features, and important terrestrial or aquatic resources are described along with the following provincial information:

- A map of landownership for the province
- A map of conservation units (i.e., ecoregions, hydrologic units, and marine bioregions) within each province
- A map of the plant communities (i.e., macrogroups) within each province
- A high-level description of the selected conservation targets (i.e., plant community, native aquatic species assemblage, or marine ecosystem) within each conservation unit
- A description of the most commonly identified pressures within each province
- A set of conservation strategies, including objectives for some targets

Appendix C lists the Species of Greatest Conservation Need (SGCN) and associated macrogroup, ecoregion, and province.

Appendix D provides a list of all the plant communities (i.e., macrogroups) within each province by ecoregion, including the provinces each macrogroup is targeted in. Additionally, it includes a crosswalk of macrogroups to California Wildlife Habitat Relationship (CWHR) classifications and macrogroup descriptions. See Chapter 1 to understand the geographical scales and target ranking approach used.



Data Source: Marine Protected Area Monitoring Action Plan. California Department of Fish and Wildlife and California Ocean Protection Council, California, USA. October 2018.

Figure 5.0-1 SWAP 2025 Provinces

Table 5.0 Summary of Conservation Targets by Province

Chapter	Province	Conservation Unit	Conservation Target	Strategy Categories	Pressures	Stresses / Marine Province - Effects of Pressures	Key Ecological Attributes (KEAs)	CWHR Classification
Appendix H	Statewide	Offshore Islands	Offshore Islands	• Data Collection and Analysis • Partner Engagement • Direct Management • Management Planning • Training and technical assistance • Outreach and education	• Climate change • Fire and fire suppression • Mining and quarrying • Invasive plants/animals • Roads and railroads	N/A	• Area and extent of community • Fire regime • Connectivity among communities and ecosystems • Community structure and composition • Key species population levels • Endemic diversity • Native versus non-native diversity • Soil and sediment deposition regimes	N/A
Chapter 5.1	North Coast and Klamath Province	Klamath Mountains Ecoregion	Alpine Vegetation	• Data Collection and Analysis • Direct Management • Economic Incentives • Management Planning • Outreach and Education • Partner Engagement • Training and Technical Assistance	• Climate change • Commercial and industrial areas • Invasive plants/animals • Livestock, farming, and ranching • Recreational activities	• Change in CO2 levels • Change in spring average temperature • Change in summer average temperature • Change in temperature extremes • Change in snow pack • Change in snow cover period • Change in soil temperature • Change in soil moisture • Change in spatial distribution of habitat types • Change in community structure or composition • Habitat fragmentation	• Area and extent of community • Connectivity among communities and ecosystems • Community structure and composition	• Alpine Dwarf-Shrub
Chapter 5.1	North Coast and Klamath Province	Northern California Interior Coast Ranges Ecoregion	California Foothill and Valley Forests and Woodlands	• Direct Management • Economic Incentives • Land Acquisition/Easement/ Lease • Outreach and Education • Partner Engagement	• Climate change • Fire and fire suppression • Invasive plants/animals • Livestock, farming, and ranching • Recreational activities	• Change in natural fire regime • Change in soil moisture • Change in community structure or composition • Change in biotic interactions (altered community dynamics) • Change in succession processes and ecosystem development	• Fire regime • Successional dynamics • Community structure and composition • Soil quality and sediment deposition regime	• Blue Oak Woodland • Blue-Oak-Foothill Pine • Closed-Cone Pine-Cypress • Coastal Oak Woodland • Juniper • Montane Hardwood • Valley Oak Woodland
Chapter 5.1	North Coast and Klamath Province	Northern California Coast Ecoregion	Coastal Dune and Bluff Scrub	• Data Collection and Analysis • Direct Management • Environmental Review • Land Acquisition/Easement/ Lease • Land Use Planning • Law and Policy • Management Planning • Partner Engagement	• Airborne pollutants • Climate change • Commercial and industrial areas • Fire and fire suppression • Housing and urban areas • Invasive plants/animals • Recreational activities • Roads and railroads	• Sea level rise • Change in sediment erosion-deposition regime • Change in natural fire regime • Change in nutrients • Change in sediment quality • Change in spatial distribution of habitat types • Change in community structure or composition • Change in succession processes and ecosystem development • Habitat fragmentation	• Area and extent of community • Fire regime • Connectivity among communities and ecosystems • Community structure and composition • Soil quality and sediment deposition regime	• Coastal Scrub
Chapter 5.1	North Coast and Klamath Province	Northern California Coast Ecoregion	Freshwater Marsh	• Economic Incentives • Land Acquisition/Easement/ Lease • Law and Policy • Management Planning • Outreach and Education	• Agricultural and forestry effluents • Annual and perennial non-timber crops • Climate change • Commercial and industrial areas • Dams and water management/use • Household sewage and urban wastewater • Housing and urban areas • Industrial and military effluents • Invasive plants/animals • Livestock, farming, and ranching • Mining and quarrying • Roads and railroads	• Sea level rise • Change in sediment erosion-deposition regime • Change in runoff and river flow • Change in water levels and hydroperiod • Change in flood occurrence, frequency, intensity, and area flooded (including hydroperiod) • Change in groundwater tables • Change in pollutants • Change in nutrients • Change in soil moisture • Change in spatial distribution of habitat types • Change in community structure and composition • Change in succession processes and ecosystem development • Habitat fragmentation	· Area and extent of community • Connectivity among communities and ecosystems • Successional dynamics • Community structure and composition • Surface water flow regime	• Fresh Emergent Wetland
Chapter 5.1	North Coast and Klamath Province	Klamath Mountains Ecoregion	Montane Upland Deciduous Scrub	• Direct Management • Environmental Review • Law and Policy • Outreach and Education • Partner Engagement	• Climate change • Fire and fire suppression • Housing and urban areas • Logging and wood harvesting	• Change in natural fire regime • Change in groundwater tables • Change in soil moisture • Change in spatial distribution of habitat types • Change in community structure or composition • Change in succession processes and ecosystem development • Habitat fragmentation	• Fire regime • Connectivity among communities and ecosystems • Successional dynamics • Community structure and composition • Hydrological regime	• Montane Chaparral

Chapter	Province	Conservation Unit	Conservation Target	Strategy Categories	Pressures	Stresses / Marine Province - Effects of Pressures	Key Ecological Attributes (KEAs)	CWHR Classification
Chapter 5.1	North Coast and Klamath Province	The Klamath-Northern California Coastal Hydrologic Unit (HUC 1801)	Native Aquatic Species Assemblages/Communities of Coastal Watersheds	• Direct Management • Economic Incentives • Land Acquisition/ Easement/ Lease • Law and Policy • Outreach and Education	• Agricultural and forestry effluents • Annual and perennial non-timber crops • Climate change • Dams and water management/use • Fire and fire suppression • Garbage and solid waste • Household sewage and urban waste water • Housing and urban areas • Industrial and military effluents • Introduced genetic material • Invasive plants/animals • Livestock, farming, and ranching • Logging and wood harvesting • Marine and freshwater aquaculture • Mining and quarrying • Parasites/pathogens/diseases • Renewable energy • Roads and railroads	• Changes in sediment erosion-deposition regime • Change in pollutants • Change in runoff and river flow • Change in water temperature • Change in water chemistry • Change in water levels and hydroperiod • Change in flood occurrence, frequency, intensity, and area flooded • Change in nutrients • Change in spatial distribution of habitat types • Change in community structure or composition • Change in succession processes and ecosystem development • Habitat fragmentation	• Area and extent of community • Community structure and composition • Soil quality and sediment deposition regime • Surface water flow regime • Water temperatures and chemistry • Pollutant concentrations and dynamics	N/A
Chapter 5.1	North Coast and Klamath Province	Northern California Coast Ecoregion	North Coastal and Montane Riparian Forest and Woodland	• Direct Management • Land Acquisition/Easement/ Lease • Law and Policy • Management Planning • Outreach and Education • Partner Engagement	• Agricultural and forestry effluents • Annual and perennial non-timber crops • Climate change • Dams and water management/use • Household sewage and urban waste water • Housing and urban areas • Invasive plants/animals • Livestock, farming, and ranching • Roads and railroads	• Sea level rise • Change in sediment erosion-deposition regime • Change in runoff and river flow • Change in water levels and hydroperiod • Change in water chemistry • Change in flood occurrence, frequency, intensity, and area flooded • Change in pollutants • Change in spatial distribution of habitat types • Change in community structure or composition • Change in succession processes and ecosystem development • Habitat fragmentation	• Area and extent of community • Connectivity among communities and ecosystems • Successional dynamics • Hydrological regime	• Montane Riparian
Chapter 5.1	North Coast and Klamath Province	Northern California Coast Ranges Ecoregion	North Coastal and Montane Riparian Forest and Woodland	• Direct Management • Land Acquisition/Easement/ Lease • Law and Policy • Management Planning • Outreach and Education • Partner Engagement	• Agricultural and forestry effluents • Annual and perennial non-timber crops • Climate change • Dams and water management/use • Household sewage and urban waste water • Housing and urban areas • Invasive plants/animals • Livestock, farming, and ranching • Roads and railroads	• Sea level rise • Change in sediment erosion-deposition regime • Change in runoff and river flow • Change in water levels and hydroperiod • Change in water chemistry • Change in flood occurrence, frequency, intensity, and area flooded • Change in pollutants • Change in pollutants • Change in spatial distribution of habitat types • Change in community structure or composition • Change in succession processes and ecosystem development • Habitat fragmentation	• Area and extent of community • Connectivity among communities and ecosystems • Successional dynamics • Hydrological regime	• Montane Riparian
Chapter 5.1	North Coast and Klamath Province	Northern California Coast Ecoregion	Pacific Northwest Conifer Forests	• Data Collection and Analysis • Direct Management • Management Planning • Outreach and Education • Partner Engagement • Training and Technical Assistance	• Agricultural and forestry effluents • Climate change • Fire and fire suppression • Introduced genetic material • Invasive plants/animals • Livestock, farming, and ranching • Logging and wood harvesting • Parasites/pathogens/diseases • Roads and railroads • Wood and pulp plantations	• Change in sediment erosion-deposition regime • Change in natural fire regime • Change in spatial distribution of habitat types • Change in community structure or composition • Change in succession processes and ecosystem development • Habitat fragmentation	• Area and extent of community • Successional dynamics • Community structure and composition • Hydrological regime • Soil quality and sediment deposition regime	• Redwood
Chapter 5.1	North Coast and Klamath Province	Northern California Coast Ranges Ecoregion	Pacific Northwest Subalpine Forest	• Data Collection and Analysis • Direct Management • Economic Incentives • Environmental Review • Land Use Planning • Management Planning • Partner Engagement • Training and Technical Assistance	• Climate change • Fire and fire suppression • Parasites/pathogens/diseases • Recreational activities	• Change in natural fire regime • Change in soil moisture • Change in spatial distribution of habitat types • Change in community structure or composition • Change in biotic interactions (altered community dynamics) • Change in succession processes and ecosystem development	• Area and extent of community • Fire regime • Successional dynamics • Community structure and composition	• Red Fir • Subalpine Conifer
Chapter 5.1	North Coast and Klamath Province	Klamath Mountains Ecoregion	Subalpine Aspen Forests and Pine Woodlands (Mature Conifer Forest)	• Data Collection and Analysis • Direct Management • Environmental Review • Law and Policy • Outreach and Education • Partner Engagement	• Climate change • Fire and fire suppression • Logging and wood harvesting • Parasites/pathogens/diseases	• Change in natural fire regime • Change in community structure or composition • Change in succession processes and ecosystem development • Habitat fragmentation	• Area and extent of community • Fire regime • Connectivity among communities and ecosystems • Successional dynamics • Community structure and composition • Soil quality and sediment deposition regime	• Aspen • Lodgepole Pine • Subalpine Conifer

Chapter	Province	Conservation Unit	Conservation Target	Strategy Categories	Pressures	Stresses / Marine Province - Effects of Pressures	Key Ecological Attributes (KEAs)	CWHR Classification
Chapter 5.1	North Coast and Klamath Province	Klamath Mountains Ecoregion	Wet Mountain Meadow Fen (Wet Meadow) Mountain Riparian Scrub and Wet Meadow Subalpine Aspen Forests and Pine Woodlands (Meadows) Western Upland Grasslands	• Data Collection and Analysis • Direct Management • Environmental Review • Law and Policy • Outreach and Education • Partner Engagement	• Climate change • Fire and fire suppression • Invasive plants/animals • Livestock, farming, and ranching • Logging and wood harvesting	• Change in natural fire regime • Change in water levels and hydroperiod • Change in groundwater tables • Change in spatial distribution of habitat types • Change in community structure or composition • Change in biotic interactions (altered community dynamics) • Change in succession processes and ecosystem development • Habitat fragmentation	• Area and extent of community • Fire regime • Successional dynamics • Community structure and composition • Hydrological regime	• Wet meadow • Annual Grassland • Perennial Grassland
Chapter 5.2	Cascades and Modoc Plateau Province	Southern Cascades Ecoregion	North Coastal Mixed Evergreen and Montane Forests	• Data Collection and Analysis • Land Acquisition/Easement/Lease • Law and Policy • Management Planning • Outreach and Education	• Climate change • Fire and fire suppression • Livestock, farming, and ranching • Logging and wood harvesting • Renewable energy • Roads and railroads • Utility and service lines	• Change in natural fire regime • Change in community structure or composition • Change in biotic interactions (altered community dynamics) • Change in succession processes and ecosystem development • Habitat fragmentation	• Fire regime • Successional dynamics • Community structure and composition • Hydrological regime	N/A
Chapter 5.2	Cascades and Modoc Plateau Province	Southern Cascades Ecoregion	Western Upland Grasslands	• Data Collection and Analysis • Direct Management • Economic Incentives • Land Acquisition/Easement/Lease • Land Use Planning • Law and Policy	• Annual and perennial non-timber crops • Climate change • Fire and fire suppression • Invasive plants/animals • Livestock, farming, and ranching • Logging and wood harvesting • Roads and railroads	• Change in natural fire regime • Change in soil moisture • Change in spatial distribution of habitat types • Change in community structure or composition • Change in succession processes and ecosystem development	• Area and extent of community • Fire regime • Successional dynamics • Community structure and composition	• Annual Grassland • Perennial Grassland
Chapter 5.2	Cascades and Modoc Plateau Province	Modoc Plateau Ecoregion	Big Sagebrush Scrub Great Basin Dwarf Sagebrush Scrub Great Basin Upland Scrub	• Data Collection and Analysis • Direct Management • Economic Incentives • Law and Policy • Management Planning • Outreach and Education • Partner Engagement	• Annual and perennial non-timber crops • Climate change • Dams and water management/use • Fire and fire suppression • Housing and urban areas • Invasive plants/animals (non-native species) • Invasive plants/animals (native species) • Livestock, farming, and ranching • Recreational activities • Renewable energy • Roads and railroads • Utility and service lines	• Change in natural fire regime • Change in spatial distribution of habitat types • Change in community structure or composition • Change in succession processes and ecosystem development • Habitat fragmentation	• Area and extent of community • Fire regime • Successional dynamics • Community structure and composition • Soil quality and sediment deposition regime	• Sagebrush • Low sage • Bitterbrush
Chapter 5.2	Cascades and Modoc Plateau Province	Northwestern Basin and Range Ecoregion	Great Basin Pinyon-Juniper Woodland	• Data Collection and Analysis • Partner Engagement • Direct Management	• Climate change • Fire and fire suppression • Invasive plants/animals • Roads and railroads • Other ecosystem modifications	• Change in natural fire regime • Change in spatial distribution of habitat types • Change in community structure or composition • Change in biotic interactions (altered community dynamics) • Change in succession processes and ecosystem development	• Fire regime • Successional dynamics • Structural diversity • Community structure and composition	• Juniper • Pinyon-Juniper
Chapter 5.2	Cascades and Modoc Plateau Province	North Lahontan Hydrologic Unit (HUC 1808)	Eagle Lake Native Fish Assemblage	• Data Collection and Analysis • Partner Engagement • Management Planning • Direct Management • Economic Incentives • Law and Policy • Outreach and Education	• Climate change • Dams and water management/use • Introduced genetic material • Invasive plants/animals • Livestock farming and ranching • Logging and wood harvesting • Roads and railroads	• Change in annual average temperatures • Change in annual average precipitation • Change in snow pack • Change in sediment erosion-deposition regime • Change in extreme events • Change in runoff and river flow • Change in water levels and hydroperiod • Change in water temperature • Change in water chemistry • Change in spatial distribution of habitat types • Change in community structure and composition • Change in biotic interactions • Habitat fragmentation	• Area and extent of community • Connectivity among communities and ecosystems • Community structure and composition • Hydrological regime • Soil quality and sediment deposition regime • Surface water flow regime • Water level fluctuations	N/A

Chapter	Province	Conservation Unit	Conservation Target	Strategy Categories	Pressures	Stresses / Marine Province - Effects of Pressures	Key Ecological Attributes (KEAs)	CWHR Classification
Chapter 5.2	Cascades and Modoc Plateau Province	Sacramento Hydrologic Unit (HUC 1802)	Goose Lake Native Fish Assemblage	• Data Collection and Analysis • Direct Management • Law and Policy • Outreach and Education	• Annual and perennial non-timber crops • Climate change • Dams and water management/use • Introduced genetic material • Invasive plants/animals • Livestock farming and ranching • Logging and wood harvesting • Roads and railroads	• Change in annual average temperatures • Change in average winter precipitation • Change in sediment erosion-deposition regime • Change in extreme events • Change in runoff and river flow • Change in water chemistry • Change in water levels and hydroperiod • Change in groundwater tables • Change in water temperature • Change in spatial distribution of habitat types • Change in community structure and composition • Change in biotic interactions (altered community dynamics) • Habitat fragmentation	• Area and extent of community • Connectivity among communities and ecosystems • Community structure and composition • Hydrological regime • Soil quality and sediment deposition regime • Surface water flow regime • Water temperatures and chemistry • Water level fluctuations • Nutrient concentration and dynamics	• Lacustrine • Riverine
Chapter 5.3	Bay Delta and Central Coast Province	Central California Coast Ranges Ecoregion	American Southwest Riparian Forest and Woodland	• Direct Management • Land Acquisition/Easement/ Lease • Outreach and Education	• Agricultural and forestry effluents • Annual and perennial non-timber crops • Climate change • Commercial and industrial areas • Dams and water management/use • Household sewage and urban waste water • Housing and urban areas • Invasive plants/animals • Livestock, farming, and ranching • Roads and railroads • Utility and service lines	• Sea level rise • Change in sediment erosion-deposition regime • Change in runoff and river flow • Change in flood occurrence, frequency, intensity, and area flooded (including hydroperiod) • Change in water levels and hydroperiod • Change in water temperature • Change in groundwater tables • Change in nutrients • Change in pollutants • Change in spatial distribution of habitat types • Change in community structure or composition • Change in biotic interactions (altered community dynamics) • Change in succession processes and ecosystem development • Habitat fragmentation	• Area and extent of community • Community structure and composition • Connectivity among communities and ecosystems • Water level fluctuations	• Valley Foothill Riparian
Chapter 5.3	Bay Delta and Central Coast Province	SF Bay Conservation Unit	American Southwest Riparian Forest and Woodland	• Direct Management • Land Acquisition/Easement/ Lease • Outreach and Education	• Agricultural and forestry effluents • Annual and perennial non-timber crops • Climate change • Commercial and industrial areas • Dams and water management/use • Household sewage and urban waste water • Housing and urban areas • Invasive plants/animals • Livestock, farming, and ranching • Roads and railroads • Utility and service lines	• Sea level rise • Change in sediment erosion-deposition regime • Change in runoff and river flow • Change in flood occurrence, frequency, intensity, and area flooded (including hydroperiod) • Change in water levels and hydroperiod • Change in water temperature • Change in groundwater tables • Change in nutrients • Change in pollutants • Change in spatial distribution of habitat types • Change in community structure or composition • Change in biotic interactions (altered community dynamics) • Change in succession processes and ecosystem development • Habitat fragmentation	• Area and extent of community • Community structure and composition • Connectivity among communities and ecosystems • Water level fluctuations	• Valley Foothill Riparian
Chapter 5.3	Bay Delta and Central Coast Province	Central California Coast Ecoregion	California Grassland, Vernal Pools, and Flowerfields	• Data Collection and Analysis • Direct Management • Land Acquisition/Easement/ Lease • Land Use Planning • Partner Engagement	• Annual and perennial non-timber crops • Climate change • Commercial and industrial areas • Fire and fire suppression • Housing and urban areas • Invasive plants/animals • Livestock, farming, and ranching • Renewable energy • Roads and railroads	• Change in natural fire regime • Change in runoff and river flow • Change in water levels and hydroperiod • Change in soil chemistry • Change in soil moisture • Change in sediment quality • Change in spatial distribution of habitat types • Change in community structure or composition position • Change in biotic interactions (altered community dynamics) • Habitat fragmentation	• Area and extent of community • Community structure and composition • Successional dynamics • Surface water flow regime	• Annual Grassland • Perennial Grassland
Chapter 5.3	Bay Delta and Central Coast Province	Central California Coast Ranges Ecoregion	California Grassland, Vernal Pools, and Flowerfields	• Data Collection and Analysis • Direct Management • Land Acquisition/Easement/ Lease • Land Use Planning • Partner Engagement	• Annual and perennial non-timber crops • Climate change • Commercial and industrial areas • Fire and fire suppression • Housing and urban areas • Invasive plants/animals • Livestock, farming, and ranching • Renewable energy • Roads and railroads	• Change in natural fire regime • Change in runoff and river flow • Change in water levels and hydroperiod • Change in soil chemistry • Change in soil moisture • Change in sediment quality • Change in spatial distribution of habitat types • Change in community structure or composition position • Change in biotic interactions (altered community dynamics) • Habitat fragmentation	• Area and extent of community • Community structure and composition • Successional dynamics • Surface water flow regime	• Annual Grassland • Perennial Grassland

Chapter	Province	Conservation Unit	Conservation Target	Strategy Categories	Pressures	Stresses / Marine Province - Effects of Pressures	Key Ecological Attributes (KEAs)	CWHR Classification
Chapter 5.3	Bay Delta and Central Coast Province	Central California Coast Ecoregion	Coastal Sage Scrub Northwest Coast Cliff and Outcrop Coastal Dune and Bluff Scrub North Coast Deciduous Scrub and Terrace Prairie	• Data Collection and Analysis • Direct Management • Environmental Review • Land Acquisition/Easement/ Lease • Land Use Planning • Law and Policy • Management Planning • Partner Engagement	• Airborne pollutants • Annual and perennial non-timber crops • Climate change • Commercial and industrial areas • Fire and fire suppression • Housing and urban areas • Invasive plants/animals • Livestock, farming, and ranching • Roads and railroads • Tourism and recreation areas	• Change in natural fire regime • Change in nutrients • Change in spatial distribution of habitat types • Change in community structure or composition • Habitat fragmentation	• Area and extent of community • Community structure and composition • Connectivity among communities and ecosystems • Fire regime • Soil quality and sediment deposition regime	• Coastal Scrub • Barren • Coastal Scrub
Chapter 5.3	Bay Delta and Central Coast Province	Central California Coastal HUC 1806	Coastal Lagoons	• Data Collection and Analysis • Direct Management • Land Acquisition/Easement/ Lease • Law and Policy • Training and Technical Assistance	• Agricultural and forestry effluents • Annual and perennial non-timber crops • Climate change • Commercial and industrial areas • Dams and water management/use • Garbage and solid waste • Housing sewage and urban waste water • Housing and urban areas • Livestock, farming, and ranching • Other ecosystem modifications • Recreational activities • Roads and railroads • Tourism and recreation areas • Wood and pulp plantations	• Sea level rise • Change in oceanic hydrodynamics • Change in sediment erosion-deposition regime • Change in runoff and river flow • Change in water chemistry • Change in groundwater tables • Change in spatial distribution of habitat types • Habitat fragmentation	• Area and extent of community • Community structure and composition • Connectivity among communities and ecosystems • Nutrient concentrations and dynamics • Surface water flow regime	• Estuarine
Chapter 5.3	Bay Delta and Central Coast Province	SF Bay Conservation Unit	Freshwater Marsh	• Economic Incentives • Land Acquisition/Easement/ Lease • Law and Policy • Management Planning • Outreach and Education	• Agricultural and forestry effluents • Annual and perennial non-timber crops • Climate change • Commercial and industrial areas • Dams and water management/use • Household sewage and urban waste water • Housing and urban areas • Industrial and military effluents • Invasive plants/animals • Livestock, farming, and ranching • Mining and quarrying • Roads and railroads	• Sea level rise • Change in sediment erosion-deposition regime • Change in runoff and river flow • Change in water levels and hydroperiod • Change in flood occurrence, frequency, intensity, and area flooded (including hydroperiod) • Change in groundwater tables • Change in pollutants • Change in nutrients • Change in soil moisture • Change in spatial distribution of habitat types • Change in community structure and composition • Change in succession processes and ecosystem development • Habitat fragmentation	• Area and extent of community • Community structure and composition • Connectivity among communities and ecosystems • Successional dynamics • Surface water flow regime	• Fresh Emergent Wetland
Chapter 5.3	Bay Delta and Central Coast Province	SF Bay Conservation Unit	Salt Marsh	• Data Collection and Analysis • Direct Management • Economic Incentives • Land Acquisition/Easement/ Lease • Law and Policy • Management Planning • Outreach and Education • Partner Engagement	• Agricultural and forestry effluents • Annual and perennial non-timber crops • Climate change • Commercial and industrial areas • Dams and water management/use • Household sewage and urban waste water • Housing and urban areas • Industrial and military effluents • Invasive plants/animals • Livestock, farming, and ranching • Mining and quarrying • Other ecosystem modifications • Recreational activities • Roads and railroads • Shipping lanes	• Sea level rise • Change in oceanic hydrodynamics • Change in sediment erosion-deposition regime • Change in runoff and river flow • Change in water levels and hydroperiod • Change in flood occurrence, frequency, intensity, and area flooded (including hydroperiod) • Change in pollutants • Change in nutrients • Change in sediment quality • Change in spatial distribution of habitat types • Change in community structure and composition • Change in succession processes and ecosystem development • Habitat fragmentation	• Area and extent of community • Community structure and composition • Pollutant concentrations and dynamics • Soil quality and sediment deposition regime • Successional dynamics • Water level fluctuations	• Saline Emergent Wetland • Tidal Freshwater Wetland (in the Delta)
Chapter 5.3	Bay Delta and Central Coast Province	Central California Coast Ecoregion	California Foothill and Valley Forests and Woodlands	• Partner Engagement • Data Collection and Analysis • Direct Management • Economic Incentives • Land Acquisition/Easement/Lease • Land Use Planning • Management Planning • Outreach and Education	• Annual and perennial non-timber crops • Commercial and industrial areas • Housing and urban areas • Invasive plants/animals • Livestock, farming, and ranching • Fire and fire suppression • Roads and railroads	• Change in natural fire regime • Change in soil chemistry • Change in soil moisture • Change in sediment quality • Change in spatial distribution of habitat types • Change in community structure or composition position • Change in biotic interactions (altered community dynamics) • Habitat fragmentation	In progress	• Blue Oak Woodland • Blue-Oak-Foothill Pine • Closed-Cone Pine-Cypress • Coastal Oak Woodland • Juniper • Montane Hardwood • Valley Oak Woodland

Chapter	Province	Conservation Unit	Conservation Target	Strategy Categories	Pressures	Stresses / Marine Province - Effects of Pressures	Key Ecological Attributes (KEAs)	CWHR Classification
Chapter 5.3	Bay Delta and Central Coast Province	Central California Coast Ranges Ecoregion	California Foothill and Valley Forests and Woodlands	• Partner Engagement • Data Collection and Analysis • Direct Management • Economic Incentives • Land Acquisition/Easement/Lease • Land Use Planning • Management Planning • Outreach and Education	• Annual and perennial non-timber crops • Commercial and industrial areas • Housing and urban areas • Invasive plants/animals • Livestock, farming, and ranching • Fire and fire suppression • Roads and railroads	• Change in natural fire regime • Change in soil chemistry • Change in soil moisture • Change in sediment quality • Change in spatial distribution of habitat types • Change in community structure or composition position • Change in biotic interactions (altered community dynamics) • Habitat fragmentation	In progress	• Blue Oak Woodland • Blue-Oak-Foothill Pine • Closed-Cone Pine-Cypress • Coastal Oak Woodland • Juniper • Montane Hardwood • Valley Oak Woodland
Chapter 5.3	Bay Delta and Central Coast Province	Central California Coast Ecoregion	Chaparral	• Data Collection and Analysis • Direct Management • Land Acquisition/Easement/Lease • Land Use Planning • Management Planning • Outreach and Education • Partner Engagement	• Annual and perennial non-timber crops • Commercial and industrial areas • Housing and urban areas • Invasive plants/animals • Livestock, farming, and ranching • Fire and fire suppression • Roads and railroads	• Change in natural fire regime • Change in soil chemistry • Change in soil moisture • Change in sediment quality • Change in spatial distribution of habitat types • Change in community structure or composition position • Change in biotic interactions (altered community dynamics) • Habitat fragmentation	In progress	• Montane Chaparral • Mixed Chaparral • Chamise-Redshank Chaparral
Chapter 5.3	Bay Delta and Central Coast Province	Central California Coast Ranges Ecoregion	Chaparral	• Data Collection and Analysis • Direct Management • Land Acquisition/Easement/Lease • Land Use Planning • Management Planning • Outreach and Education • Partner Engagement	• Annual and perennial non-timber crops • Commercial and industrial areas • Housing and urban areas • Invasive plants/animals • Livestock, farming, and ranching • Fire and fire suppression • Roads and railroads	• Change in natural fire regime • Change in soil chemistry • Change in soil moisture • Change in sediment quality • Change in spatial distribution of habitat types • Change in community structure or composition position • Change in biotic interactions (altered community dynamics) • Habitat fragmentation	In progress	• Montane Chaparral • Mixed Chaparral • Chamise-Redshank Chaparral
Chapter 5.3	Bay Delta and Central Coast Province	Central California Coast Ecoregion	North Coast Deciduous Scrub and Terrace Prairie	• Data Collection and Analysis • Partner Engagement • Management Planning • Direct Management • Environmental Review • Land Acquisition/Easement/Lease • Land Use Planning • Law and Policy	• Airborne pollutants • Annual and perennial non-timber crops • Climate change • Commercial and industrial areas • Fire and fire suppression • Housing and urban areas • Invasive plants/animals • Livestock, farming, and ranching • Roads and railroads • Tourism and recreation areas	• Change in natural fire regime • Change in nutrients • Change in spatial distribution of habitat types • Change in community structure or composition • Habitat fragmentation	• Area and extent of community • Community structure and composition • Connectivity among communities and ecosystems • Fire regime • Soil quality and sediment deposition regime	• Perennial Grassland • Coastal Scrub
Chapter 5.4	Central Valley and Sierra Nevada Province	Great Valley Ecoregion	California Grassland, Vernal Pools, and Flowerfields	• Data Collection and Analysis • Direct Management • Land Acquisition/Easement/ Lease • Land Use Planning • Partner Engagement	• Annual and perennial non-timber crops • Climate change • Annual and perennial non-timber crops • Commercial and industrial areas • Fire and fire suppression • Housing and urban areas • Invasive plants/animals • Livestock, farming, and ranching • Renewable energy • Roads and railroads • Recreational activities • Utility and service lines	• Change in natural fire regime • Change in runoff and river flow • Change in water levels and hydroperiod • Change in soil chemistry • Change in soil moisture • Change in sediment quality • Change in spatial distribution of habitat types • Change in community structure or composition position • Change in biotic interactions (altered community dynamics) • Habitat fragmentation	• Area and extent of community • Community structure and composition • Successional dynamics • Surface water flow regime	• Annual Grassland • Perennial Grassland
Chapter 5.4	Central Valley and Sierra Nevada Province	Great Valley Ecoregion	American Southwest Riparian Forest and Woodland	• Data Collection and Analysis • Direct Management • Land Acquisition/Easement/ Lease • Law and Policy • Management Planning • Outreach and Education • Partner Engagement	• Agricultural and forestry effluents • Annual and perennial non-timber crops • Climate change • Commercial and industrial areas • Dams and water management/use • Household sewage and urban wastewater • Housing and urban areas • Invasive plants/animals • Livestock, farming, and ranching • Logging and wood harvesting • Parasites, pathogens, and disease • Roads and railroads • Utility and service lines	• Change in sediment erosion-deposition regime • Change in runoff and river flow • Change in flood occurrence, frequency, intensity, and area flooded (including hydroperiod) • Change in water levels and hydroperiod • Change in water temperature • Change in groundwater tables • Change in nutrients • Change in pollutants • Change in spatial distribution of habitat types • Change in community structure or composition • Change in biotic interactions (altered community dynamics) • Change in succession processes and ecosystem development • Habitat fragmentation	• Area and extent of community • Connectivity among communities and ecosystems • Hydrological regime • Soil quality and sediment deposition regime • Successional dynamics • Surface water flow regime	• Desert Riparian

Chapter	Province	Conservation Unit	Conservation Target	Strategy Categories	Pressures	Stresses / Marine Province - Effects of Pressures	Key Ecological Attributes (KEAs)	CWHR Classification
Chapter 5.4	Central Valley and Sierra Nevada Province	Great Valley Ecoregion	Freshwater Marsh	• Economic Incentives • Land Acquisition/Easement/ Lease • Law and Policy • Management Planning • Outreach and Education	• Agricultural and forestry effluents • Annual and perennial non-timber crops • Climate change • Commercial and industrial areas • Dams and water management/use • Household sewage and urban wastewater • Housing and urban areas • Invasive plants/animals • Livestock, farming, and ranching • Mining and quarrying • Roads and railroads	• Change in sediment erosion-deposition regime • Change in runoff and river flow • Change in water levels and hydroperiod • Change in flood occurrence, frequency, intensity, and area flooded (including hydroperiod) • Change in groundwater tables • Change in pollutants • Change in nutrients • Change in soil moisture • Change in spatial distribution of habitat types • Change in community structure and composition • Change in succession processes and ecosystem development • Habitat fragmentation	• Area and extent of community • Community structure and composition • Connectivity among communities and ecosystems • Successional dynamics • Surface water flow regime	• Fresh Emergent Wetland
Chapter 5.4	Central Valley and Sierra Nevada Province	Sierra Nevada Foothills Ecoregion	Chaparral Desert Transition Chaparral Montane Chaparral California Foothill and Coastal Rock Outcrop Vegetation	• Data Collection and Analysis • Direct Management • Land Acquisition/Easement/ Lease • Management Planning • Partner Engagement	• Climate change • Fire and fire suppression • Housing and urban areas • Livestock, farming, and ranching • Invasive plants/animals • Parasites, pathogens, and disease • Renewable energy	• Change in natural fire regime • Change in spatial distribution of habitat types • Change in community structure or composition • Change in succession processes and ecosystem development • Habitat fragmentation	• Area and extent of community • Community structure and composition • Connectivity among communities and ecosystems • Fire regime • Successional dynamics	• Montane Chaparral • Chamise-Redshanks Chaparral • Mixed Chaparral • Barren
Chapter 5.4	Central Valley and Sierra Nevada Province	Sierra Nevada Foothills Ecoregion	California Foothill and Valley Forests and Woodlands	• Direct Management • Economic Incentives • Land Acquisition/Easement/ Lease • Outreach and Education • Partner Engagement	• Climate change • Fire and fire suppression • Housing and urban areas • Invasive plants/animals • Livestock, farming, and ranching • Recreational activities • Roads and railroads	• Changes in natural fire regime • Changes in soil moisture • Change in spatial distribution of habitat types • Change in community structure or composition • Change in biotic interactions (altered community dynamics) • Change in succession processes and ecosystem development • Habitat fragmentation	• Community structure and composition • Fire regime • Soil quality and sediment deposition regime • Successional dynamics	• Blue Oak Woodland • Blue-Oak-Foothill Pine • Closed-Cone Pine-Cypress • Coastal Oak Woodland • Juniper • Montane Hardwood • Valley Oak Woodland
Chapter 5.4	Central Valley and Sierra Nevada Province	Sierra Nevada Ecoregion	North Coastal Mixed Evergreen and Montane Conifer Forests	• Data Collection and Analysis • Land Acquisition/Easement/ Lease • Law and Policy • Management Planning • Outreach and Education	• Climate change • Fire and fire suppression • Livestock, farming, and ranching • Logging and wood harvesting • Renewable energy • Utility and service lines	• Change in natural fire regime • Change in community structure or composition • Change in biotic interactions (altered community dynamics) • Change in succession processes and ecosystem development • Habitat fragmentation	• Community structure and composition • Hydrological regime • Fire regime • Successional dynamics	• Douglas-Fir • Eastside Pine • Jeffrey Pine • Klamath Mixed Conifer • Montane Hardwood • Montane Hardwood-Conifer • Ponderosa Pine • Sierran Mixed Conifer • White Fir
Chapter 5.4	Central Valley and Sierra Nevada Province	Sierra Nevada Ecoregion	Alpine Vegetation	• Data Collection and Analysis • Direct Management • Management Planning • Outreach and Education • Partner Engagement • Training and Technical Assistance	• Climate change • Invasive plants/animals • Livestock, farming, and ranching • Recreational activities	• Change in soil moisture • Change in spatial distribution of habitat types • Change in community structure or composition • Change in biotic interactions (altered community dynamics) • Habitat fragmentation	• Area and extent of community • Community structure and composition • Connectivity among communities and ecosystems	• Alpine Dwarf-Shrub
Chapter 5.4	Central Valley and Sierra Nevada Province	Sierra Nevada Ecoregion	Pacific Northwest Subalpine Forest	• Data Collection and Analysis • Direct Management • Economic Incentives • Environmental Review • Land Use Planning • Management Planning • Partner Engagement • Training and Technical Assistance	• Climate change • Fire and fire suppression • Parasites/pathogens/diseases • Recreational activities	• Change in natural fire regime • Change in soil moisture • Change in spatial distribution of habitat types • Change in community structure or composition • Change in succession processes and ecosystem development • Change in biotic interactions (altered community dynamics)	• Area and extent of community • Community structure and composition • Fire regime • Successional dynamics	• Red Fir • Subalpine Conifer

Chapter	Province	Conservation Unit	Conservation Target	Strategy Categories	Pressures	Stresses / Marine Province - Effects of Pressures	Key Ecological Attributes (KEAs)	CWHR Classification
Chapter 5.4	Central Valley and Sierra Nevada Province	Sierra Nevada Ecoregion	Wet Mountain Meadow, Western Upland Grasslands	• Data Collection and Analysis • Direct Management • Land Acquisition/Easement/ Lease • Management Planning • Outreach and Education	• Annual and perennial non-timber crops • Climate change • Dams and water management/use • Fire and fire suppression • Housing and urban areas • Invasive plants/animals (non-native) • Invasive plants/animals (native species) • Livestock, farming, and ranching • Logging and wood harvesting • Parasites/pathogens/diseases • Recreational activities • Roads and railroads	• Change in sediment erosion-deposition regime • Change in natural fire regime • Change in runoff and river flow • Change in water levels and hydroperiod • Change in groundwater tables • Change in nutrients • Change in soil moisture • Change in sediment quality • Change in spatial distribution of habitat types • Change in community structure or composition • Change in succession processes and ecosystem development	• Area and extent of community • Community structure and composition • Connectivity among communities and ecosystems • Fire regime • Soil quality and sediment deposition regime • Water level fluctuations	• Wet Meadow • Annual Grassland • Perennial Grassland
Chapter 5.4	Central Valley and Sierra Nevada Province	Sacramento HUC 1802	Clear Lake Native Fish Assemblage	• Direct Management • Economic Incentives • Land Acquisition/Easement/ Lease • Law and Policy • Outreach and Education • Partner Engagement	• Agricultural and forestry effluents • Annual and perennial non-timber crops • Climate change • Dams, fish passage barriers, and water management/use • Invasive plants/animals • Mining and quarrying • Recreational activities	• Change in sediment erosion-deposition regime • Change in runoff and river flow • Change in water chemistry • Change in water levels and hydroperiod • Change in nutrients • Change in pollutants • Change in spatial distribution of habitat types • Change in community structure and composition • Change in biotic interactions (altered community dynamics) • Habitat fragmentation	• Area and extent of community • Community structure and composition • Connectivity among communities and ecosystems • Nutrient concentrations and dynamics • Pollutant concentration and dynamics • Soil quality and sediment deposition regime • Surface water flow regime	
Chapter 5.4	Central Valley and Sierra Nevada Province	Central Lahontan HUC 1605	Carson River Native Fish Assemblage	• Data Collection and Analysis • Direct Management • Land Acquisition/Easement/ Lease • Law and Policy • Management Planning • Outreach and Education • Training and Technical Assistance	• Agricultural and forestry effluents • Annual and perennial non-timber crops • Climate change • Dams and water management/use • Fire and fire suppression • Household sewage and urban waste water • Housing and urban areas • Introduced genetic material • Invasive plants/animals • Livestock, farming, and ranching • Mining and quarrying • Roads and railroads	• Change in sediment erosion-deposition regime • Change in natural fire regime • Change in runoff and river flow • Change in water temperature • Change in nutrients • Change in pollutants • Change in spatial distribution of habitat types • Change in community structure or composition • Change in biotic interactions (altered community dynamics) • Habitat fragmentation	• Area and extent of community • Community structure and composition • Fire regime • Pollutant concentration and dynamics • Soil quality and sediment deposition regime • Surface water flow regime	
Chapter 5.4	Central Valley and Sierra Nevada Province	Central Lahontan HUC 1605	Walker River Native Fish Assemblage	• Data Collection and Analysis • Direct Management • Law and Policy • Management Planning • Outreach and Education • Partner Engagement	• Climate change • Dams and water management/use • Introduced genetic material • Invasive plants/animals • Livestock, farming, and ranching • Roads and railroads	• Change in sediment erosion-deposition regime • Change in natural fire regime • Change in runoff and river flow • Change in water chemistry • Change in water levels and hydroperiod • Change in groundwater tables • Change in nutrients • Change in spatial distribution of habitat types • Change in community structure or composition • Change in biotic interactions (altered community dynamics) • Change in succession processes and ecosystem development • Habitat fragmentation	• Area and extent of community • Community structure and composition • Connectivity among communities and ecosystems • Surface water flow regime • Water quality	
Chapter 5.4	Central Valley and Sierra Nevada Province	San Joaquin HUC 1804	San Joaquin Native Fish Assemblage	• Data Collection and Analysis • Direct Management • Law and Policy • Management Planning • Outreach and Education	• Annual and perennial non-timber crops • Climate change • Dams and water management/use • Household sewage and urban waste water • Invasive plants/animals • Marine and freshwater aquaculture • Recreational activities	• Change in natural fire regime • Change in runoff and river flow • Change in flood occurrence, frequency, and intensity • Change in groundwater tables • Change in community structure and composition • Habitat fragmentation	• Area and extent of community • Community structure and composition • Connectivity among communities and ecosystems • Hydrological regime • Surface water flow regime • Water level fluctuations • Water quality • Water temperature and chemistry	
Chapter 5.4	Central Valley and Sierra Nevada Province	Tulare-Buena Vista Lakes HUC 1803	Upper Kern River Native Fish Assemblage	• Data Collection and Analysis • Direct Management • Land Acquisition/Easement/ Lease • Management Planning • Outreach and Education • Training and Technical Assistance	• Climate change • Introduced genetic material • Invasive plants/animals • Livestock, farming, and ranching	• Change in sediment erosion-deposition regime • Change in natural fire regime • Change in runoff and river flow • Change in spatial distribution of habitat types • Change in community structure and composition • Habitat fragmentation	• Area and extent of community • Community structure and composition • Fire regime • Soil quality and sediment deposition regime • Surface water flow regime	

Chapter	Province	Conservation Unit	Conservation Target	Strategy Categories	Pressures	Stresses / Marine Province - Effects of Pressures	Key Ecological Attributes (KEAs)	CWHR Classification
Chapter 5.4	Central Valley and Sierra Nevada Province	Great Valley Ecoregion	Shadscale-Saltbush Scrub	• Data Collection and Analysis • Land Acquisition/Easement/Lease • Outreach and Education • Partner Engagement • Training and Technical Assistance	• Airborne pollutants • Annual and perennial non-timber crops • Climate change • Commercial and industrial areas • Housing and urban areas • Industrial and military effluents • Invasive plants/animals • Livestock, farming, and ranching • Military activities • Mining and quarrying • Recreational activities • Renewable energy • Roads and railroads • Utility and service lines	• Change in sediment erosion-deposition regime • Change in flood occurrence, frequency, intensity, and area flooded (including hydroperiod) • Change in groundwater tables • Change in soil chemistry • Change in soil moisture • Change in spatial distribution of habitat types • Change in community structure or composition • Change in succession processes and ecosystem development • Habitat fragmentation	• Area and extent of community • Community structure and composition • Connectivity among communities and ecosystems • Hydrological regime • Successional dynamics • Soil quality and sediment deposition regime	• Alkali Desert Scrub • Desert Scrub • Desert Wash
Chapter 5.5	South Coast Province	Southern California Coast Ecoregion	Coastal Dune and Bluff Scrub	• Data Collection and Analysis • Direct Management • Land Acquisition/Easement/ Lease • Management Planning	• Airborne pollutants • Climate change • Commercial and industrial areas • Fire and fire suppression • Housing and urban areas • Invasive plants/animals • Recreational activities • Roads and railroads	• Sea level rise • Change in sediment erosion-deposition regime • Change in natural fire regime • Change in nutrients • Change in sediment quality • Change in spatial distribution of habitat types • Change in community structure or composition • Change in succession processes and ecosystem development • Habitat fragmentation	• Area and extent of community • Fire regime • Connectivity among communities and ecosystems • Community structure and composition • Soil quality and sediment deposition regime	• Coastal Scrub
Chapter 5.5	South Coast Province	South Coast Mountains and Valleys Ecoregions	Coastal Dune and Bluff Scrub	• Data Collection and Analysis • Direct Management • Land Acquisition/Easement/ Lease • Management Planning	• Airborne pollutants • Climate change • Commercial and industrial areas • Fire and fire suppression • Housing and urban areas • Invasive plants/animals • Recreational activities • Roads and railroads	• Sea level rise • Change in sediment erosion-deposition regime • Change in natural fire regime • Change in nutrients • Change in sediment quality • Change in spatial distribution of habitat types • Change in community structure or composition • Change in succession processes and ecosystem development • Habitat fragmentation	• Area and extent of community • Fire regime • Connectivity among communities and ecosystems • Community structure and composition • Soil quality and sediment deposition regime	• Coastal Scrub
Chapter 5.5	South Coast Province	South Coast Mountains and Valleys Ecoregions	Western North America Vernal Pool	• Direct Management • Land Acquisition/Easement/ Lease	• Land use change and development • Habitat fragmentation • Climate change • Human impacts	In progress	In progress	• Annual Grassland • Perennial Grassland
Chapter 5.5	South Coast Province	Southern California Coast Ecoregion	Western North America Vernal Pool	• Direct Management • Land Acquisition/Easement/ Lease	• Land use change and development • Habitat fragmentation • Climate change • Human impacts	In progress	In progress	• Annual Grassland • Perennial Grassland
Chapter 5.5	South Coast Province	Southern California Coast Ecoregion	American Southwest Riparian Forest and Woodland	• Data Collection and Analysis • Direct Management • Land Acquisition/Easement/ Lease • Law and Policy • Management Planning • Outreach and Education	• Catastrophic geological events • Climate change • Dams and water management/use • Fire and fire suppression • Garbage and solid waste • Household sewage and urban waste water • Housing and urban areas • Invasive plants/animals • Livestock, farming, and ranching • Mining and quarrying • Recreational activities • Roads and railroads • Tourism and recreation areas	• Change in sediment erosion-deposition regime • Change in natural fire regime • Change in runoff and river flow • Change in water levels and hydroperiod • Change in flood occurrence, frequency, intensity, and area flooded (including hydroperiod) • Change in groundwater tables • Change in pollutants • Change in spatial distribution of habitat types • Change in community structure or composition • Change in biotic interactions (altered community dynamics) • Change in succession processes and ecosystem development • Habitat fragmentation	• Area and extent of community • Community structure and composition • Connectivity among communities and ecosystems • Hydrological regime • Surface water flow regime • Water level fluctuations	• Valley Foothill Riparian • Palm Oasis
Chapter 5.5	South Coast Province	Southern California Coast Ecoregion	California Grassland and Flowerfields	• Data Collection and Analysis • Direct Management • Land Acquisition/Easement/ Lease • Management Planning • Partner Engagement	• Annual and perennial non-timber crops • Climate change • Fire and fire suppression • Housing and urban areas • Invasive plants/animals • Livestock, farming, and ranching • Recreational activities • Roads and railroads	• Change in natural fire regime • Change in nutrients • Change in pollutants • Change in soil moisture • Change in spatial distribution of habitat types • Change community structure or composition • Change in biotic interactions (altered community dynamics) • Habitat fragmentation	• Area and extent of community • Community structure and composition • Connectivity among communities and ecosystems • Fire regime • Nutrient concentrations and dynamics • Successional dynamics • Soil quality and sediment deposition regime	• Annual Grassland • Perennial Grassland

Chapter	Province	Conservation Unit	Conservation Target	Strategy Categories	Pressures	Stresses / Marine Province - Effects of Pressures	Key Ecological Attributes (KEAs)	CWHR Classification
Chapter 5.5	South Coast Province	Southern California Coast Ecoregion	Freshwater Marsh	• Economic Incentives • Land Acquisition/Easement/ Lease • Law and Policy • Management Planning • Outreach and Education	• Agricultural and forestry effluents • Annual and perennial non-timber crops • Climate change • Commercial and industrial areas • Dams and water management/use • Household sewage and urban waste water • Housing and urban areas • Industrial and military effluents • Invasive plants/animals • Livestock, farming, and ranching • Roads and railroads	• Sea level rise • Change in sediment erosion-deposition regime • Change in runoff and river flow • Change in water levels and hydroperiod • Change in flood occurrence, frequency, intensity, and area flooded (including hydroperiod) • Change in groundwater tables • Change in pollutants • Change in nutrients • Change in soil moisture • Change in spatial distribution of habitat types • Change in community structure and composition • Change in succession processes and ecosystem development • Habitat fragmentation	• Area and extent of community • Community structure and composition • Connectivity among communities and ecosystems • Successional dynamics • Surface water flow regime	• Fresh Emergent Wetland
Chapter 5.5	South Coast Province	Southern California Coastal HUC 1807	Native Fish Assemblage	• Data Collection and Analysis • Direct Management • Land Acquisition/Easement/ Lease • Outreach and Education	• Annual and perennial non-timber crops • Climate change • Dams and water management/use • Fire and fire suppression • Garbage and solid waste • Household sewage and urban waste water • Housing and urban areas • Invasive plants/animals • Livestock, farming, and ranching • Mining and quarrying • Parasites/pathogens/diseases • Recreational Activities	• Change in runoff and river flow • Change in water levels and hydroperiod • Change in flood occurrence, frequency, intensity, and area flooded (including hydroperiod) • Change in groundwater tables • Change in nutrients • Change in pollutants • Change in community structure or composition • Change in biotic interactions (altered community dynamics) • Change in succession processes and ecosystem development • Habitat fragmentation	• Community structure and composition • Connectivity among communities and ecosystems • Surface water flow regime • Water level fluctuations	N/A
Chapter 5.5	South Coast Province	Southern California Coastal HUC 1807	South Coast Native Aquatic Herp Assemblage	• Data Collection and Analysis • Direct Management • Land Acquisition/Easement/ Lease • Outreach and Education	• Annual and perennial non-timber crops • Climate change • Dams and water management/use • Housing and urban areas • Invasive plants/animals • Mining and quarrying • Parasites/pathogens/diseases • Recreational activities • Roads and railroads	• Change in runoff and river flow • Change in water levels and hydroperiod • Change in groundwater tables • Change in nutrients • Change in pollutants • Change in spatial distribution of habitat types • Change in community structure or composition • Habitat fragmentation	• Area and extent of community • Community structure and composition • Surface water flow regime	N/A
Chapter 5.5	South Coast Province	Southern California Mountain and Valley Ecoregion	American Southwest Riparian Forest and Woodland	• Data Collection and Analysis • Direct Management • Land Acquisition/Easement/ Lease • Law and Policy • Management Planning • Outreach and Education	• Catastrophic geological events • Climate change • Dams and water management/use • Fire and fire suppression • Garbage and solid waste • Household sewage and urban waste water • Housing and urban areas • Invasive plants/animals • Livestock, farming, and ranching • Mining and quarrying • Recreational activities • Roads and railroads • Tourism and recreation areas	• Change in sediment erosion-deposition regime • Change in natural fire regime • Change in runoff and river flow • Change in water levels and hydroperiod • Change in flood occurrence, frequency, intensity, and area flooded (including hydroperiod) • Change in groundwater tables • Change in pollutants • Change in spatial distribution of habitat types • Change in community structure or composition • Change in biotic interactions (altered community dynamics) • Change in succession processes and ecosystem development • Habitat fragmentation	• Area and extent of community • Community structure and composition • Connectivity among communities and ecosystems • Hydrological regime • Surface water flow regime • Water level fluctuations	• Valley Foothill Riparian • Palm Oasis
Chapter 5.5	South Coast Province	Southern California Mountain and Valley Ecoregion	California Grassland and Flowerfields	• Data Collection and Analysis • Direct Management • Land Acquisition/Easement/ Lease • Management Planning • Partner Engagement	• Annual and perennial non-timber crops • Climate change • Fire and fire suppression • Housing and urban areas • Invasive plants/animals • Livestock, farming, and ranching • Recreational activities • Roads and railroads	• Change in natural fire regime • Change in nutrients • Change in pollutants • Change in soil moisture • Change in spatial distribution of habitat types • Change community structure or composition • Change in biotic interactions (altered community dynamics) • Habitat fragmentation	• Area and extent of community • Community structure and composition • Connectivity among communities and ecosystems • Fire regime • Nutrient concentrations and dynamics • Successional dynamics • Soil quality and sediment deposition regime	• Annual Grassland • Perennial Grassland

Chapter	Province	Conservation Unit	Conservation Target	Strategy Categories	Pressures	Stresses / Marine Province - Effects of Pressures	Key Ecological Attributes (KEAs)	CWHR Classification
Chapter 5.5	South Coast Province	Central California Coastal HUC 1807	Coastal Lagoons	• Data Collection and Analysis • Direct Management • Land Acquisition/Easement/ Lease • Law and Policy • Training and Technical Assistance	• Agricultural and forestry effluents • Annual and perennial non-timber crops • Climate change • Commercial and industrial areas • Dams and water management/use • Garbage and solid waste • Housing sewage and urban waste water • Housing and urban areas • Livestock, farming, and ranching • Other ecosystem modifications • Recreational activities • Roads and railroads • Tourism and recreation areas • Wood and pulp plantations	• Sea level rise • Change in oceanic hydrodynamics • Change in sediment erosion-deposition regime • Change in runoff and river flow • Change in water chemistry • Change in groundwater tables • Change in spatial distribution of habitat types • Habitat fragmentation	• Area and extent of community • Community structure and composition • Connectivity among communities and ecosystems • Nutrient concentrations and dynamics • Surface water flow regime	• Estuarine
Chapter 5.6	Deserts Province	Mono Ecoregion	Big Sagebrush Scrub	• Data Collection and Analysis • Direct Management • Economic Incentives • Land Acquisition/Easement/Lease • Partner Engagement	• Climate change • Fire and fire suppression • Housing and urban areas • Invasive plants/animals • Parasites/pathogens/diseases • Recreational activities	• Change in natural fire regime • Change in spatial distribution of habitat types • Change in community structure or composition • Change in succession processes and ecosystem development	• Area and extent of community • Community structure and composition • Fire regime	• Sagebrush
Chapter 5.6	Deserts Province	Mono Ecoregion	Great Basin Pinyon-Juniper Woodland	• Data Collection and Analysis • Direct Management • Partner Engagement	• Climate change • Fire and fire suppression • Invasive plants/animals • Livestock, farming, and ranching • Other ecosystem modifications	• Change in natural fire regime • Change in soil moisture • Change in spatial distribution of habitat types • Change in community structure or composition • Change in biotic interactions (altered community dynamics) • Change in succession processes and ecosystem development	• Community structure and composition • Fire regime • Successional dynamics	• Juniper • Pinyon-Juniper
Chapter 5.6	Deserts Province	Mojave Desert Ecoregion	Shadscale-Saltbush Scrub	• Data Collection and Analysis • Land Acquisition/Easement/Lease • Management Planning • Outreach and Education • Partner Engagement • Training and Technical Assistance	• Airborne pollutants • Annual and perennial non-timber crops • Climate change • Commercial and industrial areas • Housing and urban areas • Industrial and military effluents • Invasive plants/animals • Livestock, farming, and ranching • Military activities • Mining and quarrying • Recreational activities • Renewable energy • Roads and railroads • Utility and service lines	• Change in sediment erosion-deposition regime • Change in flood occurrence, frequency, intensity, and area flooded (including hydroperiod) • Change in groundwater tables • Change in soil chemistry • Change in soil moisture • Change in spatial distribution of habitat types • Change in community structure or composition • Change in succession processes and ecosystem development • Habitat fragmentation	• Area and extent of community • Community structure and composition • Connectivity among communities and ecosystems • Hydrological regime • Successional dynamics • Soil quality and sediment deposition regime	• Alkali Desert Scrub • Desert Scrub • Desert Wash
Chapter 5.6	Deserts Province	Colorado Desert Ecoregion	Desert Wash Woodland and Scrub	• Data Collection and Analysis • Land Use Planning • Outreach and Education • Partner Engagement	• Climate change • Commercial and industrial areas • Dams and water management/use • Housing and urban areas • Military activities • Mining and quarrying • Recreational activities • Renewable energy • Roads and railroads • Tourism and recreation areas • Utility and service lines	• Change in sediment erosion-deposition regime • Change in runoff and river flow • Change in flood occurrence, frequency, intensity, and area flooded (including hydroperiod) • Change in spatial distribution of habitat types • Change in community structure or composition • Change in succession processes and ecosystem development • Habitat fragmentation	• Area and extent of community • Community structure and composition • Connectivity among communities and ecosystems • Soil quality and sediment deposition regime • Surface water flow regime	• Desert Scrub • Desert Wash
Chapter 5.6	Deserts Province	Colorado Desert Ecoregion	Sparsely Vegetated Desert Dune	• Data Collection and Analysis • Direct Management • Land Use Planning • Management Planning • Partner Engagement	• Climate change • Commercial and industrial areas • Housing and urban areas • Invasive plants/animals • Livestock, farming, and ranching • Recreational activities • Renewable energy • Tourism and recreation activities	• Change in sediment erosion-deposition regime • Change in sediment quality* • Change in community structure or composition • Change in biotic interactions (altered community dynamics) • Change in succession processes and ecosystem development • Habitat fragmentation	• Area and extent of community • Community structure and composition • Connectivity among communities and ecosystems • Hydrological regime • Soil quality and sediment deposition regime	• Barren
Chapter 5.6	Deserts Province	Southeastern Great Basin Ecoregion	American Southwest Riparian Forest and Woodland	• Data Collection and Analysis • Direct Management • Land Use Planning	• Annual and perennial non-timber crops • Climate change • Dams and water management/use • Housing and urban areas • Invasive plants/animals • Recreational activities • Renewable energy	• Change in runoff and river flow • Change in water levels and hydroperiod • Change in groundwater tables • Change in sediment quality • Change in spatial distribution of habitat types • Change in community structure or composition • Change in succession processes and ecosystem development • Habitat fragmentation	• Area and extent of community • Community structure and composition • Surface water flow regime	• Desert Riparian

Chapter	Province	Conservation Unit	Conservation Target	Strategy Categories	Pressures	Stresses / Marine Province - Effects of Pressures	Key Ecological Attributes (KEAs)	CWHR Classification
Chapter 5.6	Deserts Province	Southeastern Great Basin Ecoregion	• High Desert Wash and “Rangeland” Scrub • Great Basin Upland Scrub	• Data Collection and Analysis • Direct Management • Management Planning • Partner Engagement	• Climate change • Fire and fire suppression • Invasive plants/animals • Livestock, farming, and ranching • Mining and quarrying • Renewable energy	• Change in natural fire regime • Change in spatial distribution of habitat types • Change in community structure or composition • Habitat fragmentation	• Area and extent of community • Community structure and composition • Successional dynamics	
Chapter 5.6	Deserts Province	Sonoran Desert	Mojave and Sonoran Desert Scrub	• Land Acquisition/Easement/Lease • Land Use Planning • Management Planning • Outreach and Education • Partner Engagement • Training and Technical Assistance	• Annual and perennial non-timber crops • Climate change • Commercial and industrial areas • Housing and urban areas • Invasive plants/animals • Renewable energy • Roads and railroads • Utility and service lines	• Change in spatial distribution of habitat types • Change in community structure or composition • Change in biotic interactions (altered community dynamics) • Habitat fragmentation	• Area and extent of community • Community structure and composition • Connectivity among communities and ecosystems • Successional dynamics • Weather regime	• Desert Scrub • Desert Succulent Scrub • Joshua Tree
Chapter 5.6	Deserts Province	Central Lahontan HUC 1605	Walker River Native Fish Assemblage	• Data Collection and Analysis • Direct Management • Law and Policy • Management Planning • Outreach and Education • Partner Engagement	• Climate change • Dams and water management/use • Introduced genetic material • Invasive plants/animals • Livestock, farming, and ranching • Roads and railroads	• Change in sediment erosion-deposition regime • Change in natural fire regime • Change in runoff and river flow • Change in water chemistry • Change in water levels and hydroperiod • Change in groundwater tables • Change in nutrients • Change in spatial distribution of habitat types • Change in community structure or composition • Change in biotic interactions (altered community dynamics) • Change in succession processes and ecosystem development • Habitat fragmentation	• Area and extent of community • Community structure and composition • Connectivity among communities and ecosystems • Hydrological regime • Soil quality and sediment deposition regime • Surface water flow regime • Water quality	N/A
Chapter 5.6	Deserts Province	Northern Mojave-Mono Lake HUC 1809	Cienegas	• Data Collection and Analysis • Direct Management • Land Acquisition/Easement/Lease • Outreach and Education • Partner Engagement	• Annual and perennial non-timber crops • Climate change • Dams and water management/use • Fire and fire suppression • Housing and urban areas • Introduced genetic material • Invasive plants/animals • Livestock, farming, and ranching • Parasites/pathogens/diseases • Renewable energy	• Change in natural fire regime • Change in water chemistry • Change in water levels and hydroperiod • Change in groundwater tables • Change in spatial distribution of habitat types • Change in community structure or composition	• Area and extent of community • Community structure and composition • Fire regime • Hydrological regime	
Chapter 5.6	Deserts Province	Southern Mojave-Salton Sea HUC 1810	Cienegas	• Data Collection and Analysis • Direct Management • Land Acquisition/Easement/Lease • Outreach and Education • Partner Engagement	• Annual and perennial non-timber crops • Climate change • Dams and water management/use • Fire and fire suppression • Housing and urban areas • Introduced genetic material • Invasive plants/animals • Livestock, farming, and ranching • Parasites/pathogens/diseases • Renewable energy	• Change in natural fire regime • Change in water chemistry • Change in water levels and hydroperiod • Change in groundwater tables • Change in spatial distribution of habitat types • Change in community structure or composition	• Area and extent of community • Community structure and composition • Fire regime • Hydrological regime	
Chapter 5.6	Deserts Province	Northern Mojave-Mono Lake HUC 1809	Springs and Spring Brooks	• Data Collection and Analysis • Direct Management • Land Acquisition/Easement/Lease • Management Planning • Outreach and Education • Partner Engagement	• Annual and perennial non-timber crops • Climate change • Commercial and industrial areas • Dams and water management/use • Introduced genetic material • Invasive plants/animals • Livestock, farming, and ranching • Marine and freshwater aquaculture • Recreational activities • Renewable energy	• Change in runoff and river flow • Change in groundwater tables • Change in spatial distribution of habitat types • Change in community structure or composition • Habitat fragmentation	• Area and extent of community • Community structure and composition • Connectivity among communities and ecosystems • Hydrological regime • Soil quality and sediment deposition regime • Successional dynamics • Surface water flow regime • Water quality	
Chapter 5.6	Deserts Province	Northern Mojave-Mono Lake HUC 1809	Anthropogenically Created Aquatic Features	• Data Collection and Analysis • Direct Management • Land Use Planning • Law and Policy • Outreach and Education • Partner Engagement	• Agricultural and forestry effluents • Climate change • Dams and water management/use • Invasive plants/animals • Marine and freshwater aquaculture • Recreational activities • Renewable energy • Roads and railroads	• Change in sediment erosion-deposition regime • Change in runoff and river flow • Change in nutrients • Change in spatial distribution of habitat types • Change in community structure or composition	• Area and extent of community • Community structure and composition • Connectivity among communities and ecosystems • Soil quality and sediment deposition regime • Surface water flow regime • Water quality	

Chapter	Province	Conservation Unit	Conservation Target	Strategy Categories	Pressures	Stresses / Marine Province - Effects of Pressures	Key Ecological Attributes (KEAs)	CWHR Classification
Chapter 5.6	Deserts Province	Southern Mojave-Salton Sea HUC 1810	Anthropogenically Created Aquatic Features	• Data Collection and Analysis • Direct Management • Land Use Planning • Law and Policy • Outreach and Education • Partner Engagement	• Agricultural and forestry effluents • Climate change • Dams and water management/use • Invasive plants/animals • Marine and freshwater aquaculture • Recreational activities • Renewable energy • Roads and railroads	• Change in sediment erosion-deposition regime • Change in runoff and river flow • Change in nutrients • Change in spatial distribution of habitat types • Change in community structure or composition	• Area and extent of community • Community structure and composition • Connectivity among communities and ecosystems • Soil quality and sediment deposition regime • Surface water flow regime • Water quality	
Chapter 5.7	Marine Province	• North Coast Marine Bioregion • Central Coast Marine Bioregion • South Coast Marine Bioregion	Embayments, Estuaries, and Lagoons	• Data Collection and Analysis • Partner Engagement • Management Planning • Direct Management • Land Use Planning • Economic Incentives • Environmental Review • Land Acquisition, Easement, and Lease • Land Use Planning • Law and Policy • Outreach and Education • Training and Technical Assistance	• Climate Change (1) • Fishing and Harvesting Aquatic Resources (Fishing, harvesting, collecting) (2) • Fishing and Harvesting Aquatic Resources (Interactions of non-target animals with fishing gear) (3) • Garbage and solid waste (Discarding of solid waste) (4) • Housing and Urban Areas; Commercial and Industrial Areas - Shoreline Development (5) • Industrial and Military Effluents (Oil spills) (6) • Invasive Plants/Animals (7) • Marine and Freshwater (estuarine) Aquaculture (8) • Other Ecosystem Modifications - Artificial Structures (9) • Parasites/Pathogens/Diseases (10) • Renewable Energy (11) • Shipping Lanes - Ballast Water (12) • Utility and Service Lines (13) • Agricultural and Forestry Effluents (14) • Airborne Pollutants (15) • Dams and Water Management/Use (16) • Other Ecosystem Modifications - Modification of Mouth/Channels (17) • Other Ecosystem Modifications - Ocean/Estuary Water Diversion/Control (18)	•(1) Increasing occurrence of disruptive events like marine heatwaves, ocean warming causing species range shifts and population impacts, ocean acidification causing impacts to invertebrate species. •(2) Direct effects on species abundance and indirect impacts to habitats and predator/prey relationships. •(3) Direct effects on non-target species abundance and survivorship. •(4) Direct effects on habitats. •(5) Direct effects through intertidal habitat alteration or destruction, and indirect effects of increased sedimentation, wave action, and freshwater runoff. •(6) Direct effects on habitat destruction and wildlife fouling. •(7) Direct effects on species survivorship through competition and predation and indirect effects on habitats and ecosystems. •(8) Direct effects on habitats and water quality and indirect effects on prey species used for aquaculture feed. •(9) Direct effects on habitats through installation of structures and indirect effects through altered migratory routes, spatial utilization patterns, and changes to local species abundance or biological productivity. •(10) Direct and indirect effects to biological productivity of native and aquaculture species. •(11) Direct effects on habitat through offshore energy installation and potential indirect effects on ocean currents, upwelling, and species distribution and abundance. •(12) Direct and indirect effects of invasive species introduction. •(13) Direct effects on habitat through offshore energy transmission line installation and maintenance. •(14) Indirect effects through increased sediment loading in coastal rivers and streams. •(15) Indirect effects through greenhouse gas emissions as drivers of climate change. •(16) Indirect effects through reduced water flow from coastal rivers and streams and reduced sand supply to beach habitat and impacts to anadromous fish spawning habitats. •(17) Indirect effects through tidal flow changes and nearshore spawning habitats. •(18) Indirect effects through reduced water flow, tidal flow changes, and nearshore spawning habitats.	• Area or extent of the ecosystem communities • Relative abundance of key species populations • Species age or size class heterogeneity • Diversity in species composition • Abundance ratio: native to invasive/non-native species • Changes in abiotic parameters • Changes in human use patterns	Estuarine
Chapter 5.7	Marine Province	• North Coast Marine Bioregion • Central Coast Marine Bioregion • South Coast Marine Bioregion	Intertidal Zone	• Data Collection and Analysis • Partner Engagement • Management Planning • Direct Management • Land Use Planning • Economic Incentives • Environmental Review • Land Acquisition, Easement, and Lease • Land Use Planning • Law and Policy • Outreach and Education • Training and Technical Assistance	• Climate Change (1) • Fishing and Harvesting Aquatic Resources (Fishing, harvesting, collecting) (2) • Fishing and Harvesting Aquatic Resources (Interactions of non-target animals with fishing gear) (3) • Garbage and solid waste (Discarding of solid waste) (4) • Housing and Urban Areas; Commercial and Industrial Areas - Shoreline Development (5) • Industrial and Military Effluents (Oil spills) (6) • Invasive Plants/Animals (7) • Marine and Freshwater (estuarine) Aquaculture (8) • Other Ecosystem Modifications - Artificial Structures (9) • Parasites/Pathogens/Diseases (10) • Renewable Energy (11) • Shipping Lanes - Ballast Water (12) • Utility and Service Lines (13) • Agricultural and Forestry Effluents (14) • Airborne Pollutants (15) • Dams and Water Management/Use (16) • Other Ecosystem Modifications - Modification of Mouth/Channels (17) • Other Ecosystem Modifications - Ocean/Estuary Water Diversion/Control (18)	•(1) Increasing occurrence of disruptive events like marine heatwaves, ocean warming causing species range shifts and population impacts, ocean acidification causing impacts to invertebrate species. •(2) Direct effects on species abundance and indirect impacts to habitats and predator/prey relationships. •(3) Direct effects on non-target species abundance and survivorship. •(4) Direct effects on habitats. •(5) Direct effects through intertidal habitat alteration or destruction, and indirect effects of increased sedimentation, wave action, and freshwater runoff. •(6) Direct effects on habitat destruction and wildlife fouling. •(7) Direct effects on species survivorship through competition and predation and indirect effects on habitats and ecosystems. •(8) Direct effects on habitats and water quality and indirect effects on prey species used for aquaculture feed. •(9) Direct effects on habitats through installation of structures and indirect effects through altered migratory routes, spatial utilization patterns, and changes to local species abundance or biological productivity. •(10) Direct and indirect effects to biological productivity of native and aquaculture species. •(11) Direct effects on habitat through offshore energy installation and potential indirect effects on ocean currents, upwelling, and species distribution and abundance. •(12) Direct and indirect effects of invasive species introduction. •(13) Direct effects on habitat through offshore energy transmission line installation and maintenance. •(14) Indirect effects through increased sediment loading in coastal rivers and streams. •(15) Indirect effects through greenhouse gas emissions as drivers of climate change. •(16) Indirect effects through reduced water flow from coastal rivers and streams and reduced sand supply to beach habitat and impacts to anadromous fish spawning habitats. •(17) Indirect effects through tidal flow changes and nearshore spawning habitats. •(18) Indirect effects through reduced water flow, tidal flow changes, and nearshore spawning habitats.	• Area or extent of the ecosystem communities • Relative abundance of key species populations • Species age or size class heterogeneity • Diversity in species composition • Abundance ratio: native to invasive/non-native species • Changes in abiotic parameters • Changes in human use patterns	Marine

Chapter	Province	Conservation Unit	Conservation Target	Strategy Categories	Pressures	Stresses / Marine Province - Effects of Pressures	Key Ecological Attributes (KEAs)	CWHR Classification
Chapter 5.7	Marine Province	• North Coast Marine Bioregion • Central Coast Marine Bioregion • South Coast Marine Bioregion	Nearshore Subtidal Zone	• Data Collection and Analysis • Partner Engagement • Management Planning • Direct Management • Land Use Planning • Economic Incentives • Environmental Review • Land Acquisition, Easement, and Lease • Land Use Planning • Law and Policy • Outreach and Education • Training and Technical Assistance	• Climate Change (1) • Fishing and Harvesting Aquatic Resources (Fishing, harvesting, collecting) (2) • Fishing and Harvesting Aquatic Resources (Interactions of non-target animals with fishing gear) (3) • Garbage and solid waste (Discarding of solid waste) (4) • Housing and Urban Areas; Commercial and Industrial Areas - Shoreline Development (5) • Industrial and Military Effluents (Oil spills) (6) • Invasive Plants/Animals (7) • Marine and Freshwater (estuarine) Aquaculture (8) • Other Ecosystem Modifications - Artificial Structures (9) • Parasites/Pathogens/Diseases (10) • Renewable Energy (11) • Shipping Lanes - Ballast Water (12) • Utility and Service Lines (13) • Agricultural and Forestry Effluents (14) • Airborne Pollutants (15) • Dams and Water Management/Use (16) • Other Ecosystem Modifications - Modification of Mouth/Channels (17) • Other Ecosystem Modifications - Ocean/Estuary Water Diversion/Control (18)	•(1) Increasing occurrence of disruptive events like marine heatwaves, ocean warming causing species range shifts and population impacts, ocean acidification causing impacts to invertebrate species. •(2) Direct effects on species abundance and indirect impacts to habitats and predator/prey relationships. •(3) Direct effects on non-target species abundance and survivorship. •(4) Direct effects on habitats. •(5) Direct effects through intertidal habitat alteration or destruction, and indirect effects of increased sedimentation, wave action, and freshwater runoff. •(6) Direct effects on habitat destruction and wildlife fouling. •(7) Direct effects on species survivorship through competition and predation and indirect effects on habitats and ecosystems. •(8) Direct effects on habitats and water quality and indirect effects on prey species used for aquaculture feed. •(9) Direct effects on habitats through installation of structures and indirect effects through altered migratory routes, spatial utilization patterns, and changes to local species abundance or biological productivity. •(10) Direct and indirect effects to biological productivity of native and aquaculture species. •(11) Direct effects on habitat through offshore energy installation and potential indirect effects on ocean currents, upwelling, and species distribution and abundance. •(12) Direct and indirect effects of invasive species introduction. •(13) Direct effects on habitat through offshore energy transmission line installation and maintenance. •(14) Indirect effects through increased sediment loading in coastal rivers and streams. •(15) Indirect effects through greenhouse gas emissions as drivers of climate change. •(16) Indirect effects through reduced water flow from coastal rivers and streams and reduced sand supply to beach habitat and impacts to anadromous fish spawning habitats. •(17) Indirect effects through tidal flow changes and nearshore spawning habitats. •(18) Indirect effects through reduced water flow, tidal flow changes, and nearshore spawning habitats.	• Area or extent of the ecosystem communities • Relative abundance of key species populations • Species age or size class heterogeneity • Diversity in species composition • Abundance ratio: native to invasive/non-native species • Changes in abiotic parameters • Changes in human use patterns	Marine
Chapter 5.7	Marine Province	• North Coast Marine Bioregion • Central Coast Marine Bioregion • South Coast Marine Bioregion	Offshore Rocks and Islands	• Data Collection and Analysis • Partner Engagement • Management Planning • Direct Management • Land Use Planning • Economic Incentives • Environmental Review • Land Acquisition, Easement, and Lease • Land Use Planning • Law and Policy • Outreach and Education • Training and Technical Assistance	• Climate Change (1) • Fishing and Harvesting Aquatic Resources (Fishing, harvesting, collecting) (2) • Fishing and Harvesting Aquatic Resources (Interactions of non-target animals with fishing gear) (3) • Garbage and solid waste (Discarding of solid waste) (4) • Housing and Urban Areas; Commercial and Industrial Areas - Shoreline Development (5) • Industrial and Military Effluents (Oil spills) (6) • Invasive Plants/Animals (7) • Marine and Freshwater (estuarine) Aquaculture (8) • Other Ecosystem Modifications - Artificial Structures (9) • Parasites/Pathogens/Diseases (10) • Renewable Energy (11) • Shipping Lanes - Ballast Water (12) • Utility and Service Lines (13) • Agricultural and Forestry Effluents (14) • Airborne Pollutants (15) • Dams and Water Management/Use (16) • Other Ecosystem Modifications - Modification of Mouth/Channels (17) • Other Ecosystem Modifications - Ocean/Estuary Water Diversion/Control (18)	•(1) Increasing occurrence of disruptive events like marine heatwaves, ocean warming causing species range shifts and population impacts, ocean acidification causing impacts to invertebrate species. •(2) Direct effects on species abundance and indirect impacts to habitats and predator/prey relationships. •(3) Direct effects on non-target species abundance and survivorship. •(4) Direct effects on habitats. •(5) Direct effects through intertidal habitat alteration or destruction, and indirect effects of increased sedimentation, wave action, and freshwater runoff. •(6) Direct effects on habitat destruction and wildlife fouling. •(7) Direct effects on species survivorship through competition and predation and indirect effects on habitats and ecosystems. •(8) Direct effects on habitats and water quality and indirect effects on prey species used for aquaculture feed. •(9) Direct effects on habitats through installation of structures and indirect effects through altered migratory routes, spatial utilization patterns, and changes to local species abundance or biological productivity. •(10) Direct and indirect effects to biological productivity of native and aquaculture species. •(11) Direct effects on habitat through offshore energy installation and potential indirect effects on ocean currents, upwelling, and species distribution and abundance. •(12) Direct and indirect effects of invasive species introduction. •(13) Direct effects on habitat through offshore energy transmission line installation and maintenance. •(14) Indirect effects through increased sediment loading in coastal rivers and streams. •(15) Indirect effects through greenhouse gas emissions as drivers of climate change. •(16) Indirect effects through reduced water flow from coastal rivers and streams and reduced sand supply to beach habitat and impacts to anadromous fish spawning habitats. •(17) Indirect effects through tidal flow changes and nearshore spawning habitats. •(18) Indirect effects through reduced water flow, tidal flow changes, and nearshore spawning habitats.	• Area or extent of the ecosystem communities • Relative abundance of key species populations • Species age or size class heterogeneity • Diversity in species composition • Abundance ratio: native to invasive/non-native species • Changes in abiotic parameters • Changes in human use patterns	Marine

5.1 North Coast and Klamath Province

5.1.1 Geophysical and Ecological Description of the Province

Encompassing approximately 14 million acres, the North Coast and Klamath Province extends along the Pacific coast from the California-Oregon border in the north to the San Francisco Bay watershed in the south (Figure 5.1-1). The province's eastern (inland) boundary is formed by the Cascade Range along the northern portion of the province and by the transition to the Sacramento Valley along the southern portion. The province is characterized by large expanses of rugged, forested mountains that range in elevation from sea level to 9,000 feet (Avers and McNab 1994) and includes the Klamath, Siskiyou, Marble Mountain, Trinity, and North Coast ranges. The Klamath Mountains consist of low- to moderate-elevation mountains or uplifted and dissected granitic, sedimentary, and volcanic rock formations that rise to 9,000 feet. The coastal mountain ranges within the province are aligned somewhat parallel and low to moderate in elevation (maximum approximately 7,500 feet). The climate varies considerably across the province, with high precipitation levels and moderate temperatures in coastal areas to dry areas caused by rain shadow effects and higher temperatures in some inland valleys. The province has a generally wet climate and receives more rainfall than other parts of the state, feeding more than ten river systems.

The province's major inland waterways are part of the Klamath River system, which includes the Klamath, Scott, Salmon, and Trinity rivers. The upper portions of these watersheds contain alluvial valleys, which historically supported freshwater marshes and grasslands but have since been converted to agriculture. Below these alluvial valleys, the Klamath-system rivers are generally confined between steep mountain slopes over most of their length and support narrow riparian habitats. Most rivers in this province flow westerly in deeply incised canyons with bedrock-controlled channels. Some easterly flowing streams, also in deeply incised canyons, flow inland to the Sacramento River. Dams are present on the Trinity River and a significant portion of the Trinity River is diverted to the Sacramento River. Dams on the Klamath River were removed in 2024 as part of the Klamath River Renewal Project (see more information about this project in Section 6). Additionally, this province contains numerous lakes and meadows associated with glaciated areas occurring above 5,000 feet.

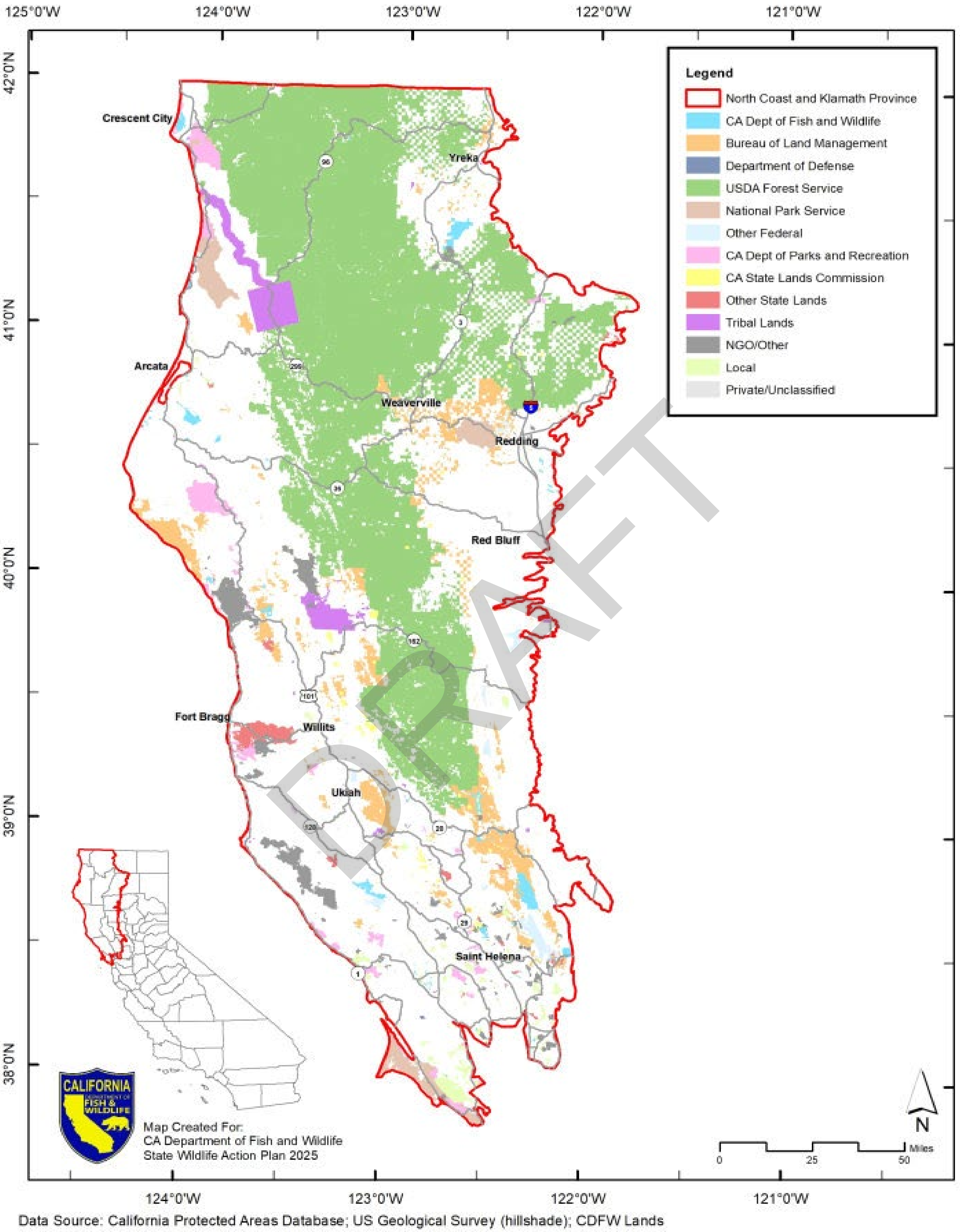


Figure 5.1-1 Land Ownership of the North Coast and Klamath Province

River systems draining the province's Coast Ranges include the Eel, Russian, Mattole, Navarro, Smith, Mad, and Gualala rivers, as well as Redwood Creek, numerous smaller coastal streams, and Humboldt Bay. Because the Coast Range is composed of soft, easily eroded soils, these rivers carry high sediment loads and have carved extensive floodplains that support riparian habitats. Most of the North Coast and Klamath Province's large rivers widen as they approach their ocean outlets, forming alluvial floodplains and deltas. These floodplains once supported mixed-conifer, extensive black cottonwood, willow, and red alder forests, but have now been largely converted to agricultural uses and rural developments.

North Coast and Klamath Province vegetation consists predominantly of conifer and mixed-conifer forests dissected by chaparral stands, riparian forests, and wetlands. Valley and foothill grassland and woodland communities emerge along the central and southeastern border of the province, while coastal wetlands and marshes appear along the coastline. Specifically, Douglas-fir, mixed-evergreen, western hardwoods, and chaparral-mountain shrub dominate the province.

Along the coast, sandy beaches host snowy plover, willet, and sanderling, while rocky shoreline habitats support black oystercatcher, ruddy turnstone, and surfbird. Coastal wetland communities, including estuaries, lagoons, marshes, and open-water bays, are also important for shorebirds and provide nursery habitats for anadromous, oceanic, and near-shore fish. Among the province's notable coastal wetlands are the estuary at the mouth of the Smith River, Lake Talawa, Lake Earl, Klamath River Estuary, Humboldt Bay, the mouth of the Eel River, Bodega Bay, Tomales Bay (Page and Shuford 2000), and Big and Stone lagoons.

Terrestrial communities along the coast include grasslands, coastal shrub, pine forests, mixed evergreen forests, and redwood forests. Unique, geographically limited habitats include sphagnum bogs and pygmy scrub forests. The province's coastal redwoods are among the largest, tallest, and oldest trees in the world, often exceeding 200 feet in height, 15 feet in diameter, and 2,000 years in age. Old growth redwood groves are patchily distributed across the coastal fog belt can extend 40 miles inland and where winter rains and summer fog provide a persistent moist environment; second and third growth redwood forests occur nearly continuously from the Oregon border to the southern end of the region within the coastal fog belt. Wildlife inhabitants of coastal redwood forests include black bear, Roosevelt elk, Wilson's warbler, pacific-slope flycatcher, pacific wren, varied thrush, Northern spotted owl, marbled murrelet, Pacific giant salamander, rough-skinned newt, and banana slug.

The province's inland Klamath-Siskiyou Mountain ranges are recognized for their biological diversity (Whittaker 1961; Whittaker 1976; Kauffmann and Garwood 2022); they have been designated as an area of global botanical significance by the World Conservation Union, as one of 200 global conservation priority sites by the World Wildlife Fund, and as a proposed United Nations' biosphere reserve (Ricketts et al. 1999). The inland Klamath-Siskiyou mountains harbor some of the most floristically diverse temperate coniferous forests in the world, attributable in part to the province's variable climate, geography, and soil types that create a variety of ecological communities. Unique, localized conditions have given rise to endemic species that have evolved to specialize in these areas, including nearly 100 plant species that are restricted to serpentine soils.

Ecological communities of the inland mountain ranges include both mesic and xeric inland forests dominated by Douglas fir, ponderosa pine, white fir, incense cedar, and sugar pine mixed with a variety of other conifers and hardwoods; drier oak forests and savannas; serpentine soil–associated plant communities; shrublands, including such species as mountain heather-bilberry, mountain whitethorn, and manzanita; high-elevation subalpine forests dominated by white and red fir, western white pine, and mountain hemlock; and less-widespread cranberry and pitcher plant fens and alpine grasslands on high peaks. More than 3,000 plant species are known from these mountains, and the area supports some 30 temperate conifer tree species, more than any other ecosystem in the world. Wildlife inhabitants include such sensitive species as the Northern spotted owl, Northern goshawk, Humboldt marten, and Pacific fisher, as well as common species like black-tailed deer, Roosevelt elk, black bear, and red-tailed hawk.

Portions of the province remained unglaciated during the last ice age, serving as refuge for species that have since dispersed and evolved in the region. These mountains represent the intersection of coastal ecosystems with the inland Klamath Basin. As a result, the inland mountains and river systems support rich flora and fauna that include species from both coastal and inland regions. The Klamath River system, for instance, harbors anadromous fish, including coho salmon, steelhead, cutthroat trout, lampreys, and sturgeon; estuarine and coastal fish such as tidewater goby and coast range sculpin; and inland fish such as the Klamath tui chub.

The province is known for its extensive river systems and the anadromous fish populations they support. The majority of California's river segments with state or federal Wild and Scenic River designations are in the North Coast and Klamath Province, including portions of the Klamath, Trinity, Smith, Scott, Salmon, Van Duzen, and Eel rivers. Anadromous fish species include coho and Chinook salmon, steelhead, coastal cutthroat trout, green and white sturgeon, Pacific lamprey, western river lamprey, eulachon, and longfin smelt. The province has seen sharp declines in its fish populations, with an 80 percent decline in salmon and steelhead between the 1950s and 1990s (CA State Lands Commission 1993). Fish population declines are a result of multiple pressures including degradation of river systems by forestry and other land uses; decreased instream flows resulting from small and large scale water diversions and agricultural water use; migration barriers to spawning grounds; overharvesting of fish (beginning in the mid-1800s and lasting until the late 1970s, at which time substantial restrictions on ocean harvest were enacted by the Pacific Marine Fisheries Council); and natural and human-influenced variation in oceanic conditions, such as plankton densities and temperatures. Other native freshwater fish, like the Lost River sucker and shortnose sucker, have experienced substantial population declines because of alterations of the province's freshwater river systems (CDFG 2005).

The Smith River and South Fork Eel River have been designated by CalFish (a cooperative program of agencies and organizations) as "salmon strongholds." Salmon strongholds are watersheds supporting "wild, diverse, and abundant" salmon populations that make the greatest contribution towards regional conservation goals. See Chapter 6 for a detailed discussion of anadromous fish.

The province's rivers support one-third of the state's Chinook salmon, most of the state's coho salmon and steelhead, and all the coastal cutthroat trout (CA State Lands Commission 1993).

5.1.2 Conservation Units and Targets

The conservation units associated with the North Coast and Klamath Province include the Northern California Coast, Northern California Coast Ranges, Northern California Interior Coast Ranges, and Klamath Mountains ecoregions (Figure 5.1-2), and the Klamath-Northern California Coastal hydrologic unit (Figure 5.1-3), which are summarized below.

Ecoregion Summaries

Northern California Coast: Encompasses mountains, hills, valleys, and plains in the northern California Coast Ranges and small parts of the Klamath mountains. Climate modified greatly by marine influence. Summers are characterized by fog, cool temperatures, and high humidity. Predominant vegetation communities consist of redwood, Douglas-fir-tanoak, Oregon white oak, tanoak, and coast live oak. The elevation range is 0 to 3,000 feet.

Northern California Coast Ranges: Interior to the Northern California Coast, north of the Carquinez Strait. Marine air modifies winter and summer temperatures, but oceanic effects are greatly diminished because of distance from coast. Predominant vegetation communities include Douglas-fir-tanoak, blue oak, Oregon white oak, chamise, cheatgrass, mixed conifer, and white fir. The elevation range is 300 to 8,100 feet.

Northern California Interior Coast Ranges: Located in the southeastern edge of the northern California Coast Ranges mountains, and hills and terraces along the west side and north end of the Sacramento Valley. Predominant vegetation communities in this section include blue oak, foothill pine, and chamise. The elevation range is 200 to 3,000 feet.

Klamath Mountains: Located between the Southern Cascades Mountains and the Coast Range mountains. The southern limit is the northern end of the Sacramento Valley. Predominant vegetation communities in this section include Douglas-fir, Douglas-fir-tanoak, Jeffrey pine, mixed conifer, white fir, Douglas-fir – ponderosa pine, canyon live oak, Oregon white oak, mixed chaparral shrublands, red fir, and mixed subalpine forest. The elevation range is 200 to 9,000 feet.

Hydrologic Unit Summaries

The Klamath-Northern California Coastal Hydrologic Unit (HUC 1801; Figure 5.1-3) includes two major watershed basins: the Klamath River Basin and the North Coastal River Basin. The Klamath River Basin covers approximately 10,830 square miles. It is bounded by the Oregon border on the north, the Pacific Ocean on the west, Redwood Creek and Mad River hydrologic units on the south, and by the Sacramento Valley to the east. The North Coastal Basin covers approximately 8,560 square miles located along the north-central California Coast. The Basin is bounded by the Pacific Ocean on the west, by the Klamath River and Trinity River Basins on the north, by the Sacramento Valley, Clear Lake, Putah and Cache Creeks, and the Napa River Basin on the east, and by the Marin-Sonoma area to the south.

This hydrologic unit (HUC 180) is characterized by distinct temperature zones. Along the coast, the climate is temperate and foggy with minimal temperature variation. Precipitation is greater than for any other part of California. The elevation range is 0 to 10,700 feet.

Conservation Targets

Conservation targets were selected in this province as priorities for conservation planning within the conservation units; targets are listed in a searchable, sortable table (Table 5.0). The conservation targets are summarized in Section 5.1.6 along with the strategies for each. The conservation targets include:

- Alpine Vegetation
- California Foothill and Valley Forests and Woodlands
- Coastal Dune and Bluff Scrub
- Fen (wet meadow)
- Freshwater Marsh
- Montane Upland Deciduous Scrub
- Mountain Riparian Scrub and Wet Meadow
- North Coastal and Montane Riparian Forest and Woodland
- Native Aquatic Species Assemblages/Communities of Coastal Watersheds
- Pacific Northwest Conifer Forest
- Pacific Northwest Subalpine Forest
- Subalpine Aspen Forests and Pine Woodlands
- Western Upland Grasslands

- Wet Mountain Meadow

Although numerous potential conservation targets were identified within the province, conservation strategies were only developed for the targets that contain the greatest number of Species of Greatest Conservation Need (SGCN) and that are under immediate threat. Additional key targets will be addressed through future conservation planning efforts.

Figure 5.1-4 shows the distribution of the plant communities (CWHR common names) within the province. Some of the plant communities identified as conservation targets do not appear on the figure because they exist in areas smaller than the mapping unit. Information about the methods used to prioritize conservation targets is presented in Chapter 1.5 and Appendix D.

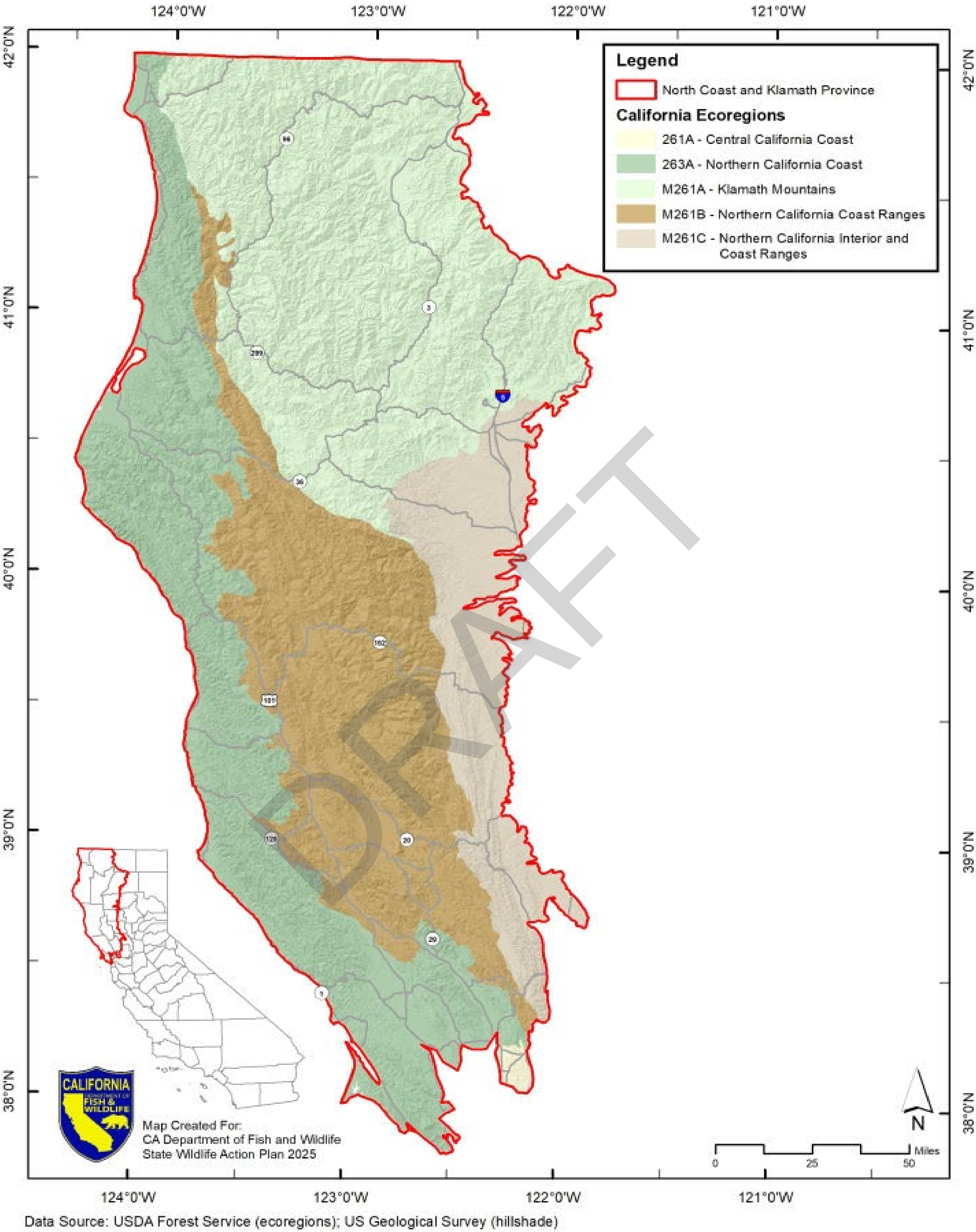
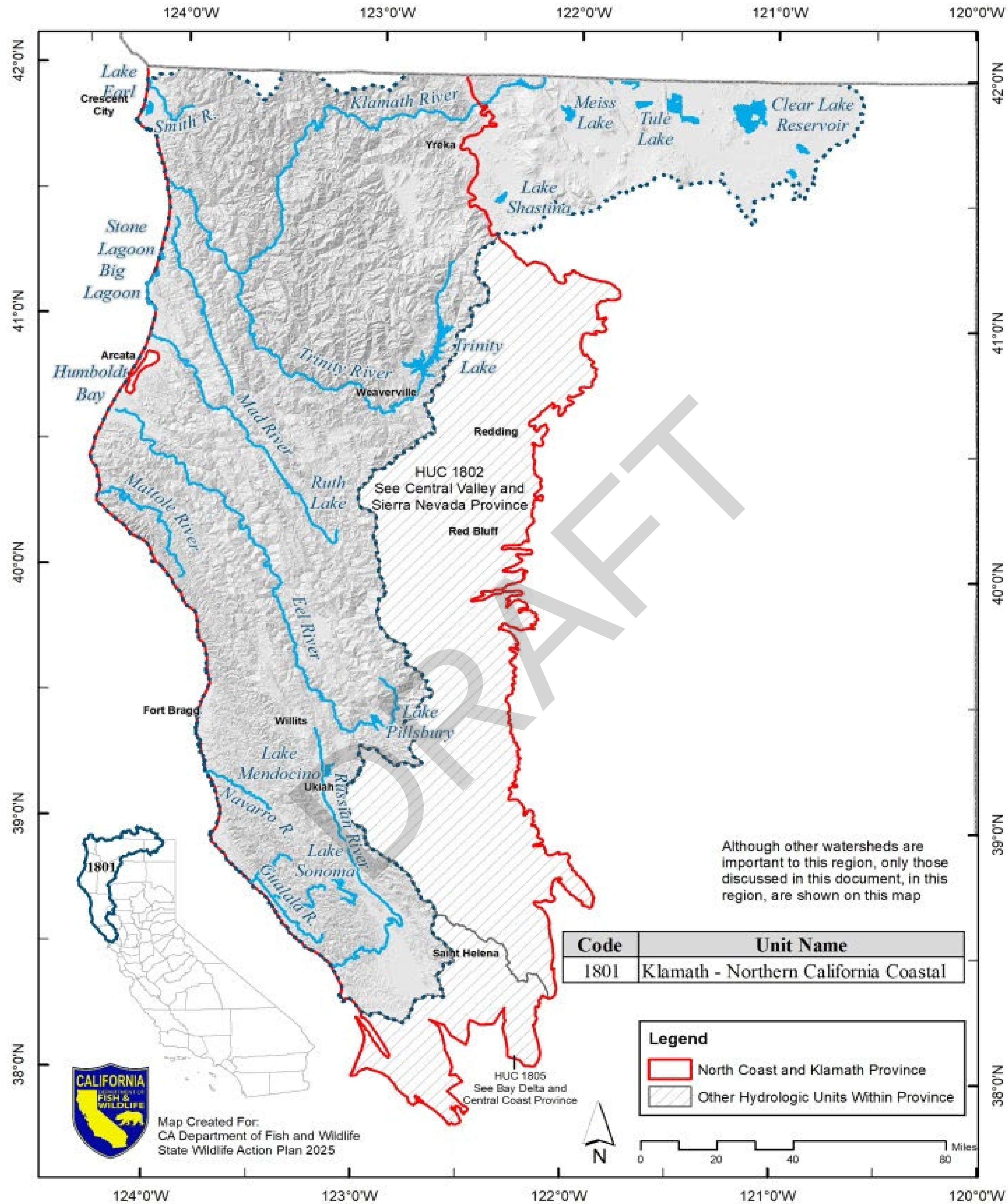


Figure 5.1-2 Ecoregions of the North Coast and Klamath Province



Data Source: National Hydrologic Dataset (NHD); US Geological Survey (hillshade)

Figure 5.1-3 Hydrologic Units of the North Coast and Klamath Province

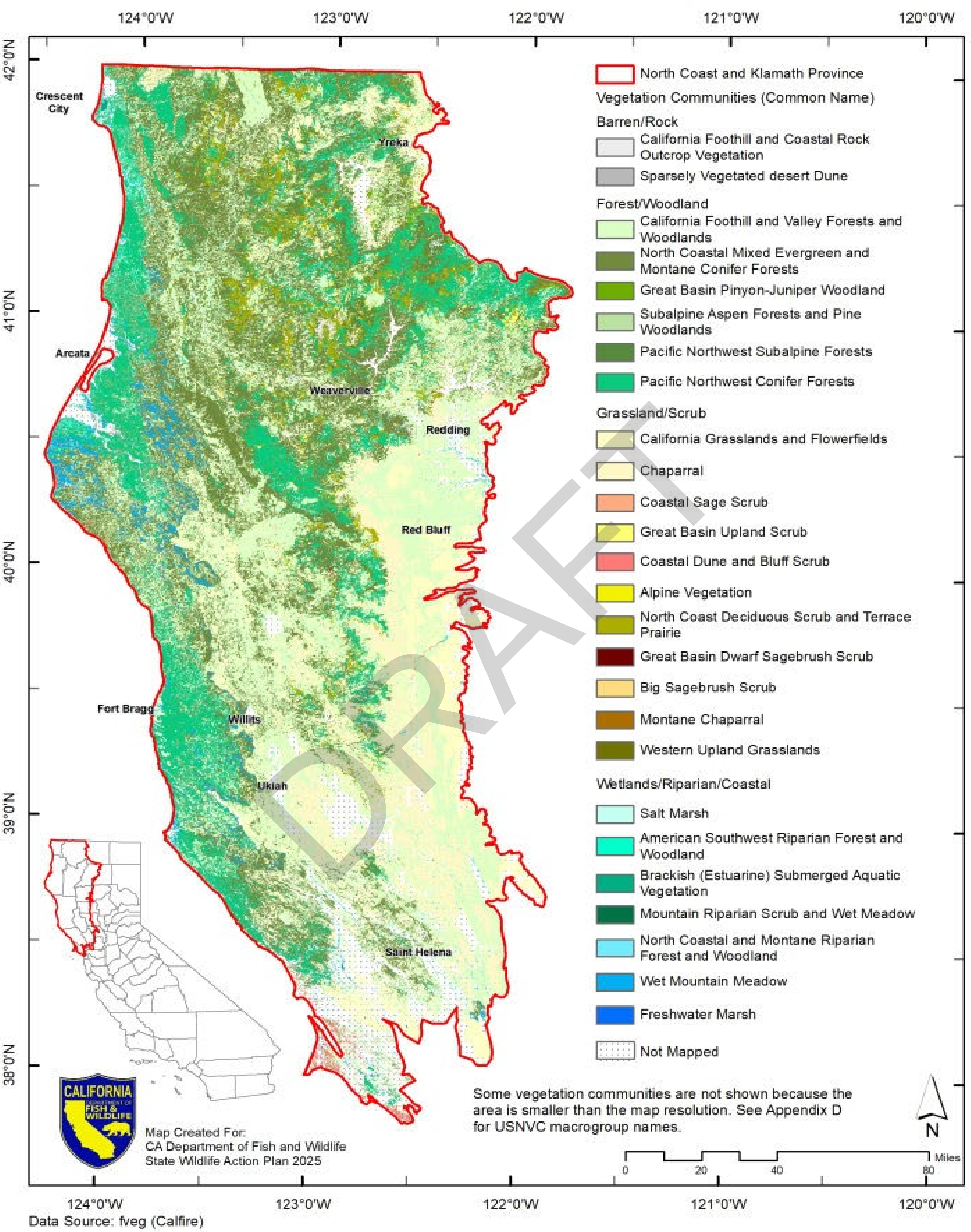


Figure 5.1-4 Plant Communities of the North Coast and Klamath Province

5.1.3 Key Ecological Attributes

Key ecological attributes (KEAs) were identified for each conservation target (Table 5.0). These attributes are considered the most important for the viability of the targets and their associated species. The most commonly identified attributes for the North Coast and Klamath Province include the following:

- area and extent of community
- connectivity among communities and ecosystems
- successional dynamics
- community structure and composition
- hydrological regime

Species of Greatest Conservation Need in the North Coast and Klamath Province

The North Coast and Klamath Province's wide range of habitats has given rise to remarkable biological diversity. In SWAP 2005, it was noted that there are 501 vertebrate species that inhabit the North Coast and Klamath Province at some point in their life cycle, including 282 birds, 104 mammals, 26 reptiles, 30 amphibians, and 59 fish. Of these species, 13 are endemic to the North Coast and Klamath Province, and nine other species found here are endemic to California but not restricted to this province.

The SWAP identified the Species of Greatest Conservation Need (SGCN) for the entire state and identified ecoregion(s) and province(s) associated with each SGCN; data is summarized in Appendix C. The conservation strategies are aimed at benefiting the SGCN via the conservation targets.

For those SGCN that do not occur within the conservation targets identified for the province, conservation actions that target SWG funding should align with existing recovery plan documents where applicable, or demonstrate they address a critical conservation need for the species.

5.1.4 Pressures on Conservation Targets

Using the Open Standards of Conservation, a stress is an impaired aspect of a conservation target, equivalent to a degraded KEA (Conservation Measures Partnership 2020). Pressures are primarily human activities, or natural phenomena influenced by humans, that amplify environmental stress and further degrade conservation target(s). The pressures identified in the North Coast and Klamath Province (Table 5.0) are the most significant pressures to the conservation targets, but do not constitute a complete list of pressures in the province. Some principal pressures in the province are discussed in more detail below.

Annual and Perennial Non-Timber Crops

Agriculture occupies about seven percent of the province (CDOC 2002). However, in flatter coastal areas and valleys, urban and agricultural land uses cover a much larger proportion of the land and have substantially reduced and altered wildlife habitats.

Agricultural development has occurred primarily in the major river valleys, where common crops are alfalfa and irrigated pasturelands. Agricultural uses also occur on coastal grasslands, where dairy operations are widespread, and on alluvial plains formed at the coastal outlets of large rivers. Some southern portions of the province support wine grapes, nursery stock, and orchards. Vineyard acreage is expanding from Napa and Sonoma counties to Mendocino and Lake counties.

In some river valleys, agricultural use of alluvial plain and delta areas has virtually eliminated native riparian black cottonwood, willow, and red alder forests, limiting habitat for riparian species like willow flycatcher (Riparian Habitat Joint Venture 2004). In these areas, berms and canals prevent flooding of agricultural fields and pastures, which disconnects the rivers from their natural floodplains and eliminates benefits of natural flooding regimes, such as deposition of river silts on valley-floor soils, recharging of wetlands, and flushing flows that prevent logging of coastal outlets. Braided channel structure and backwaters are eliminated, resulting in higher velocity flows. These changes lower habitat suitability for anadromous fish, which need refuges to keep from being flushed out of river channels during flood flows.

Many of the province's coastal agricultural lands were created by draining and diking wetlands and salt marshes, particularly around Humboldt Bay and the Eel River estuary, where more than 90 percent of the historical tidal marshlands have been lost (CDFG 2010). The resulting habitat includes coastal grasslands that are extensively used for grazing, especially by dairy cattle. Creating these grasslands reduced marsh and wetland habitats used by shorebirds and estuarine nursery areas important for anadromous and marine fish. The one benefit is that these newly created agricultural grasslands now provide valuable habitats for many bird species (Page and Shuford 2000). If improperly managed, livestock use can result in eutrophication of wetlands and coastal waters. Similarly, in the Eel River watershed leading up to Humboldt Bay, much of the historic connectivity between tidal flow and salt marsh has been blocked by levees and flood gates. This has led to a reduction in tidal connectivity and loss of estuary habitat. Additionally, mining, timber logging, grazing and agriculture uses removed historic forests, riparian, and wetlands habitat, increasing sedimentation and decreasing the ability of the Eel River Basin to support anadromous fisheries, aquatic invertebrates, and other wildlife.

In agricultural river valleys, substantial habitat alteration results from river diversions and water use. Many small-scale irrigation diversions and small dams deplete the flows of river systems in the province, sometimes resulting in complete drying of rivers. In livestock production areas, water is also diverted to provide cattle-watering sources.

In the southern portion of the province, irrigated vineyards use large amounts of water during the grape-production season, sometimes resulting in streams completely drying up. Stream habitats are also adversely affected by sedimentation, because some irrigated vineyards tend to be erosion-prone, especially if located on hillsides. Vineyards also fragment habitats and restrict wildlife movement to a greater degree than pasturing or cultivating alfalfa.

Cannabis Cultivation

Ideal for growing cannabis because of the sparse human population and the remote and forested landscape, Humboldt, Mendocino, and Trinity counties are the three main counties known for illegal and legal cannabis cultivation in this province of California. Sonoma, Napa, and Marin also have a notable amount of cultivation. Chapter 2 details the multitude of impacts to wildlife due to cannabis cultivation, including hydrologic and chemical impacts, habitat degradation and destruction, and the resulting fragmentation. Chapter 4 describes strategies to reduce impacts of cannabis cultivation in the Law & Policy section. Impacts specific to this province are summarized below.

Most cannabis cultivation operations require large amounts of water and are often planted illegally near waterways or divert water illegally for use. This flow reduction can have lethal or sub-lethal effects on diverse aquatic and riparian SGCN species such as coho salmon, steelhead, and sensitive amphibians, including the southern torrent salamander, and the coastal tailed frog. Private cannabis crops can reduce streamflow by 23% in some streams and water demand for cultivation could use more than 100% of stream flow during the summer dry season (Bauer et al. 2015). Stopping illegal diversions is critical to salmonid survival in this province.

The effects of illegal streamflow diversion will worsen with ongoing climate change. Climate change is expected to result in reduced stream flows and higher air and surface water temperatures. This was exemplified by the 2021 record low flows in the Eel River when the ongoing drought conditions, likely worsened by water diversions for cannabis cultivation, had the effect of disconnecting the South Fork Eel River from the main Eel River and the bed being mostly dry near Dyerville (Bauer et al. 2015). Drought and diversion combined can also increase temperatures in cold water streams making them uninhabitable by cold water fishes such as trout and salmon. Future droughts prolonged by climate change combined with diminished stream flows due to cannabis diversions could be catastrophic for aquatic species (Bauer et al. 2015).

Beyond hydrologic impacts, cannabis cultivation causes various pressures in Northern California, Rodenticide used in cannabis cultivation threatens many species (examples: Pacific fisher and northern spotted owl) by either direct ingestion or bioaccumulation (toxins accumulate in the body from feeding on contaminated prey). Cannabis farms have replaced sections of forests and hilltops, destroying sensitive forested and aquatic habitats. Heavy equipment used at growing sites increases the threat of landslides, buried stream, and sedimentation of streams, while grading can destroy spawning areas, kill bottom dwelling organisms, and injure fish. Cannabis cultivation also threatens natural fens and peat-forming wetlands.

Dams and Water Management/Use

With relatively high precipitation levels across most of the province, the North Coast and Klamath Province produces about 40 percent of California's total natural runoff (DWR 2023). Large-scale dams and diversions on many of the province's major river systems supply water and hydropower, most of which is exported out of the province. The province's water resources are also taxed by smaller-scale water diversions for local use and by groundwater extraction. Dams in this province, including the Cape

Horn and Scott Dams from the upper Eel River, and dams from upper Klamath and Trinity rivers, and the Mad River, have been a main pressure on declining native anadromous fish species. (See Chapter 6, Section 6.6.3 for a description of the Klamath Dams Removal Project.) Additionally, numerous dams are constructed on smaller river systems such as the Mad River for water supply, and small streams for agriculture irrigation and frost protection use; many of the dams and water diversions are not in compliance with state regulations.

In this province, the Trinity River dams increase deep water along shores and eliminates low-velocity areas and lowers water temperatures, which degrades habitat for the western pond turtle (Reese and Welsh Jr 1998), stunting their growth and affecting their reproduction. Seasonal pulse flows resulting from dam releases impact foothill yellow-legged frogs, which survive below the dams, by creating stressful or fatal velocity conditions in early life stages, reducing the survival of young. Changed water levels and temperatures also create habitat for invasive species like warm water fishes such as largemouth bass and bluegill and predatory bullfrogs. For fish species, movement is limited when dams and diversions cause some river reaches to dry out, severing the connectivity between different sections of a river basin. Fish can be stranded in isolated river sections without access to tributaries or river reaches that provide cool temperatures or important habitat features like pools and cover. Additionally, without flood flows, willow trees and other vegetation can encroach into river channels—as has occurred in portions of the Klamath basin and below the Trinity Dam—resulting in narrower channels and reduced instream habitat. Groundwater pumping from fractured bedrock in the montane areas of the coastal and interior regions, and the alluvial and volcanic basins of the valley areas, also results in the decline or cessation of the flow of springs and seeps that maintain critical cold-water refugia for over-summering rearing salmonids.

Dams and diversion structures also restrict fish movement. Dams and diversions can hinder migration and block access to important spawning and rearing habitats for anadromous species, such as Pacific lamprey, Western river lamprey, steelhead, Chinook and coho salmon, cutthroat trout, and white and green sturgeon. Dams can also isolate population segments and disrupt gene flow for species that move widely within rivers, such as coastal cutthroat and rainbow trout, Klamath River lamprey, Sacramento pikeminnow, and Klamath smallscale sucker. Dams also block sediment movement. Coupled with altered flows, restricted sediment supply can result in substantial alteration of channel structure and degradation of instream and riparian habitats downstream of dams.

Reduced flows and reservoir conditions can contribute to water quality problems. In the Klamath system, for example, agricultural runoff in the upper basin, including fertilizers and animal waste, favors algal growth that depletes oxygen levels in reservoirs. Flow levels below dams are not sufficient to flush away or dilute these poor water quality conditions. Low flows also diminish aquatic systems' capacity to transport and discharge sediment, sometimes resulting in increased turbidity or sediment deposition. In fall 2002, on the Klamath River below Iron Gate Dam, low flows coupled with poor water quality conditions contributed to the deaths of more than 33,000 fish, largely Chinook salmon (Belchik et al. 2004).

The cumulative effects of small-scale surface water diversions have substantial consequences for some of the province's river systems. Agricultural and domestic water use has resulted in low flows and has dried upriver segments. Increasing numbers of groundwater wells are being used to supply water for expanding agricultural and residential development, further contributing to lower flows and drying. Small-scale diversions (livestock, agriculture, cannabis cultivation) to provide livestock water sources have depleted instream flows in some waterways, such as the Navarro River and Mad River, and the Eel and Van Duzen River watersheds. These changes will be compounded by longer, drier summers brought on by the effects of climate change.

Housing and Urban Areas

The North Coast and Klamath Province is sparsely populated when compared to other areas of California. Rugged topography has limited urban and agricultural development across much of the province. Urban land use is low in the province's area and low-density rural residential development is a low percentage. The province's population centers include coastal cities (e.g., Eureka, Arcata, Fort Bragg, and Crescent City) and inland cities (e.g., Santa Rosa and Redding). In the interior portions of the province, residential growth has closely followed agricultural development in the major valleys.

The most significant population pressures are felt in the southern portion of the province and in the Russian River basin, with population growth in Napa and Sonoma counties beginning to expand to Mendocino and Lake Counties. Some areas, like Humboldt and Siskiyou counties are seeing increasing subdivision of large landholdings into smaller parcels for second-home and rural residential development. Development removes and fragments habitat, increases the spread of invasive species (through increased human use of the nearby landscape), and increases demand for limited water resources. As development expands on private lands adjacent to major highways, traffic increases, migrating mule deer, elk, and antelope will be less able to move between seasonal ranges and the incidence of road mortality will increase. Increased traffic loads also increase the frequency of bird, small mammal, reptile, and amphibian mortalities as they attempt to cross the highways. Without conservation planning future development along these corridors will likely have a significant impact on the region's wildlife distribution and abundance.

As seasons change in the mountainous areas of the province the survival of many mammals, birds, amphibians, reptiles and fish species depends on their ability to migrate between higher and lower elevations. Because of development and roads these species are cut off from necessary uplands or aquatic habitats. For instance, turtles and garter snakes inhabiting streams leave to nest and overwinter in the uplands, and pond-breeding amphibians migrate en masse from the uplands to aquatic habitat when the winter rains hit. But opportunities to migrate successfully have been compromised by dams, reservoirs, highways, altered stream flows, residential community development, and predation by free-roaming domestic pets.

Invasive Plants/Animals

As in other provinces, invasive species put negative pressure on biodiversity. In addition to introduced invasive species, some native species have been favored by human activity to the point where they have become pests, threatening sensitive, native species. Many of the conservation actions described below address prevention, early detection, and rapid response to new invasive plants to prevent them from becoming widespread. Distribution maps and summary reports for invasive plants, as well as regional strategic plans for prioritized invasive plant species can be found on CalWeedMapper. Some of the invasive species affecting the province are discussed below. Invasive species are discussed in more detail in Appendix E.

Coastal beach and dune habitats are threatened by a number of invasive plant species in the North Coast and Klamath Province. These habitats support unique plant and animal communities, including sensitive species like western snowy plover and beach layia, a small succulent plant endemic to the province. Dune habitats are naturally dynamic, with dune migration serving as a natural disturbance that keeps early successional dune and beach habitat available. Coastal development and urbanization along many of the province's sandy beach areas has limited the ability of dunes to migrate. This problem is exacerbated by colonization by non-native plants, including European beach grass and yellow bush lupine, which form dense monocultures of vegetation and result in unnatural stabilization of beach and dune systems (Bossard et al. 2000). These invasive plants also displace native vegetation, including short-grass areas, degrading the habitat of such sensitive species as western lily and hippolyta fritillary. In salt marshes and coastal estuaries, particularly around Humboldt Bay, native plant communities are threatened by introduced dense-flowered cordgrass. Coastal wetlands are also threatened by invasive reed canary grass.

Sudden Oak Death (SOD), and the invasion of Jubata grass and Selloana grass are the greatest invasive threats to the north coast redwood forests. Tanoak is particularly susceptible to SOD; given its importance in the lower canopies of most upland forests its loss will radically alter competitive dynamics, increase coarse woody fuel loads, alter surface fire weather conditions and fire behavior, and remove an important food source for wildlife. SOD is likely to bring a profound and essentially permanent change to the coast redwood landscape.

Populations of Jubata grass and Selloana grass (pampas grasses) have been detected in north coast redwood-Douglas fir forests. Initially brought in as ornamental plants, these grasses have begun to dominate young clearcuts across the North Coast and many naturally disturbed areas. Establishment of these invasive grasses can reduce or preclude fir or redwood seed establishment through competition with seedlings. The change in forest understory due to the loss of tanoak from SOD and the historically moderate fire behavior associated with hardwood litter and increased grass cover may alter small mammal assemblages and reduce the quality of foraging habitat for sensitive species such as the Northern spotted owl. Because of the natural openness of redwood-Douglas fir forests, the imminent loss of tanoak to SOD, and the elevated wildfire risk because of increased fuel and possibly climate change, forest canopies may never close enough to shade out this invasive completely (USDA: USFS Pacific Southwest Region 2015) .

Inland areas of the province are being invaded by such invasive weeds as yellow starthistle, spotted knapweed, and Scotch broom (Bossard et al. 2000). Medusa head, barbed goat grass, and perennial pepperweed are causing major problems in the Northern California Interior Coastal Ranges by invading and replacing native perennial grassland areas. Additionally, these annual plants increase the risk of fire in the system by becoming dry earlier in the season than native grasses. Most of these invasive plants spread via roadways and river corridors and then invade surrounding lands because of disturbance by fire, forest management practices, or agricultural practices and livestock grazing.

Native and non-native avian species causing problems in the province include brown-headed cowbirds, European starlings, common ravens, and jays. Native brown-headed cowbirds thrive in grazing lands, where they are attracted to livestock droppings and feed. With the historic growth of grazing lands, cowbirds have greatly expanded their range and have experienced population increases. Cowbirds can lower the reproductive success of native birds by laying their eggs in other birds' nests, causing them to raise the cowbird nestlings at the expense of their own. Native common ravens, Steller's jays, and introduced European starlings also thrive in human-altered environments, including recreational areas and have increased their populations to coincide with humans. Starlings compete with native birds, while ravens and jays prey on many native bird species. Ravens and jays are one of the main causes for marbled murrelet nest failures within coastal redwood forests. Studies and monitoring in Redwood National State Parks, and elsewhere, have demonstrated that where there are high numbers of park visitors with food, like in campgrounds, there are very high numbers of Steller's jays and common ravens, and high number of murrelet eggs predated (NPS 2025).

There are two invasive mammalian species that threaten ecosystem changes within the province: wild pigs and nutria. Wild pigs are highly destructive in Lake Colusa, Marin, Tehama and Sonoma counties. They forage on blue oak acorn crops, which are vital to mule deer and other wildlife as a fall food source. By removing this critical resource, mule deer and other wildlife no longer have forage when resources are limited. Additionally, because they are omnivorous and forage by rooting, wild pigs have the potential to impact a wide variety of plants and animals directly by consumption and indirectly through disturbance. In particular, rooting disturbance reduces survival of tree seedlings, and limits tree regeneration in oak woodlands. Nutria, a semiaquatic rodent native to South America, has become established just north of the California/Oregon border in Klamath Falls and in central California. Nutria can be extremely damaging to freshwater wetlands, turning marshes and wetlands into open water. Avid foragers, nutria can devour and destroy native aquatic vegetation, crops, and wetland areas. Their potential range expansion or dispersal from infested drainages in southern Oregon (e.g., Applegate, Middle Rogue) and in Suisun Marsh puts northern California wetlands and (potentially) agricultural crops in Siskiyou County at risk in the future (Cook-Fletcher 2025).

Invasive aquatic invertebrates, which have become a problem in California waterways in recent years, may soon critically threaten the waterways and open water habitat within the North Coast and Klamath. Quagga mussels, zebra mussels, and New Zealand mud snails (NZMS) are a large focus of the California Aquatic Invasive Species Management Plan (CDFG 2008), and a standard decontamination protocol is being implemented to prevent spread by recreational users. State-run fish hatcheries inspect and ensure their facilities and fish are not contaminated by these mollusks, which would hitchhike on hatchery raised fish into waters when planted. The NZMS is now present in the Warm Spring Hatchery, which limits the streams where the Coho broodstock can be planted. These species proliferate rapidly once introduced within waterways and threaten native habitat and species by changing ecosystem dynamics. For instance, once introduced into an area, NZMS can reach densities exceeding 500,000 per square meter. Such high densities, when reached, can have a negative effect on populations of other aquatic organisms, such as native snails and the insects and fish that feed on them. These species threaten to outcompete and displace native macroinvertebrates that are important food sources for trout and salmon. Additionally, invasive aquatic invertebrates can alter community composition, impact stream productivity, and negatively affect nutrient cycling.

As of 2021, data show that quagga mussels and zebra mussels are not recorded within the province and have only taken a foothold in southern California (CDFW 2021). Prevention of quagga and zebra mussel introduction and establishment of these in any northern California waterbodies are critical parts of the state management plan. Keeping these two species from North Coast and Klamath waterbodies is critical for water quality, the economy, native fish and aquatic invertebrates, and recreation within the province. NZMS have been detected in several waterbodies throughout the province in Del Norte, Humboldt, Mendocino, Sonoma, Marin, Napa, Yolo, Solano, Shasta, and Tehama counties (USGS 2025). NZMS are established within the province in the Lower Smith River, Lake Earl, Redwood Creek, Stone and Big Lagoons, Lower Klamath, Tomales-Drake's Bay drainages, the Russian, Garcia, and Napa rivers, and Putah Creek. Their establishment in important salmonid streams within the province equates to additional stress on the struggling populations by eliminating important food sources. Vinson and Baker (2008) showed that Green River trout (Utah) with NZMS in their guts had significantly poorer body conditions than those without. In feeding trials, rainbow trout fed an exclusive diet of unlimited NZMS passed 54 percent of mudsnails through the digestive tract alive and subsequently lost up to 0.48 percent of their initial body weight each day (which is nearly equal to the impact of starvation). NZMS has no known natural predators, parasites, or pathogens in California. Because there are no feasible eradication technologies, the first line of defense against New Zealand mud snail is containment and education to limit spreading populations. It is likely that freshwater ecosystems within the North Coast Range and Northern California Interior Coast Range ecoregion will be adversely affected in the future as these snail populations continue to grow. Many local and regional agencies are taking proactive efforts to prevent spread of invasive aquatic organisms. For example, Humboldt Bay Municipal Water District is trying to prevent contamination of Ruth Lake in Trinity County by requiring all watercraft be registered and inspected.

Non-native fish species like largemouth and smallmouth bass, yellow perch, sunfish, black and white crappie, yellow perch, brown and brook trout, catfish and bullhead are present in waters throughout this province. Yellow perch, brown and brook trout, and Sacramento pikeminnow are some of those that negatively affect SGCN within the province. Yellow perch compete with trout and are believed to prey upon juvenile salmonids, while brown and brook trout aggressively out-compete native trout species. Brook trout are present in many of the cold water streams and creeks within the region and CDFW has begun eradication programs to remove these fish from critical native fish habitat especially Davis and Pine Creeks (CDFW et al. 2015).

Sacramento pikeminnow are predatory fish, present in the Eel River, that eat juvenile fish and compete with adults for food (Brown and Moyle 1997). The spread of this species is especially threatening to protected northern and coastal populations of coho and Chinook salmon and steelhead. Clear Lake hitch, located in the southern part of the province, is threatened by non-native sportfish like largemouth bass (which prey upon them) and other fish like Mississippi silversides and threadfin shad (which directly compete with it for food). Further information on Clear Lake hitch is provided in Chapter 5.4 because it is found in a watershed that primarily overlaps with the Central Valley and Sierra Nevada Province. Finally, with the increase in water temperatures because of dams and climate change, more waters may see an increase in warmwater centrarchid fish populations such as sunfish and crappies and a decrease in cold water native salmon and steelhead. As these warm-water fish increase, they compete for limited food and resources with native fish.

American bullfrogs, an invasive non-native predator of California herpetofauna and many other species of fish and wildlife is a major and ongoing threat to biodiversity and continues its spread into cool coastal habitats and high elevations through dispersal and assisted dispersal by humans (van Hattem 2025). Eradicating bullfrog populations is a major component of conservation for many SGCN frogs and fish species. With the increase in water temperatures because of dams and climate change and the importation of bullfrogs for food production in California, this species has proliferated and radiated into inland waters throughout northern California. With climate change potentially warming coastal areas, bullfrog populations that are held at bay because of colder weather may proliferate in the future.

In the North Coast and Klamath Province, bullfrogs are currently a threat to sensitive species of frogs such as California red-legged frog, and fish such as the endangered coho salmon. Bullfrogs have been implicated in the spread of chytrid fungus, which has decimated native amphibian populations and continues to do so throughout California and will likely spread through the province threatening already declining populations. To combat this threat, CDFW compiles new and historic records of presence/absence of bullfrogs to characterize their range expansion and impacts to native species and to inform management opportunities and priorities.

Many of the conservation strategies identified in the following section address prevention and early eradication of new invasive plants to stop them from becoming widespread. Cal-IPC has worked with stakeholder groups in this province to identify important early eradications species, many which are widespread in other parts of the state but not yet in the north, and others (like nutria) that have the potential to move south from Oregon or northwest from the Sacramento-San Joaquin Delta. Some of these species include *Sesbania punicea, Euphorbia oblongata, Fallopia japonica, F. sachalinensis, Salvia aethiopsi, Chondrilla juncea, and Geranium lucidum*. Contact Cal-IPC for more information or refer to CalWeedMapper.

Fire and Fire Suppression

Wildfire is a natural ecosystem process and an ecologically important disturbance in the North Coast and Klamath Province. Prior to European colonization, fire events in this province were caused by lightning and Native American cultural burning practices, and both contributed to fire-adapted vegetation communities that depend on specific fire regimes. While the frequency of fire and annual acreage burned remains lower than pre-colonization levels, the size and severity of wildfires has increased since 1932 when detailed records of California's wildfire history became available.

In fire-adapted vegetation communities such as drier forests and oak woodland habitats, fires promote a mix of habitat types and successional stages. Some vegetation species and communities in this province are fire-dependent; for example, ceanothus and some other montane shrubs need fire to germinate. Some vegetation species and communities in this province are fire-enhanced; for example, California black oaks can sprout after fire and seedling establishment is promoted in open post-burn habitats. Additionally, fires create important habitat features like downed wood, hollow logs, and tree cavities and platforms serve as dens, nesting structures, and refugia for wildlife species. Fires create and maintain openings in forests and woodlands, and maintain meadow margins, providing important foraging habitat for grazers and native pollinators. Regularly occurring fire can prevent the invasion of non-native plant species, which provide suboptimal habitat for wildlife species. Fires can also prevent the encroachment of later successional species into important habitat types, such as conifer encroachment into aspen meadows.

Weather, fuels, terrain, and ignition sources determine the extent, frequency, and severity of wildfires. Due to the moist coastal climate in the Northern California Coast Ecoregion, redwood forests are believed to have naturally infrequent fire events, whereas grasslands and oak woodlands of the Northern California Interior Coast Ranges Ecoregion are believed to have had moderately frequent fire events of low intensity. The high frequency of fire in grasslands and oak woodlands prior to European colonization was due to Native American cultural burning, which occurred near villages and in areas where California Native American tribes used fire to manage the landscape for hunting and harvesting.

Over the last century, land management and development activities have altered the role of fire in the province. Fire suppression, including the removal of cultural burning on the landscape, has had important effects on the province's ecosystems. Because fires have not been allowed to burn, many areas of today's forests are denser than early 20th-century forests, and conifers have encroached on many meadow and oak woodland habitats. When fires do occur, the buildup of fuel accumulation due to fire suppression practices contributes to an increase in the size and severity of fires in many fire-adapted vegetation communities. Seven of the largest wildfires in recorded California history have occurred in the North Coast and Klamath Province in the last 20 years (CAL FIRE 2024). Most recently, the Smith River Complex Fire (2023) burned 95,107 acres in Del Norte County, The August Complex Fire (2020) burned 1,032,648 acres in Mendocino, Humboldt, Trinity, Tehama, Glenn, Lake, and Colusa counties, and the Mendocino Complex Fire (2018) burned 459,123 acres in Colusa, Lake Mendocino, and Glenn counties.

Development of roads and rural housing has expanded the wildland urban interface, which has in turn increased human-caused fire (without careful planning and implementation to achieve ecosystem goals) in localized areas. Additionally, some tree plantations, forests managed for the purpose of commercial harvest, experience more high severity fires than mixed-aged forests due to their unnatural vegetation structure (Odion et al. 2004). In some areas, these land management and development activities have altered the fire regime (frequency, severity, or type of fire) outside the range for which vegetation communities are adapted.

Furthermore, climate has a synergistic effect with landscape-scale changes that have occurred due to land management and development activities. Climate scientists project warmer and drier conditions in the coming century (Turco et al. 2023; Wasserman and Mueller 2023; Franklin and MacDonald 2024) . The combined and interacting effects of landscape scale changes such as altered fire regime, urbanization, and climate change have created an increasingly difficult challenge for managing wildlife populations and their habitats.

Livestock, Farming, and Ranching

Livestock grazing on private lands is prevalent in many portions of the province, as well as on public lands through allotments within the national forests. The effects of grazing on wildlife vary from beneficial to detrimental, depending upon how grazing is managed, including the seasonality and duration of grazing and the type and number of livestock. These effects also depend on the relative sensitivities of individual wildlife species, because not all species respond the same way to grazing. Well-managed livestock grazing can benefit sensitive plant and animal species, particularly by controlling annual grasses and invasive plants where these have become established and clearing undergrowth vegetation to create a fire-resilient landscape. These working lands are an essential part of the solution to conserving the state's wildlife.

While recognizing the values of appropriate grazing practices, the following discussion describes those situations where excessive grazing practices results in stresses to the conservation targets. Excessive grazing, as used here, refers to livestock grazing at a frequency or intensity that causes degradation of native plant communities, reduces habitat values for native wildlife species, degrades aquatic or other ecosystems, or impairs ecosystem functions.

The effects of grazing depend on rangeland management practices, including the seasonality and duration of grazing and the type and number of livestock. Livestock grazing in riparian areas can be a cause for concern because cattle congregate in these habitats, because of the proximity to water sources. Livestock trampling of stream channels results in collapse of stream banks and erosion of soils. In heavily grazed areas, cattle trails and reduced plant cover also contribute to erosion. Increased sediment in waterways can shade out aquatic plants, fill important pool habitats, and scour away or smother stream-bottom sediments that are important spawning sites and invertebrate habitats.

Livestock consume and trample riparian plants, which decreases shade and can increase water temperatures, reducing habitat for species that depend on cool water (CDFG 2004). The coastal portion of the province has historically had more than 40 percent of the river miles listed as impaired under the Federal Clean Water Act, which list grazing as one of the causes of pollution (CAL FIRE: FRAP 2003). The effects of grazing on the water quality and temperature of spring-fed seeps and waterways can also be of concern, because these spring-fed systems often support many snail and amphibian species that can be very sensitive to water quality conditions (Ricketts et al. 1999).

Excessive grazing also contributes to changes in plant communities. Annual forage grasses replace native perennial grasses, and livestock can aid the spread of invasive weeds. They also graze away emergent vegetation from ponds, removing the structure amphibians attach their eggs onto and trample eggs masses when bathing and drinking. In the province's coniferous forest lands, grazing reduces grasses and other understory plants, eliminating habitat for some wildlife species, including small mammals and birds like chipping sparrow and fox sparrow that require herbaceous cover (CA Partners in Flight 2002). Where forest understory plants are consumed by livestock, woody species may increase in density in the absence of competition. Dense woody growth limits habitat for species requiring more open-forest habitats, such as Nashville warbler and mountain bluebird (CA Partners in Flight 2002).

Logging and Wood Harvesting; Wood and Pulp Plantations

Forestry is the most widespread land use in the North Coast and Klamath Province, being the state's leading timber-producing area (CAL FIRE: FRAP 2003). There are 1.9 million acres of privately owned timber production lands in the province, the majority located in the coastal portion of the province and owned by large private timber companies (USFWS 2005). Inland, a large proportion of the province's forest lands are in public ownership. The province's five national forests (Six Rivers, Klamath, Shasta-Trinity, Mendocino, and a small portion of the Siskiyou) comprise 4.8 million acres (34 percent of the province) and are managed by U.S. Forest Service (USFS) and U.S. Bureau of Land Management (BLM). USFS is updating the Northwest Forest Plan, which is a coordinated management plan for national forests in the northwest.

Historical forest management practices resulted in significant impacts on the province's forest habitats and waterways. Regulations governing current logging practices and advances in technology have substantially improved timber-harvest practices. However, some ongoing management practices continue to adversely affect the vegetation communities and wildlife habitats of forest systems (Linnell et al. 2023). Wildlife that depends on old, closed-canopy disturbances are sensitive to forest disturbances, including timber harvest and high-severity wildfires. These disturbances can happen rapidly, and recovery can take centuries. Forests that have experienced a combination of timber harvest and fire suppression may take longer to recover to their historic state after a major disturbance, like a high-severity wildfire (Sterner et al. 2022). Historical logging practices removed over-story growth, reducing the shade that creates cool microclimates along stream channels.

Shaped by natural disturbances and variable ecological conditions, forests are characterized by a mosaic of habitat types, including stands of trees of different ages, shrub-dominated habitats, and numerous open meadows containing grasses and forbs, and wet fens. In recently disturbed areas, saplings, shrubs, and herbaceous understory vegetation are abundant. Other forest areas are dominated by large trees several centuries old and support complex habitat features like large, standing dead trees and decaying, fallen trees.

Over the last century and a half, forest management practices have included cultivation of even-aged timber stands (aka clear cutting), fire suppression, clearing of dead trees and downed wood, and road building for forest access and timber transport. Herbicide use to reduce shrub growth and shorten harvest rotations has also been employed. The cumulative effects of these practices have resulted in substantial changes in the forest habitats of the North Coast and Klamath Province, often making these forests less suitable for some wildlife communities while making them more suitable for others. There are fewer old forest areas, and second- and third-growth forests can be simplified, with reduced structural diversity and less varied habitats. Approval and implementation of large-scale conservation plans, such as Habitat Conservation Plans, Safe Harbor Agreements Candidate Conservation Agreements with Assurances, combined with third party forest certification programs, have resulted in much greater retention and recruitment of legacy forest elements on private industrial timberlands. Fire suppression and lack of harvest or thinning in areas planted for timber production result in unnaturally dense growth. This dense, woody growth can displace open-forest habitats like meadows and prevent sunlight from reaching the forest floor to support herbaceous vegetation.

Poorly constructed or maintained roads and ground disturbance resulting from timber harvest can also result in soil and surface-water runoff. High rainfall levels, steep topography, and erodible soils make many parts of the province particularly vulnerable to increased erosion and landslides. Erosion and sedimentation can have substantial consequences for aquatic systems, leading to turbidity and fine-sediment deposition that smothers spawning gravels as well as amphibian and invertebrate habitats (USFWS 2002; CDFG and Commission 2004). Headwaters amphibians like southern torrent salamanders and coastal tailed frogs need cool, clear, fast running water, and so sedimentation is a significant threat to their persistence. The addition of coarse sand, gravel, and cobble to waterways can raise stream bed levels and alter channel shape, resulting in shallower waterways and elevated temperatures. Under standards established by the National Clean Water Act, many rivers in the province (e.g., Albion, Big, Gualala, Russian, Navarro, Mattole, Eel, Van Duzen, Elk, Mad, Scott, and Trinity rivers and Freshwater, Jacoby, and Redwood creeks) are considered impaired because of excessive sediment loads and elevated temperatures that are at least partially attributable to timber harvest (SWRCB 2016). Forest roads can introduce invasive plant and animal species (Lindenmayer and Franklin 2013).

Timber harvest can fragment forest lands, with adverse effects on wildlife and ecosystems. Some species, like the varied thrush, Northern spotted owl, Northern goshawk, and Pacific fisher use a mosaic of habitat types for foraging. The Northern spotted owl in particular relies on nesting or resting sites that include a core area with unfragmented interior forest characteristics (USDA: USFS: Pacific Southwest Region 2017).

Natural and human-caused disturbances (including timber harvest) can benefit forest communities by creating canopy gaps that allow for the growth of understory vegetation and edge-habitats that are important to some of the province's wildlife species such as black-tailed deer. Some species, like Northern goshawk and Pacific fisher, depend on large, old trees for nesting or denning but forage in more open areas where herbaceous vegetation supports abundant prey species (DellaSala et al. 2004). Many songbird species nest in open-canopy mixed grass and shrub habitats, while cavity-nesting birds, like the pileated woodpecker and Vaux's swift, depend on dead trees hollowed by fire (CA Partners in Flight 2002) .

Once thought to be the major stressor on species like spotted owl, goshawk, and fisher, silviculture methods and fuels reduction that includes reducing tree density is now seen by some to be a partial solution to the devastating impacts of the large catastrophic wildfires the province has seen in the last decade (Jones et al. 2016)

Renewable Energy

Renewable energy development is increasing in the inland reaches of the North Coast and Klamath Province, although at a slower pace compared to the more populous and industrially developed regions of the state. The energy development of the northern part of the state's vast natural resources, including wind, solar, and geothermal potential, has been mostly limited to small-scale residential and agricultural solar and wind projects. Inland areas of the North Coast and Klamath Province are anticipated to have an increase in renewable energy projects over the next decade, with recent policies like the California Renewable Portfolio Standard, California Assembly Bill 205, and the Bureau of Land Management's Western Solar Plan. Such initiatives are anticipated to expand renewable energy infrastructure into more rural parts of northern California.

The expansion of renewable energy infrastructure throughout the North Coast and Klamath Province may pose significant risks to local ecosystems and biodiversity. Large-scale projects, including solar and wind farms, may lead to habitat fragmentation, displacement of species, and direct mortality, particularly of birds, bats and pollinators (Organisation for Economic Co-operation and Development 2024). It is estimated that tens to hundreds of thousands of bats die at wind turbines each year in North America alone (USGS 2020). The United States Fish and Wildlife Service notes two of California's migratory tree-roosting bat species are of particular vulnerability from wind development including the hoary bat (*Lasiurus cinereus*) and silver-haired bat (*Lasionycteris noctivagans*).

Hydroelectric developments have been found to disrupt aquatic habitats, affecting fish migration and water quality (U.S. Energy Information Administration 2022). Additionally, construction and infrastructure development may disturb sensitive plant communities and introduce non-native species, furthering the degradation and integrity of the ecological functions of our natural environments (CNPS n.d.). Increased human activity in previously undisturbed areas could also lead to disturbances like noise and light pollution and long-term habitat degradation. Without careful planning and mitigation, the increase in renewable energy infrastructure could significantly impact the region's biodiversity.

5.1.5 Climate Change

The climatic changes presented below will likely affect all conservation targets identified in this province. Climate change has only been included as a pressure for a subset of targets that are considered more vulnerable to climate impacts, and/or in instances where it was determined that interactions between climate change and other pressures could be addressed in a meaningful way through a conservation strategy.

The climate projections that follow are presented as averages across the entire province, except where otherwise indicated. While these projections provide more insight into the expected magnitude and direction of change in important climate variables compared to the statewide estimates in Chapter 2, climate change will not unfold uniformly across the province. For additional information on regional variability in climatic change and associated vulnerabilities within the north coast region of California, refer to the following resources (not an exhaustive list):

- Overview of Climate Trends and Projections for the Northern California Climate Adaptation Project (Hilberg and Kershner, 2021)
- North Coast Summary Report: California's Fourth Climate Change Assessment (Grantham 2018)
- Conserving California's Coastal Habitats: A Legacy and a Future with Sea Level Rise (Heady et al. 2018)

Temperature

Climatic changes along the Northern California Coastline, the Northern Coast Ranges, and Interior Coast Ranges are expected to include increased mean maximum temperatures of approximately 4.8°F by mid-century (2035–2064, centered on the year 2050) and 8.2°F by end-of-century (2070–2099, centered on the year 2085), compared to a historical baseline period (1961–1990); minimum temperatures are projected to increase across the province on average by 4.4°F by 2050 and 7.7°F by end-of-century (Pierce et al. 2018). Projections were generated based on a high-end greenhouse gas emissions scenario and multiple climate models (RCP 8.5).

Precipitation and Snowpack

Within the North Coast and Klamath Province, changes in annual precipitation will vary geographically, but precipitation rates are projected to slightly increase throughout the century, compared to a historical baseline (Pierce et al. 2018).

April snow water equivalent, a common measure of snowpack in California, is expected to decline across the state. In the north coast region, the April 1 extent of snow is projected to decline to 11% by end-of-century under a warm, moderate rainfall scenario (Grantham 2018).

Projected loss of snowpack in this region would suggest a potential decrease in duration and magnitude of streamflow. Non-snowmelt dominated streams in northwest California have been trending towards later stream flow timing. There could also be a shift in timing of the heaviest runoff.

Wildfire Risk

Wildfire risk is determined using several factors. Acres burned and re-burned, fire regime, and probability of ignition, are some of those factors. Over the last 20 years, approximately 41%, or 6,300,000 of 15,506,000 acres have burned and reburned in the North Coast and Klamath Province in California (2004–2023, CALFIRE FRAP fire perimeters). Most of these fires have occurred in the Klamath Mountains and Northern California Coast Ranges ecoregions, with large areas, particularly in the Klamath Mountains Ecoregion, burning multiple times. In areas that have burned at a high severity or frequency, there has been a conversion of mature forest to shrublands, in part due to inadequate funding for restoration.

Based on a climate adaptation planning analysis conducted in 2012, a "substantial increase in fire risk is expected throughout the region. Modest increases in area burned are projected for 2050. By 2100, the projected frequency of wildfire increases dramatically, eight times greater in parts of Del Norte, Humboldt, and Mendocino counties. Lake County and Northern Mendocino County are projected to have up to 2.5 times greater wildfire frequency" (CalEMA 2012).

This projection has been updated using the 2018 Cal-Adapt wildfire data from California's Fourth Climate Assessment's (Assessment) North Coast Region. A 21% increase in area burned annually is projected from 2025 to the mid-century average (2035-2064), and a 45% increase is projected by the end-century average (2070-2099). By 2100, the projected average annual wildfire probability is not expected to increase throughout the Assessment's North Coast Region; however, the probability is expected to increase in localized areas of Del Norte County, and parts of the Northern California Coast Ranges, Northern California Interior Coast Ranges, and Klamath Mountains ecoregions. Based on these datasets, wildfire will continue to significantly affect fish and wildlife and their habitats in the North Coast and Klamath provinces for the foreseeable future.

Based on Assessment data, annual area burned within the footprint of this province is expected to increase by approximately 59% by mid-century and 121% by the end of the century under a high-end emissions scenario, compared to a 1961–1990 baseline (Westerling 2018).

Sea Level Rise

Along the coast, mean sea level will continue to rise. California recently updated its sea level rise projections for the next century, resulting in five plausible scenarios that encompass a range of possible futures for the state. At a local scale, sea level rise projections were generated for a series of NOAA tide gauges along the coast. Below are projections for the tide gauges located within the North Coast and Klamath Province (CA OPC 2024). These projections are relative to a 2000 baseline and incorporate local estimates of vertical land motion.

- Crescent City: 0.1–0.8ft (by 2050); 0.2–5.6ft (by 2100)
- North Spit: Humboldt Bay: 0.9–1.6ft (by 2050); 1.8–7.3ft (by 2100)
- Arena Cove: 0.4–1.1f (by 2050); 0.8–6.4ft (by 2100)
- Point Reyes 0.5–1.3ft (by 2050); 1.0–6.6ft (by 2100)

5.1.6 Conservation Strategies

SWAP 2025 presents target habitats with their associated conservation strategies, including strategy objectives and targeted pressures, for the North Coast and Klamath Province. Actions that were identified for specific conservation units are listed with the strategy. Table 5.0 summarizes conservation targets for the province.

Target: North Coastal and Montane Riparian Forest and Woodland

These riparian forests occur along the major rivers and streams in the outer and middle North Coast Ranges, and along the foothill and lower montane reaches of rivers and streams. Predominant vegetation includes red alder, white alder, and shining willow. Most of stands are surrounded by cool temperate coniferous forest either from the coastal belt or the mid elevation montane coniferous belt. A few species of conifers may intermix with the deciduous dominants. These include redwood, Douglas-fir, Sitka spruce, grand fir, and western hemlock in the north coastal stands, while ponderosa pine, incense-cedar, white fir, and red fir may mix with the montane stands.

Conservation Strategy 1 (Outreach and Education): Provide outreach and education for the conservation of natural resources

Objective(s):

- Educate CDFW staff, local agencies, and the public on the value of riparian habitats and the impacts to the system, including invasive issues
- Co-develop a comprehensive invasive eradication and control outreach plan
- Coordinate with CDFW invasive program, Non-governmental Organizations (NGOs), local landowners, and local/federal agencies
- Provide the public with information about the negative impacts on fish and wildlife and their habitats associated with illegal cannabis cultivation

Targeted pressure(s): Invasive plants/animals; housing and urban areas

Conservation Strategy 2 (Direct Management): Habitat restoration and enhancement

Objective(s):

- Recover ecological function of keystone species; where appropriate allow beaver colonies to persist for benefit of riparian habitat
- Remove or setback levees to facilitate habitat restoration

Targeted pressure(s): Strategy acts directly on target

Conservation Strategy 3 (Direct Management): Develop buffers along major rivers and streams

Objective(s):

- Create riparian buffers along rivers and streams

Targeted pressure(s): Housing and urban areas; annual and perennial non-timber crops; logging and wood harvesting; Livestock, farming, and ranching.

Conservation action(s):

- Redesignate buffers as natural resource zones in county general plans and encourage adoption of riparian buffer policies by cities and municipalities.
- Revisit CA Forest Practice Rules and riparian protection policies

Conservation Strategy 4 (Law and Policy): Develop CDFW Riparian Conservation Policy

Objective(s):

- Conserve riparian habitats and create CDFW policy for their conservation

Targeted pressure(s): Livestock, farming, and ranching; annual and perennial non-timber crops; logging and wood harvesting

Conservation action(s):

- Change CDFW or state regulations to have harsher penalties for environmental impacts resulting from cannabis cultivation activities
- Deter water diversions from streams and creeks that impact riparian vegetation
- Deter peat collection from fens

Conservation Strategy 5 (Management Planning): Improve implementation of grazing best management practices (BMPs)

Objective(s):

- Improve the condition of riparian habitat by improving grazing management techniques (i.e., fenced buffers with discrete watering lanes or off channel watering) and reducing the impact from improper grazing practices
- Increase implementation of appropriate grazing BMPs on private lands

Targeted pressure(s): Livestock, farming, and ranching; housing and urban areas

Conservation action(s):

- Coordinate with National Resource Conservation Service (NRCS)
- Coordinate with California State Water Resources Control Board (SWRCB) for Total Maximum Daily Loads (TMDL)
- Coordinate with California Cattleman's Association, the California Farm Bureau Federation, and federal lands permittees
- Develop and utilize recommendations for use in CEQA and other land use trustee and responsible agency engagement where appropriate.

Conservation Strategy 6 (Partner Engagement): Develop Riparian and Wetlands Task Force

Objective(s):

- Compile CDFW expertise to find solutions for statewide resource conservation issues
- Improve the CDFW riparian conservation approaches so that they are more scientifically sound

Targeted pressure(s): Strategy acts directly on target.

Conservation action(s):

- Involve CDFW's Science Institute

Conservation Strategy 7 (Partner Engagement): Coordinate with Regional Conservation Districts (RCDs), flood control agencies, counties, cities, and watershed groups/councils, and tribal governments

Objective(s):

- Restore natural riverine floodplains, currently being used for grazing and farming, by reconnecting the river to the floodplain; pool resources, funding and expertise to ensure success of this process
- Gather support for the process with multi-agency collaboration and partnerships
- Streamline processes such as the Incidental Take Permitting, California Environmental Quality Act (CEQA) review, Coastal Development Permitting, and grant funding
- Educate stakeholders
- Consider funding for watershed coordinator positions through Fisheries Restoration Grant Program or other sources

Targeted pressure(s): Dams and water management/use

Conservation action(s):

- Work with NRCS and Fisheries Restoration Grant Program

Conservation Strategy 8 (Land Acquisition/Easement/Lease): Implement Santa Rosa Plain Conservation Strategy and Santa Rosa Plain Recovery Plan; Utilize potential and existing conservation lands, including banks, mitigation sites and other public and private lands to develop and implement conservation actions and management plans for SGCN that inhabit grassland habitats, vernal pools and associated habitats on the Santa Rosa Plain

Objective(s):

- Implement Santa Rosa Plain Conservation Strategy and the Santa Rosa Plain Recovery Plan

Targeted pressure(s): Housing and urban areas; Annual and perennial non-timber crops; commercial and industrial areas

Conservation action(s):

- Develop and implement conservation actions, land acquisition and management plans as part of the Santa Rosa Plain Conservation Strategy and Santa Rosa Plain Recovery Plan

Target: Freshwater Marsh

This vegetation type consists of freshwater emergent marshes and coastal/tidal marshes and meadows. It can be found surrounding streams, rivers, lakes, and wet meadows. These habitats occur on virtually all exposures and slopes, provided a basin or depression is saturated or at least periodically flooded. Dominant species are generally perennial monocots including graminoids such as rushes, reeds, grasses, and sedges. Dominant species include common reeds, hardstem bulrush, small-fruited bulrush, water parsley, slough sedge, soft rush, salt rush, and pacific silverweed.

Conservation Strategy 1 (Outreach and Education): Provide outreach and education

Objectives:

- Influence public awareness of proper land management for freshwater marshes by providing information to landowners regarding BMPs and proper wetland management
- Coordinate with local landowners to determine what conservation efforts they are engaged with and determine how CDFW may assist in their efforts

Targeted pressure(s): Livestock, farming, and ranching

Conservation action(s):

- Target Buckeye Conservancy and RCDs
- Design and produce brochures with wetland conservation messages
- Employ web-based media to provide information to public

Conservation Strategy 2 (Land Acquisition/Easement/Lease): Purchase land and conservation easements

Objective(s):

- Improve land management by removing invasive species and creating better grazing practices

Targeted pressure(s): Livestock, farming, and ranching; annual and perennial non-timber crops

Conservation action(s):

- Prioritize this target in acquisitions and conduct Environmental Site Assessment

Conservation Strategy 3 (Law and Policy): Advocate for laws and policies

Objective(s):

- Strengthen regulatory authority over wetlands, protecting from runoff, pollution and development
- Integrate beaver ecology into wetland restoration activities

Targeted pressure(s): Livestock, farming, and ranching; annual and perennial non-timber crops

Conservation action(s):

- Evaluate and update Wetlands Policy
- Implement wetland and riparian technical memorandum
- Implement new CDFW policy on beaver restoration
- Update wetlands implementation policy

- Conservation Strategy 4 (Management Planning): Develop management plans

Objective(s):

- Develop BMPs for ecosystem and invasive species management on CDFW lands
- BMPs would provide guidance on managing CDFW lands for multi-species use and benefit both recreation and conservation of native species

Targeted pressure(s): Invasive plants/animals; livestock, farming, and ranching; annual and perennial non-timber crops

Conservation action(s):

- Revise CDFW Land Management Plan (LMP) guidelines to include ecosystem management
- Update LMPs to be consistent with new guidelines for managing at an ecosystem level
- Develop policy on ecosystem management on public lands

Conservation Strategy 5 (Economic Incentives): Provide economic incentives for improved resource management

Objective(s):

- Provide economic incentives through restoration grants

Targeted pressure(s): Livestock, farming, and ranching; annual and perennial non-timber crops

Conservation action(s):

- Coordinate with Watershed Councils, NRCS, RCDs, and California Farm Bureau Federation to advertise grant opportunities

Target: Pacific Northwest Conifer Forests

Restricted to coastal areas. All variations of topography, from gradual elevational changes to steep, abrupt mountain ranges that are common in the central north coast. Dominant tree species include: grand fir, redwood, red alder, and Douglas-fir. Western red cedar western hemlock, and Sitka spruce are also associates, but rarely compose the major portion of a stand.

Conservation Strategy 1 (Data Collection and Analysis): Conduct research (data management) on conifer forest ecosystems and response to fire

Objective(s):

- Research efficacy of different techniques to manage forest and reduce catastrophic fire
- Study and document the post-fire wildlife response and the response of wildlife to different logging systems
- Document baseline conditions and monitor trends of the conifer forests ecosystem and trends of target SGCN using occupancy as a metric
- Conduct post-fire monitoring and prevention of invasive species invasion

Targeted pressure(s): Invasive plants/animals; introduced genetic material; climate change

Conservation Strategy 2 (Outreach and Education): Provide outreach and education

Objective(s):

- Provide information to the public on invasive species identification and management, grazing BMPs, and wildlife-friendly land use policies
- Increase public awareness of the values of intact redwood habitats
- Recruit public participation in monitoring invasive species and rapid response
- Coordinate with local landowners to determine what conservation efforts they are engaged with and determine how CDFW may assist in their efforts

Targeted pressure(s): Invasive plants/animals; introduced genetic material

Conservation Strategy 3 (Direct Management): Manage invasive species

Objective(s):

- Reduce the spread of invasive species in redwood habitat; This reduction should include active management and control (i.e., treating disturbed soil to prevent establishment of invasive species).

Targeted pressure(s): Invasive plants/animals

Conservation action(s):

- Coordinate with California Invasive Plant Council (CalIPC)
- Work with California Department of Forestry and Fire Protection (CAL FIRE) to monitor post-harvest sites
- Identify acceptable herbicides

Conservation Strategy 4 (Management Planning): Advocate for wildlife-friendly fire management

Objective(s):

- Develop policies to reduce invasive species during post-fire treatment
- Restore native vegetation to ensure fire resistance in target vegetation.

Targeted pressure(s): Invasive plants/animals; agricultural and forestry effluents

Conservation action(s):

- Coordinate with fire agencies to develop BMPs for active and post-fire treatment
- Develop comprehensive sage habitat map identifying quality and recommended action during fire

Conservation Strategy 5 (Management Planning): Provide input on project planning and decision-making process, by leading or participating in land use planning for rural, urban, or agricultural lands (e.g., provide input on local land use plans), developing county-wide zoning plans, and participating in workgroup regarding low impact development siting

Objective(s):

- Participate in planning and decision-making processes to ensure that redwood habitat is conserved
- When Caltrans is currently implementing BMPs, look for opportunities for alignment of BMPs through the implementation of SWAP strategies and existing processes such as those in place at Caltrans

Targeted pressure(s): Parasites/pathogens/diseases; logging and wood harvesting; roads and railroads.

Conservation Strategy 6 (Management Planning): Develop management plans for the conservation of natural resources.

Objective(s):

- Improve existing fire management plans to include use of fire for habitat improvements and identify high value wildlife habitat

Targeted pressure(s): Strategy acts directly on target

Conservation action(s):

- Engage USFWS about listed species and management indicator species
- Identify high value forested wildlife habitats

Conservation Strategy 7 (Partner Engagement): Partner with USFS, NRCS, The Nature Conservancy (TNC), Western Klamath Restoration Partnership, Mendocino Firescape, tribal governments, and others for joint advocacy.

Objective(s):

- Influence management of federal lands with partnerships

Targeted pressure(s): Parasites/pathogens/diseases; logging and wood harvesting

Conservation action(s):

- Coordinate with USFS on forest plan revisions and other landscape level planning efforts, when appropriate
- Coordinate with partners to prevent intense wildfires to protect wildlife habitat, water quality, and recreation opportunities
- Collaborate with Western Klamath Restoration Partnership and Mendocino Firescape on landscape level planning efforts that overlap with SWAP strategies
- Advocate for appropriate grazing practices
- Review existing ranching and grazing BMPs

- Partner and advocate for reducing rodenticide use
- Work with NRCS, BLM, USFS, California Cattleman's Association, California Farm Bureau Federation, and landowners to modify BMPs, as needed
- Incorporate use of BMPs into CEQA comment letters
- Identify key private landowners to whom outreach is directed
- Advocate prescribed burns
- Advocate for post burn weed control
- Coordinate with local Air Quality Management Districts to consider ways to allow for more prescriptive burn days

Conservation Strategy 8 (Training and Technical Assistance): Provide training on invasive species management

Objective(s):

- Train regional staff and managers on invasive species management and control techniques
- Provide regular annual training for CDFW staff and make training available to other agencies, non-governmental organizations and consultants

Targeted pressure(s): Introduced genetic material; invasive plants/animals.

Target: Pacific Northwest Subalpine Forest

Occurs on ridges and rocky slopes around timberline in northern California. Include montane conifer forests and woodlands adapted to very high winter snowfall, from montane to subalpine altitudes. Characterized by short, cool summers, rainy autumns and long, cool, wet winters with heavy snow cover for 5-9 months. The heavy snowpack is ubiquitous and is required for soil moisture by many of the tree species. Dominant tree species include red fir, western hemlock, western white pine, and lodgepole pine.

Conservation Strategy 1 (Data Collection and Analysis): Collect more information on climate-related impacts to species and habitats in the red fir/subalpine zone, to better predict future distribution and viability and inform land acquisition and other strategies

Objective(s):

- Identify clear management needs and outcomes with input from relevant data users
- Conduct research that provides answers to relevant questions, allows appropriate audiences to access data, develops and provides recommendations for conservation actions, and uses data to inform conservation actions

Targeted pressure(s): Fire and fire suppression; climate change

Conservation Strategy 2 (Data Collection and Analysis): Collect data to evaluate effects of fuels treatments in the red fir zone, and whether treatments can partly offset climate-related increases in fire severity

Objective(s):

- Identify clear management needs and outcomes with input from relevant data users
- Conduct research that provides answers to relevant questions, allows appropriate audiences to access data, develops and provides recommendations for conservation actions, and uses data to inform conservation actions

Targeted pressure(s): Fire and fire suppression

Conservation Strategy 3 (Economic Incentives): Develop economic incentives to reduce greenhouse gas emissions within California

Objective(s):

- Develop and provide economic incentives to reduce greenhouse gas emissions in California

Targeted pressure(s): Climate change

Conservation Strategy 4 (Land Use Planning): Provide input on local land use plans regarding the conservation of natural resources

Objective(s):

- CDFW provides input to local land use planners on land use plans
- Land use plan is approved and consistent with the input provided by CDFW
- Plans are implemented in a manner that is consistent with the CDFW input

Targeted pressure(s): Fire and fire suppression

Conservation Strategy 5 (Direct Management): Implement fuels treatments in red fir, if determined to be effective (see "Data Collection and Analysis")

Objective(s):

- Management actions are implemented
- *Targeted pressure(s):* Fire and fire suppression

Conservation Strategy 6 (Management Planning): Develop or update management plans to integrate the effects of climate change

Objective(s):

- Clear management needs and outcomes that have been identified with input from relevant data users

- Management plans include appropriate strategies, action and monitoring plan for SGCN, habitats, and natural processes
- Appropriate audiences are accessing data

Targeted pressure(s): Fire and fire suppression

Conservation Strategy 7 (Partner Engagement): Establish partnership to co-monitor target habitat on state and federal lands

Objective(s):

- Develop a mutually agreed upon partnership and monitoring strategy and monitoring is implemented

Targeted pressure(s): Fire and fire suppression

Conservation Strategy 8 (Environmental Review): Review projects for potential increases in greenhouse gas emissions; require mitigation as needed

Objective(s):

- Input on environmental review document is provided.
- An environmental review document is approved that is consistent with the input provided
- The plan is implemented in a manner that is consistent with the input and the behavior of local entity is consistent with input

Targeted pressure(s): Climate change.

Conservation Strategy 9 (Training and Technical Assistance): Provide science-based applications and tools for climate change and natural resources management

Objective(s):

- Target audience (land managers) that were trained have knowledge consistent with the training
- Target audience (land managers) have adopted or continued actions consistent with the training

Targeted pressure(s): Livestock, farming, and ranching; invasive plants/animals

Conservation action(s):

- Identify priority list of invasive species

Target: California Foothill and Valley Forests and Woodlands

Includes all Mediterranean climate woodlands and forests in California from sea level to the point where snow and frost in combination with high winter precipitation enables cool temperate species of trees to dominate the overstory layer. These forests and woodlands are composed of tree species largely adapted and endemic to the warm, dry summers, and cool rainy winters of California's Mediterranean climate, including foothill oak-riparian, oak-conifer, pine-cypress, and juniper vegetation types. Coastal oak woodlands are primarily dominated by coast live oak, California bay, Shreve oak, and Engelmann Oak. Foothill oak woodland stands are either dominated by valley oaks, blue oaks, blue oak-foothill pine mixes, valley oak –riparian mixes, or montane hardwoods such as California buckeye, California bay, and California walnut. The coniferous component within the broad habitat category consists of closed cone pine-cypress dominant and juniper dominant vegetation types. Dominant cypress species include McNabe cypress, Monterey cypress, and Sargent cypress. Dominant pines include knobcone pine and foothill pine.

Conservation Strategy 1 (Economic Incentives): Provide economic incentives for improved resource management

Objective(s):

- Provide economic incentives to landowners for managing grazing at appropriate residual dry matter (RDM)

Targeted pressure(s): Fire and fire suppression; livestock, farming, and ranching; invasive plants/animals

Conservation Strategy 2 (Direct Management): Conduct ecologically sound prescribed burns on CDFW lands

Objective(s):

- Conduct ecologically sound prescribed burns on CDFW lands

Targeted pressure(s): Fire and fire suppression

Conservation Strategy 3 (Direct Management, Outreach and Education): Conduct demonstration management, including providing public demonstrations of successful BMPs and scientifically documenting environmental change from implementation of BMPs

Objective(s):

- Provide public demonstrations of successful BMPs and scientifically document environmental change from BMP implementation

Targeted pressure(s): Livestock, farming, and ranching; invasive plants/animals

Conservation Strategy 4 (Land Acquisition/Easement/Lease): Purchase and provide long-term conservation of land

Objective(s):

- Provide long-term conservation to land purchased

Targeted pressure(s): Livestock, farming, and ranching; invasive plants/animals

Conservation Strategy 5 (Land Acquisition/Easement/Lease): Protect land through conservation easements

Objective(s):

- Protect land through conservation easements

Targeted pressure(s): Livestock, farming, and ranching; invasive plants/animals

Conservation Strategy 6 (Outreach and Education): Provide outreach and education for the conservation of natural resources

Objective(s):

- Work with landowners and allotment lessees to implement BMPs for grazing
- Inform public of incentive programs available to them
- Educate recreation-focused landowners on wildlife BMPs
- Grazing fees will be used to provide funding for recreation use)
- Keep CDFW staff current on relevant science such as restoration techniques and science
- Coordinate with local landowners to determine what conservation efforts they are engaged with and determine how CDFW may assist in their efforts

Targeted pressure(s): Livestock, farming, and ranching

Conservation Strategy 7 (Partner Engagement): Establish partnerships to enhance conservation opportunities

Objective(s):

- Develop partnerships with agencies, organizations, and tribal governments to enhance conservation opportunities; Current partnerships include BLM, Resource Conservation Districts, UC Davis, Audubon Society, Blue Ridge-Berryessa Partnership.

Targeted pressure(s): Recreational activities; invasive plants/animals; livestock, farming, and ranching

Target: Alpine Vegetation

Limited to the highest elevations and generally above timberline on slopes and ridgelines, on the highest peaks of the Klamath Range. Characteristic species are either herbaceous (many are cushion plants, some tufted or rhizomatous graminoids) or low prostrate or dwarf shrubs. Different groups segregate based on substrate type (scree, talus, felfield) and moisture regime (snowbank, felfield, etc.). Common shrubs occurring are creambush, oceanspray, Greene goldenweed, and mountain white heather. Felfield indicators include alpine reedgrass, Congdon sedge, alpine goldenbush, and Phlox species, among others. Alpine turf indicators include dwarf willows, dwarf huckleberry, Muir's hairgrass, and several sedges.

Conservation Strategy 1 (Data Collection and Analysis): Gather more information on alpine habitat requirements and impacts of climate change on the plant community and its KEAs, specifically in the North Coast and Klamath Province

Objective(s):

- Provide answers to relevant questions
- Information is obtained on macrogroup habitat requirements and impacts from climate change on the macrogroup and KEAs specifically in the Klamath/Cascade regions. Information on KEAs needed include soil moisture and regime and area requirements of target alpine vegetation as a whole; snowpack levels and snow cover period requirements including minimal seasonality and weather regimes required to maintain target vegetation; changes in the above KEAs; and area and extent of macrogroup in relation to current weather changes from climate change.
- Appropriate audiences access information and data is used to inform conservation actions; Data is used to inform state and federal land managers; land managers develop conservation strategies to reduce any pressures to macrogroup habitat that may be cumulative to climate change (e.g., recreation, grazing)

Targeted pressure(s): Climate change

Conservation action(s):

- Develop conservation strategies to reduce any pressures on alpine habitat that may be cumulative with adverse effects of climate change (e.g., recreation, grazing)

Conservation Strategy 2 (Outreach and Education): Engage urban citizens, educate grade school children on climate change, and expand conservation education programs to include climate change and solutions to reduce impacts such as reducing greenhouse gas emissions

Objective(s):

- Target audience receives the message
- Target audience has desired attitudes and values
- Target audience continues the desired behavior

Targeted pressure(s): Climate change; livestock, farming, and ranching; invasive plants/animals; recreational activities

Conservation Strategy 3 (Economic Incentives): Develop economic incentives to reduce greenhouse gas emissions within California

Objective(s):

- Economic incentive is developed, provided and implemented in a manner that is consistent with design
- Desired pressure reduction is seen

Targeted pressure(s): Climate change

Conservation Strategy 4 (Direct Management): Restore subalpine and alpine meadows, including restoration or enhancement of degraded habitats, monitoring populations, fencing for protection and removing barriers to species movement

Objective(s):

- Management actions are implemented

Targeted pressure(s): Climate change; livestock, farming, and ranching; recreational activities; invasive plants/animals

Conservation action(s):

- Prioritize restoration of subalpine and alpine meadows
- Remove non-native or invasive species
- Add fencing to restrict livestock and human access to sensitive areas
- Consider retirement of grazing allotments on state-controlled lands
- Add BMPs for assisting vegetation shift from impending climate change

Conservation Strategy 5 (Direct Management): Manage grazing and invasive species by removing trails, restricting grazing and pack animal use of subalpine and alpine meadows on public lands, removing campground use away from subalpine and alpine meadows, and removing invasive species

Objective(s):

- Management actions are implemented

Targeted pressure(s): Livestock, farming, and ranching; invasive plants/animals; recreational activities

Conservation action(s):

- Add BMPs for assisting vegetation shift from impending climate change
- Consider retirement of grazing allotments on state-controlled lands

Conservation Strategy 6 (Management Planning): Develop or update management plans to integrate the effects of climate change

Objective(s):

- Information is obtained on local climate change impacts to the target alpine vegetation; More information is obtained on local impacts of climate change and on the management actions that exacerbate climate change impacts to KEAs
- Management plans include appropriate strategies, actions and monitoring plans for SGCN, habitats, and natural processes; Plan recommendations (management strategies, and action and monitoring plans) are developed for SGCN, habitats, and natural processes
- Plan recommendations are being used to inform conservation actions; Conservation strategies are implemented based on research into KEAs and climate change impacts to macrogroup habitat to reduce any pressures to macrogroup habitat that may be cumulative to climate change (e.g., recreation and grazing)

Targeted pressure(s): Climate change; recreational activities; livestock, farming, and ranching; invasive plants/animals

Conservation Strategy 7 (Partner Engagement): Establish partnerships to co-monitor target on state, federal, and tribal managed lands to 1) establish decision-making processes with other public and private entities (including tribal governments) to determine or implement strategies, 2) convene an advisory committee to assist with implementation of strategies, and 3) engage university students in research

Objective(s):

- After engaging with the partner, a mutually agreed upon partnership and monitoring strategy is developed
- After engaging with the partner, monitoring is implemented

Targeted pressure(s): Climate change; livestock, farming, and ranching; invasive plants/animals; recreational activities

Conservation Strategy 8 (Training and Technical Assistance): Provide training on science-based applications and tools. Provide science-based applications and tools for climate change and natural resources management

Objective(s):

- Target audience (land managers) that were trained have knowledge consistent with the training
- Target audience (land managers) have adopted or continue actions consistent with the training

Targeted pressure(s): Climate change; livestock, farming, and ranching; invasive plants/animals; recreational activities

Target: Wet Mountain Meadow; Fen (Wet Meadow); Mountain Riparian Scrub and Wet Meadow; Subalpine Aspen Forests and Pine Woodlands (Meadows); Western Upland Grasslands

Wet Mountain Meadow: Typical of low-lying sites in the mountains and in some lower elevation valleys and depressions; Widespread throughout the state wherever freshwater meadows and seeps occur. Saturated soil or standing water through the growing season are key characteristics. Wet mountain meadows are generally characterized by herbaceous plants with shrubs or trees absent or sparse (<20 percent cover), or along the edges. Most species are perennial, and canopy cover is generally dense (60-100 percent).

Fen (Wet Meadow): Fens are hydrologically and chemically unique wetlands, which are typically nutrient-poor and support many endemic vascular and non-vascular plants (mostly mosses). In California, fens are typically small in size and occur in the Sierra, Klamath, and Cascade ranges and the north coast. Characteristic plants include both low woody shrubs such as laurel, bog Labrador tea, as well as specialized carnivorous herbs such as pitcher plant, sundew, and bladderworts, along with many species of rushes, sedges, grasses and mosses.

Mountain Riparian Scrub and Wet Meadow: Typical of low-lying sites in the mountains and in some lower elevation valleys and depressions. Widespread throughout the state wherever freshwater meadows and seeps occur. Saturated soil or standing water through the growing season are key characteristics. Wet mountain meadows are generally characterized by herbaceous plants with shrubs or trees absent or sparse (<20 percent cover), or along the edges. Most species are perennial, and canopy cover is generally dense (60-100 percent).

Subalpine Aspen Forests and Pine Woodlands: This vegetation type represents the cold but less snowy subalpine areas of the Klamath Mountain ranges. This vegetation type includes higher elevation forested stands dominated by aspen, subalpine conifer, and lodgepole pine. Aspen stands are limited to cooler, riparian drainages at mid to high elevation in montane regions. Small stands are scattered generally north and westward into northern Trinity and western Siskiyou Counties. Conifer habitats are dominated by lodgepole pine, Engelmann spruce, subalpine fir, foxtail pine, and whitebark pine.

Western Upland Grasslands: Dominated by grasses, which are typically not restricted to moisture surrounding landscape (not seeps, riparian, or wet meadows). Dominant vegetation generally includes native grasslands of Idaho fescue, Great Basin wild rye, blue wild rye, one-sided bluegrass. It also includes the non-native grasslands that are from cool temperate settings in Eurasia such as creeping bentgrass, velvetgrass, Kentucky bluegrass, and Harding grass, and cheat-grass.

Conservation Strategy 1 (Data Collection and Analysis): Conduct comprehensive ecological assessment (research) and evaluate climate effects on aspen meadows

Objective(s):

- Study and understand the wildlife response in the aspen community to management and restoration of aspen meadows
- Delineate aspen meadows within the ecoregion

Targeted pressure(s): Fire and fire suppression; climate change

Conservation Strategy 2 (Data Collection and Analysis): Gather and analyze data regarding aspen meadows and wildlife.

Objective(s):

- Complete baseline inventory of aspen meadows within ecoregion

Targeted pressure(s): Fire and fire suppression

Conservation Strategy 3 (Outreach and Education): Provide outreach and education for the conservation of natural resources

Objective(s):

- Ensure forest professionals, students, and the public are more knowledgeable about forest practices that benefit wildlife
- Provide best available science and strategies to landowners when opportunities present themselves
- Develop and maintain CDFW website
- CDFW staff should attend workshops, symposia, online meetings and trainings, and other forums to identify shortcomings and strategies

Targeted pressure(s): Fire and fire suppression; logging and wood harvesting.

Conservation Strategy 4 (Law and Policy): Advocate for laws and policies that protect natural resources

Objective(s):

- Standardize BMPs developed for management of aspen-wet meadows that build on current guidelines and include a monitoring component
- Develop and implement policies that benefit forest maturation with the Board of Forestry

- Approve and implement policies that benefit management of aspen-wet meadows
- Policies eliminate barriers to management (i.e., Forest Practice Regulations [FPRs])
- Develop timber harvest cumulative-impact standards for each watershed or group of adjacent watersheds to protect aquatic ecosystems and conserve wildlife habitat
- Policies adopt a "no net loss" policy for critical habitat
- Devote CDFW staff to engaging the appropriate decision-making agencies and boards

Targeted pressure(s): Fire and fire suppression

Conservation action(s):

- Change Fish and Game Code (FGC) and/or California Code of Regulations to have harsher penalties for environmental impacts resulting from cannabis cultivation activities
- Work to develop cumulative impacts standards
- Develop no-net-loss policy for meadow aspen

Conservation Strategy 5 (Direct Management): Implement habitat restoration and enhancement of aspen meadows

Objective(s):

- Restore aspen meadows through active management
- Remove encroaching conifer trees greater than 18 inches diameter at breast height from aspen meadows
- Use managed thinning or conduct prescribed burns

Targeted pressure(s): Fire and fire suppression; climate change

Conservation action(s):

- Inventory aspen meadows, evaluate condition, establish baseline
- Coordinate with USFS, CAL FIRE, NGOs and private landowners

Conservation Strategy 6 (Environmental Review): Conduct environmental review, maintain devotion of staff to environmental review of CEQA projects, and enhance staffing levels to commit to environmental review of National Environmental Policy Act (NEPA) projects on federal lands

Objective(s):

- Improve CDFW staffing capacity through redirected or new positions to allow participation in state and federal environmental review

Targeted pressure(s): Logging and wood harvesting

Conservation action(s):

- Develop statewide management and implementation strategy

Conservation Strategy 7 (Partner Engagement): Partner for joint advocacy by establishing partnership for privately and tribal managed lands and decision-making processes with other public and private entities, including tribal governments

Objective(s):

- Form partnerships between agencies and landowners that benefit wildlife on timberlands
- Agencies and landowners jointly implement projects that benefit wildlife

Targeted pressure(s): Fire and fire suppression; logging and wood harvesting

Target: Subalpine Aspen Forests and Pine Woodlands (Mature Conifer Forest)

This vegetation type represents the cold but less snowy subalpine areas of the Klamath Mountain ranges; higher elevation forested stands dominated by aspen, subalpine conifer, and lodgepole pine. Aspen stands are limited to cooler, riparian drainages at mid to high elevation in montane regions. Small stands are scattered generally north and westward into northern Trinity and western Siskiyou Counties. Conifer habitats are dominated by lodgepole pine, Engelmann spruce, subalpine fir, foxtail pine, and whitebark pine.

Conservation Strategy 1 (Data Collection and Analysis): Conduct comprehensive ecological assessment (research) on target, particularly aspen, meadows

Objective(s):

- Delineate mature forests
- Increase and understand wildlife use of restored mature forests

Targeted pressure(s): Fire and fire suppression

Conservation Strategy 2 (Data Collection and Analysis): Gather and analyze data on subalpine aspen forests and pine woodlands (mature conifer forest)

Objective(s):

- Study the area and extent of baseline inventory of mature forests to inform fire management decisions

Targeted pressure(s): Fire and fire suppression

Conservation Strategy 3 (Outreach and Education): Provide outreach and education.

Objective(s):

- To increase the knowledge in forest professionals, students, and the public about forest practices that benefit wildlife
- Provide best available science and strategies to landowners when opportunities present themselves
- Develop and maintain CDFW website
- CDFW attend workshops, symposia, online meetings and trainings, and other forums to identify shortcomings and strategies
- Enlist professional foresters to conduct outreach at elementary and high schools, junior and undergraduate colleges, and other educational formats

Targeted pressure(s): Fire and fire suppression; logging and wood harvesting

Conservation Strategy 4 (Law and Policy): Advocate for laws and policies that protect natural resources

Objective(s):

- Develop and implement standardized BMPs for management of mature forests that built on current guidelines and include a monitoring component. Build on current guidelines and include monitoring component
- Approve and implement policies that benefit management of mature forests
- Policies eliminate barriers to management (i.e., FPRs)
- Develop timber harvest cumulative-impact standards for each watershed or group of adjacent watersheds to protect aquatic ecosystems and conserve wildlife habitat
- Policies will adopt a "no net loss" policy for critical habitat
- Devote CDFW staff to engaging the appropriate decision-making agencies and boards

Targeted pressure(s): Fire and fire suppression

Conservation action(s):

- Work to develop cumulative impacts standards
- Develop no-net-loss policy for meadow aspen

Conservation Strategy 5 (Direct Management): Implement habitat restoration and enhancement of aspen meadows.

Objective(s):

- Restore mature forests through active management
- Remove encroaching conifer trees greater than 18 inches diameter at breast height from aspen meadows
- Use managed thinning or conduct prescribed burns

Targeted pressure(s): Fire and fire suppression

Conservation action(s):

- Inventory aspen meadows, evaluate condition, establish baseline
- Coordinate with USFS, CAL FIRE, NGOs, and private landowners

Conservation Strategy 6 (Partner Engagement): Partner for joint advocacy with public and private sectors, including tribal governments

Objective(s):

- Form partnerships between agencies and landowners that benefit wildlife on timberlands
- Participate in the Fire Learning Network, and develop partnerships with USFS, California Native American tribes, Fire Safe councils, and others planning landscape level restoration activities
- Agencies and landowners jointly implement projects that benefit wildlife

Targeted pressure(s): Fire and fire suppression; logging and wood harvesting

Conservation Strategy 7 (Environmental Review): Conduct environmental review, maintain devotion of staff to environmental review of CEQA projects, and enhance staffing levels to commit to environmental review of NEPA projects on federal lands

Objective(s):

- Improve staffing capacity to participate in state and federal environmental review

Targeted pressure(s): Logging and wood harvesting

Conservation action(s):

- Statewide management and implementation strategy

Target: Montane Upland Deciduous Scrub

Characteristic species include drought or winter deciduous montane chaparral species. Dominant species include deer brush ceanothus, Garry oak, bitter cherry, chokecherry, basket bush sumac, and oak gooseberry. Any of these species may be dominated under various environmental regimes. Understory vegetation in the mature stages is generally largely absent. Various grasses and forbs grow in interstitial spaces sparsely or moderately depending on shrub type. Conifer and oak trees such as Ponderosa pine, canyon oak, and live oak may occur in sparse stands or as scattered individuals within the chaparral type.

Conservation Strategy 1 (Outreach and Education): Provide outreach and education for the conservation of natural resources

Objective(s):

- Increase knowledge of forest professionals, students, and the public about forest practices that benefit wildlife
- Provide the best available science and strategies to landowners when opportunities present themselves
- Develop and maintain CDFW website
- Have CDFW staff attend workshops, symposia, online meetings and trainings, and other forums to identify shortcomings and strategies
- Enlist professional foresters to conduct outreach at elementary and high schools, junior and undergraduate colleges, and other educational formats

Targeted pressure(s): Logging and wood harvesting

Conservation Strategy 2 (Law and Policy): Advocate for laws and policies that protect natural resources

Objective(s):

- Policies with the Board of Forestry are developed that help conserve montane shrubland and grassland (early seral forest habitat)
- Develop and implement standardized BMPs for management of aspen wet meadows that built on current guidelines and include a monitoring component; Build on current guidelines and include monitoring component
- Approve and implement policies that benefit management of aspen wet meadows
- Policies eliminate barriers to management (i.e., FPRs)
- Develop timber harvest cumulative-impact standards for each watershed or group of adjacent watersheds to protect aquatic ecosystems and conserve wildlife habitat
- Policies will adopt a "no net loss" policy for critical habitat
- Devote CDFW staff to engaging the appropriate decision-making agencies and boards

Targeted pressure(s): Climate change

Conservation action(s):

- Develop policy statement for Board of Forestry and Fish and Game Commission
- Collaborate with USFS, BLM, and private landowners on development of BMP
- Work to develop cumulative impacts standards
- Develop no-net-loss policy for meadow aspen
- Increase wildlife use of restored aspen meadows
- Aspen community has positively responded to management actions

Conservation Strategy 3 (Direct Management): Implement habitat restoration and enhancement for aspen meadows

Objective(s):

- Restore aspen meadows through active management
- Remove encroaching conifer trees greater than 18 inches diameter at breast height from 10 percent of aspen meadows through managed thinning and conducting prescribed burns

Targeted pressure(s): Fire and fire suppression

Conservation Strategy 4 (Partner Engagement): Partner for joint advocacy with public and private sectors; Establish partnership for privately and tribal managed lands; Establish decision making processes with other public and private entities (including tribal governments) to determine or implement strategies; Creating and maintaining partnerships will ensure the coordinated development of conservation strategies or actions to reduce climate-related stresses to species and habitats

Objective(s):

- Form partnerships between agencies and landowners that benefit wildlife on timberlands
- Agencies and landowners jointly implement projects that benefit wildlife

Targeted pressure(s): Logging and wood harvesting

Conservation Strategy 5 (Environmental Review): Conduct environmental review; Maintain devotion of staff to environmental review of CEQA projects; Enhance staffing levels to commit to environmental review of NEPA projects on federal lands

Objective(s):

- Improve staffing capacity to participate in state and federal environmental review

Targeted pressure(s): Logging and wood harvesting; housing and urban areas

Conservation action(s):

- Develop statewide management and implementation strategy

Target: Coastal Dune and Bluff Scrub

Stands of coastal dune and bluff vegetation are limited to salty, rocky, or sandy settings immediately adjacent to the open coast. Traits include adaptation to salt spray, wind and shifting sands, result in several lifeforms including succulent or hairy leaves, long underground roots and stolons (adaptation to shifting sands), and good colonization of relatively unstable and sterile substrates.

Conservation Strategy 1 (Land Acquisition/Easement/Lease): Protect priority habitats through fee title acquisition, permanent conservation easement, or other means; purchase land in a corridor connecting two protected areas to provide connectivity of habitat

Objective(s):

- Ensure that funds are in place and priority sites are placed in easements; and, at each annual review, ensure that easements or leases are in compliance

Targeted pressure(s): Tourism and recreation areas; annual and perennial non-timber crops; housing and urban areas; climate change; commercial and industrial area

Conservation Strategy 2 (Land Acquisition/Easement/Lease): Designate conservation areas with emphasis on sites or landscapes that have unique and important value to wildlife

Objective(s):

- Designate conservation area status

Targeted pressure(s): Roads and railroads; housing and urban areas; commercial and industrial areas

Conservation Strategy 3 (Data Collection and Analysis): Collect biological and ecological data to address key information gaps on SGCN, habitats, and pressures

Objective(s):

- Ensure that the proposal includes clear management needs and outcomes that have been identified with input from relevant data users.
- Research provides answers to relevant questions.
- Appropriate audiences are accessing data.
- Research provides recommendations for conservation actions.
- Data are being used to inform conservation actions.
- Ensure that conservation strategies are implemented, based on research, to reduce any pressures to conservation targets that may be cumulative to climate change (e.g., recreation, grazing).
- When Caltrans is currently implementing best management practices (BMPs), look for opportunities for alignment of BMPs through the implementation of SWAP strategies and existing processes such as those in place at Caltrans.

Targeted pressure(s): Housing and urban areas; commercial and industrial areas; tourism and recreation areas; annual and perennial non-timber crops; fire and fire suppression; invasive plants/animals; airborne pollutants; climate change

Conservation Strategy 4 (Law and Policy): Develop or influence law and policy that addresses vehicle emissions, timber harvest cumulative impacts, critical habitat, and marine species with ranges that overlap jurisdictional boundaries

Objective(s):

- Adopt policies that address vehicle emissions, no net loss of critical habitat, timber harvest cumulative impact standards, and interstate enforcement for marine species with ranges that cross jurisdictional boundaries

Targeted pressure(s): Airborne pollutants; climate change

Conservation Strategy 5 (Land Use Planning): Provide input to land use planning decisions

Objective(s):

- Ensure that local land use planners receive input on land use plans; a land use plan is approved that is consistent with input provided; the plan is implemented in a manner consistent with the input; and, at each annual review, the behavior of local entities is consistent with input

Targeted pressure(s): Housing and urban areas; commercial and industrial areas; annual and perennial non-timber crops; roads and railroads; airborne pollutants

Conservation action(s):

- Provide comments on documents such as City and County general plans, CEQA and NEPA documents, timber harvest plans, Integrated Natural Resource Management Plans (INRMPs) on military lands, etc.

Conservation Strategy 6 (Direct Management): Conduct direct resource management

Objective(s):

- Desired management actions are implemented; Examples of applicable actions include: restore or enhance degraded habitats, monitor populations, and remove barriers to species movement; conduct prescribed burns, wet burns, fire hazard abatement, and periodic burning in wildland areas; conduct managed thinning; enhance partnerships in private lands to increase direct management of natural resources; conduct managed grazing; manage invasive species; remove non-native species; conduct resource assessments to inform management decisions; and establish BMPs to implement across partnerships

Targeted pressure(s): Fire and fire suppression; invasive plants/animals

Conservation action(s):

- Coordinate with CAL FIRE
- Coordinate with Weed Management groups
- Apply for funding

Conservation Strategy 7 (Management Planning): Develop and implement needed management plans

Objective(s):

- Develop management plans for target area; examples of applicable management planning actions include working with partners on the development of large landscape conservation planning
- Develop or update management plans to integrate the effects of climate change
- Development of management plans for species, habitats and natural processes
- Develop a management plan for habitat of SGCN; reintroduction, relocation or stocking of native animals or plants or animals to an area where they can better adapt
- Translocate/breed in captivity SGCN to establish new populations in suitable habitat
- Restore SGCN to historically occupied habitats

Targeted pressure(s): Invasive plants/animals

Conservation action(s):

- Coordinate with weed management groups

Conservation Strategy 8 (Partner Engagement): Establish and engage in partner relationships

Objective(s):

- Engage state and federal agencies, tribal governments, the NGO community and other partners to achieve shared objectives and broader coordination across overlapping areas
- Establish partnership to co-monitoring species/habitats on federally managed lands
- Establish decision-making processes with other public and private entities to determine or implement strategies
- Convene an advisory committee to assist with implementation of strategies.
- Establish BMPs to implement across partnerships
- When Caltrans is currently implementing BMPs, look for opportunities for alignment of BMPs through the implementation of SWAP strategies and existing processes such as those in place at Caltrans

Targeted pressure(s): Housing and urban areas; commercial and industrial areas; annual and perennial non-timber crops; tourism and recreation areas; fire and fire suppression; invasive plants/animals; climate change.

Conservation Strategy 9 (Environmental Review): Implement environmental review, with focus on the following: non-conservation-oriented policies; projects and plans to help ensure impacts to wildlife are minimized and benefits maximized; infrastructure development projects to ensure they are designed and sited to avoid impacts on species and habitat; state highway plans; forest management plans; and plans for transmission corridor siting

Objective(s):

- Review appropriate plans (i.e., EIRs, EISs, Negative Declarations, Biological Opinions, Land use changes, General Plans)

Targeted pressure(s): Housing and urban areas; commercial and industrial areas; roads and railroads; dams and water management/use; renewable energy

Target: Native Aquatic Species Assemblages/Communities

20 species of fish, 12 amphibians and reptiles, and five species of aquatic invertebrates are included in the aquatic assemblage for this area. Species include: Chinook salmon (spring and fall runs), Coho salmon, Steelhead and resident rainbow trout (summer, winter runs), Coastal cutthroat trout, Pacific lamprey, Western river lamprey, Western brook lamprey, Klamath river lamprey, Green sturgeon, White sturgeon, Tidewater goby, Eulachon, Longfin smelt, Reticulate sculpin, Navarro roach, Gualala roach, Lost River sucker, Shortnose sucker, Klamath large scale sucker, Blue chub, Hitch Russian river tule perch, Southern torrent salamander, Coastal tailed frog, California giant salamander, Foothill yellow-legged frog, California red-legged frog, Northern red-legged frog, Cascades frog, Oregon spotted frog, Southern long toed salamander, California tiger salamander, Red-bellied newt, Northwestern western pond turtle, Klamath crayfish, California Linderiella (fairy shrimp), California freshwater shrimp, California floater mussel, Western ridge mussel, other freshwater mussels

Conservation Strategy 1 (Land Acquisition/Easement/Lease): Acquire riparian areas; Protect stream ecosystems by riparian land purchase and conservation easements

Objective(s):

- CDFW identifies and prioritizes Areas of Conservation Emphasis (ACE)

Targeted pressure(s): Housing and urban areas

Conservation action(s):

- Establish in lieu fee program

- Update areas of conservation emphasis database
- Explore options such as Natural Community Conservation Plans (NCCPs) and Regional Conservation Investment Strategies (RCIS) with landowners

Conservation Strategy 2 (Outreach and Education): Provide outreach and education; Outreach includes both formal (classroom) and non-formal education efforts to: (1) landowners to implement land management practices to benefit species; and (2) decision makers about impacts on at-risk quality standards for key water bodies and aquatic species.

Objective(s):

- Increase public awareness of BMPs through the creation and distribution of manuals for road construction and maintenance
- Road maintenance BMPs will be improved to decrease sedimentation in streams and creeks protecting aquatic species habitat
- Increase the public awareness of the pressure and impact of invasive species
- Increase public awareness of the negative impact to fish from excessive water use and how water conservation measures would benefit fish
- Inform landowners on their responsibilities for water rights compliance

Targeted pressure(s): Roads and railroads; Dams and water management/use; invasive plants/animals

Conservation action(s):

- Coordinate with State Water Resources Control Board for water quality

Conservation Strategy 3 (Economic Incentives): Provide economic incentives to private landowners to influence responsible stewardship of land/water and specific species and establish good stewardship recognition or payments to landowners practicing sound resource management that benefits stream ecosystems

Objective(s):

- Support and contribute to efforts to provide restoration grants to manage invasive species
- Target state and federal grants that incentivize landowners to conserve and restore habitat through the removal and/or control of the spread of invasive and non-native species
- Change farming practices to be more fish friendly by increasing buffers, reducing sediment, and reducing chemical use, target wineries, crops and livestock farms
- Obtain monetary grants to upgrade and enhance critical road problems impacting anadromous fish streams through state and federal grant programs

Targeted pressure(s): Roads and railroads; dams and water management/use; annual and perennial non-timber crops

Conservation action(s):

- Prioritize identifying and remediating critical road problems impacting anadromous fish streams on state and county-controlled lands and roadways

Conservation Strategy 4 (Law and Policy): Support effective law enforcement by increasing funding for federal and state enforcement resources and increasing public awareness

Objective(s):

- Monitor and where necessary enforce compliance with water rights and FGC section 1602 Lake and Streambed Alteration Agreements
- Monitor and investigate illegal diversions and increase Law Enforcement Division (LED) staffing levels

Targeted pressure(s): Dams and water management/use

Conservation action(s):

- Include BMPs as conditions FGC section 1602 Lake and Streambed Alteration Agreements
- Include BMPs as enforceable condition of water right permit/license
- Coordinate with law enforcement officers
- Provide law enforcement with maps of critical problem areas
- Advocate for opportunities to improve prosecutions of environmental laws
- Evaluate and increase law enforcement officer staffing levels
- Provide funding for enforcement to enforce laws protecting riparian habitat
- Identify laws and regulations governing riparian areas and work with governing agencies to apply effectively
- Support instream flow dedications under Water Code section 1707 for fish and wildlife benefits
- Make recommendations to enhance enforcement of existing laws and regulations

Conservation Strategy 5 (Law and Policy): Advocate for laws and policies; Develop, change, influence, and help implement legislation, regulations, and voluntary standards

Objective(s):

- Create and implement policies to ensure that landowners and agencies protect lower order streams above fish-bearing reaches

- Develop timber harvest cumulative-impact standards for each watershed or group of adjacent watersheds to protect aquatic ecosystems and conserve aquatic habitat
- Adopt a "no net loss" policy for critical habitat
- Ensure riparian function and processes are maintained to provide desired conditions and manage riparian buffers to achieve mature to late-seral stand conditions

Targeted pressure(s): Logging and wood harvesting; Annual and perennial non-timber crops

Conservation action(s):

- Change regulations to have harsher penalties for environmental impacts resulting from cannabis cultivation activities that deter water diversion from streams and creeks and impact riparian vegetation
- Change regulations to have robust penalties to deter peat collection from fens for cannabis cultivation
- Participate in interagency working group to advocate for lower order stream protection
- Advocate for compliance monitoring

Conservation Strategy 6 (Direct Management): Develop buffers; Develop county stream buffer policy and guidelines in conjunction with ongoing regional efforts to develop riparian buffers; Adequate support and clear policy guidelines are needed.

Objective(s):

- Landowners increase riparian buffers along rivers and streams
- Manage riparian buffers to achieve mature to late-seral stand conditions. Properly functioning riparian buffers reduce erosion, reduce sediment input, and provide shade and micro-climate to help keep stream water cool, source of large woody debris, nutrient inputs
- Ensure riparian function and processes are maintained to provide desired conditions. Improve water quality in streams and rivers by meeting TMDL standards
- Improve agriculture practices by increasing efficiency of water diversions (i.e., lining or piping canals, plastic pipes, drip systems to reduce evaporation)
- Reduce demand for water diversions in arid and drought impacted areas.
- *Targeted pressure(s):* Annual and perennial non-timber crops; livestock, farming, and ranching

Conservation action(s):

- Make recommendations to local agencies to establish minimum buffers
- Re-designate buffers as natural resource zones in county general plans

Conservation Strategy 7 (Direct Management): Promote water conservation measures by reducing the amount of land growing water intensive crops, considering less water intensive crops, providing incentives for water conservation, and encouraging public participation in enforcement of wasteful use of water.

Objective(s):

- Increase the efficient use of domestic water by the agricultural community with improved agricultural practices; Achieve this through low water use on vegetation or in irrigation using locally adapted plants, implementing household conservation actions, and using low flow shower heads and toilets
- Improve landscape practices by increasing efficiency of water diversions i.e., plastic pipes to reduce evaporation

Targeted pressure(s): Dams and water management/use; livestock, farming, and ranching

Conservation action(s):

- Evaluate the efficacy of existing conservation measures
- Develop new or improve existing water conservation strategies
- Implement water conservation strategies/programs
- Develop partnerships for joint advocacy
- Incentivize fallowing or rotating water intensive crops with less water intensive crops in arid areas and areas experiencing drought
- Develop water banking/storage opportunities

Conservation Strategy 8 (Direct Management): Manage dams and other barriers by reviewing potential cost/benefit of modifying or removing dams that block access to significant amounts of high-quality salmonid spawning and rearing habitat and partner on the removal of Cape Horn Dam and Scott Dam from the upper Eel River

Objective(s):

Targeted pressure(s): Dams and water management/use

Conservation action(s):

- Water managers allow sufficient bypass flows in anadromous fish streams to support biological live history needs
- Gather and analyze data on water use and hydrological connectivity to identify the current conditions on amount of water use and water use efficiency, of fish passage including allocating the major barriers
- Develop restoration objectives within management planning
- Investigate the impact from water diversion, including stream flow modification and fish passage barriers

- Investigate the potential to develop water conservation and fish passage barrier improvements or removal and evaluate the effectiveness of the measures.
- Prioritize the conservation scope; Decide the timeframe, appropriate restoration tools and methodology; Find funding to contract for developing a plan for restoration and management implementation
- Modify or remove all small diversion dams by landowners on anadromous fish streams; Diversions are regulated by FGC section 1600 et seq. and subject to CEQA; Many diversions currently occurring are not permitted; Some may be linked to appropriated water rights and should follow consistent and effective BMPs, such as timing of removal.
- Modify or remove all large dams
- Remove all impairments to fish passage; CDFW should review diversions and investigate any need to improve fish passage

Conservation Strategy 9 (Direct Management): Reduce need for livestock access to streams and riparian corridors by providing and locating water supply to livestock in grazing areas away from streams (use wells and other off channel sources)

Objective(s):

- Livestock farmers will provide off-stream watering sources for their animals on anadromous fish streams.
- Landowners and ranchers will construct exclusionary fencing to protect anadromous fish streams from their use.

Targeted pressure(s): Livestock, farming, and ranching

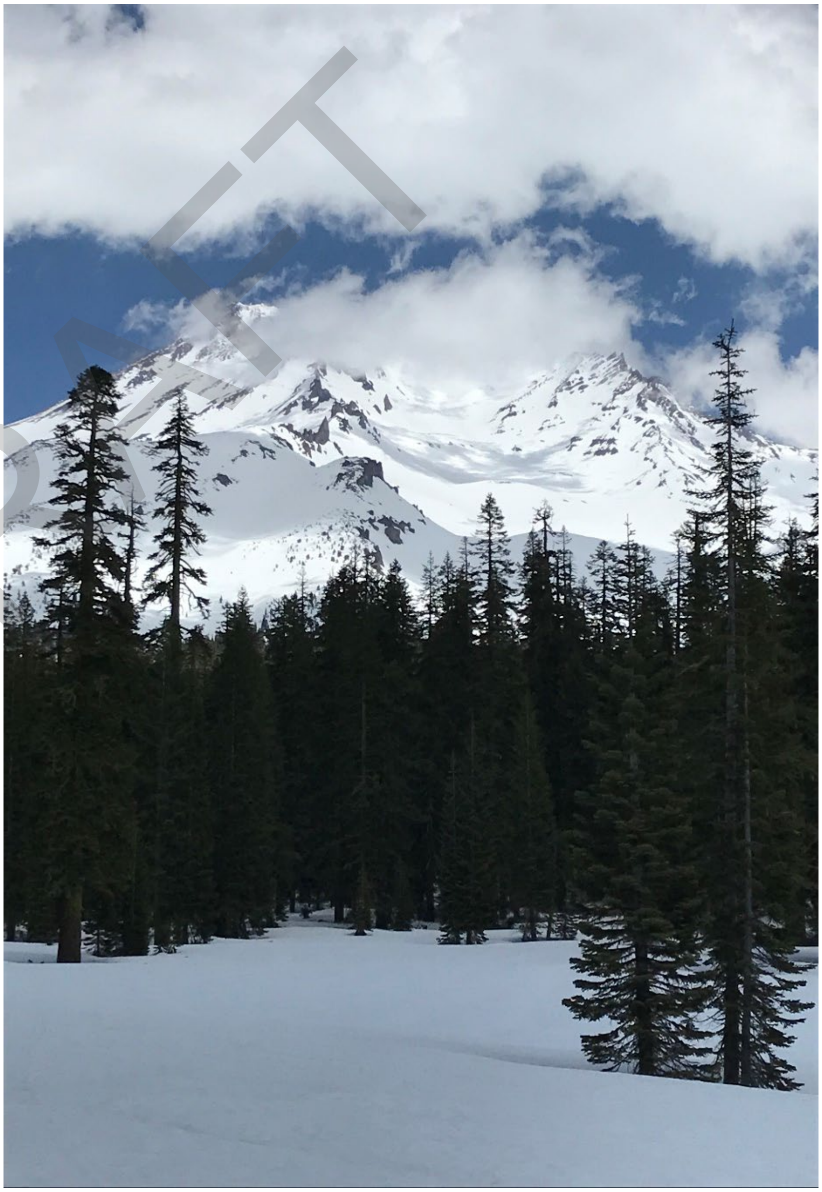
Conservation action(s):

- Coordinate with other agencies and private landowners on use of alternative watering locations and exclusionary fencing
- Prioritize locations for reducing impact of livestock having access to watercourses
- Identify alternative watering structures and water sources, including groundwater
- Identify appropriate locations to develop off stream water sources and exclusionary fencing
- Use groundwater management to assist in surface water management

5.2 Cascades and Modoc Plateau Province

5.2.1 Geophysical and Ecological Description of the Province

The Cascades and Modoc Plateau Province encompasses over 7 million acres in the far northeastern corner of California (Figure 5.2-1). This province is composed of two distinct geographic and ecological areas, the Modoc Plateau and the Southern Cascades. Elevations in the province average higher than other provinces, ranging from 3,000 feet throughout the Modoc Plateau to over 14,000 feet in the Southern Cascades. Northeastern California is an outstanding region for wildlife, providing habitat for mountain lion, mule deer, pronghorn, elk, yellow-bellied marmot, porcupine, greater sage-grouse, wolf, and the colorful waterfowl of the Pacific Flyway that funnel through the area during their annual migrations. Golden eagle, prairie falcon, cascade frog, southern long-toed salamander, Northern goshawk, Northern spotted owl, sooty grouse, greater sandhill crane, and American white pelican nest and hunt or forage in the varied habitats in the province. Sharp-tailed grouse historically occurred in this province but have been extirpated. The varied aquatic habitats and natural barriers along the Pit River and Klamath River and their tributaries have allowed the evolution of several unique aquatic communities that include endemic fish and invertebrates in the Cascades and Modoc Plateau Province.

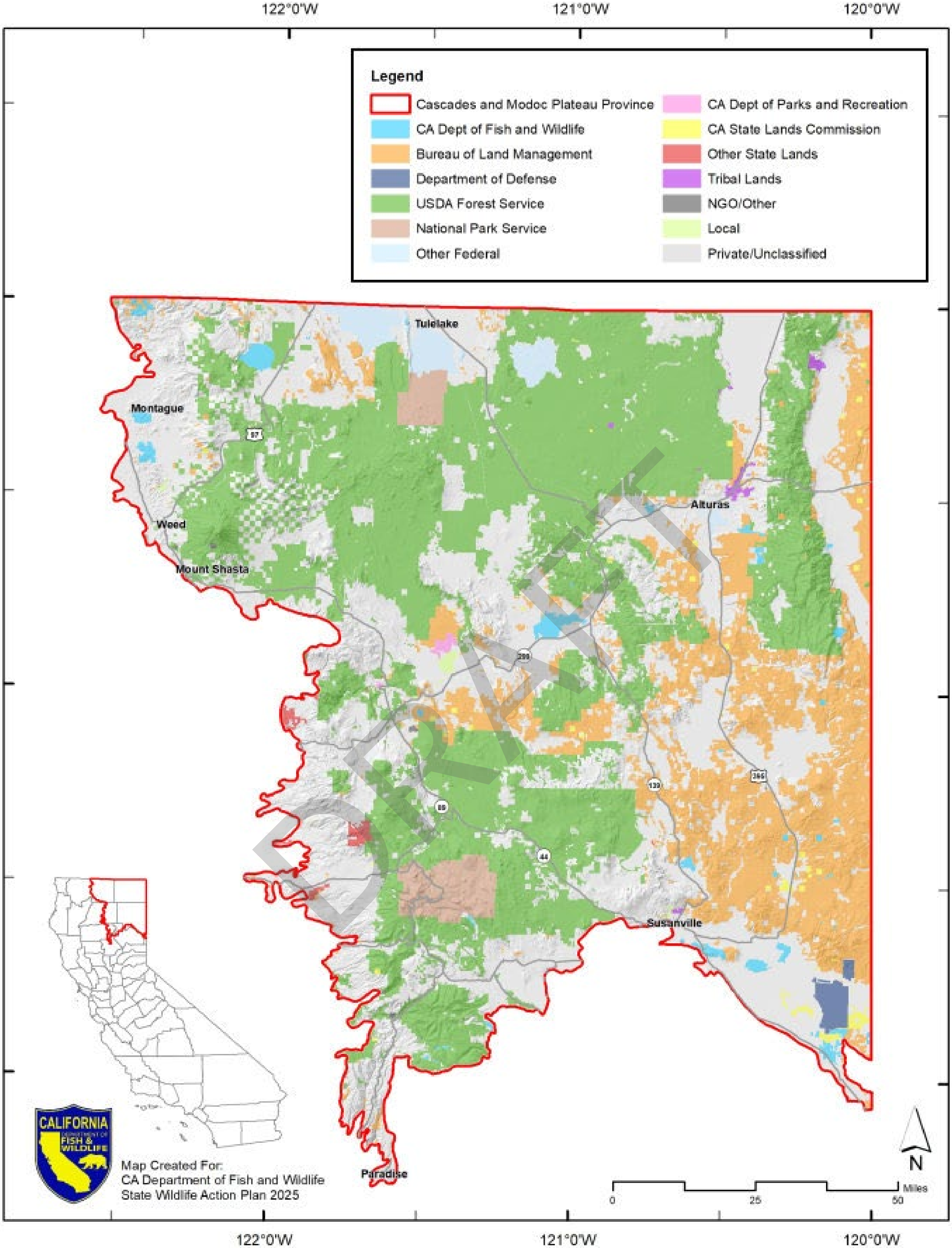


Modoc Plateau

The Modoc Plateau is located in the northeastern corner of the state, framed by and including the Warner Mountains and Surprise Valley along the Nevada border to the east, and to the west by the edge of the southern Cascades Range. The area extends north to the Oregon border and south to include the Skedaddle Mountains and the Honey Lake Basin.

A million years ago, layered lava flows formed the 4,000–5,000-foot elevation Modoc Plateau, separating the watersheds of the area from the Klamath drainage to the northwest. The waters of the western slope of the Warner Mountains and the Modoc Plateau carved a new course, the Pit River, flowing to the southwest through the Cascades and joining the Sacramento River at Lake Shasta. Many of the springs and creeks of northeastern California drain via the Pit River.

Situated on the western edge of the Great Basin, the Modoc Plateau historically has supported high desert plant communities and ecosystems similar to that region—shrub-steppe, perennial grasslands, sagebrush, antelope bitterbrush, mountain mahogany, and juniper woodlands. Sagebrush plant communities are characteristic of the area, providing important habitat for sagebrush-dependent wildlife such as greater sage-grouse and pygmy rabbit. Conifer forests dominate the higher elevations of the Warner Mountains and the smaller volcanic mountain ranges and hills that shape the area. Wetland, spring, meadow, vernal pool, riparian, and aspen communities scattered across the rugged and otherwise dry desert landscape support diverse wildlife. The area has varied aquatic habitats, from high mountain streams to the alkaline waters of Goose Lake and Eagle Lake to clear spring waters of Fall River and Ash Creek.



Data Source: California Protected Areas Database; US Geological Survey (hillshade); CDFW Lands

Figure 5.2-1 Land Ownership of the Cascades and Modoc Plateau Province

The 3-million-acre Pit River watershed is the major drainage of the Modoc Plateau and spans the border of northern California and Oregon as well as the Modoc Plateau and Southern Cascades ecoregions. It is of major importance to California water supply and fish populations as it provides 20 percent of the water to the Sacramento River. The upper reaches of the watershed include the Warner Mountains that drain into Goose Lake. Goose Lake occupies about 144 square miles between California and Oregon with most of the water being on the California side. The major portion of the water comes from Dry, Mill, Drews, Antelope, Cottonwood, Thomas, Crane, Cogswell, Tandy, and Kelley creeks. The north fork of the Pit River flows from Goose Lake southwest and merges with the south fork of the Pit River, which drains the southern Warner Mountains.

The Pit River meanders across the plateau and farmlands, receiving the drainage of Ash Creek and the flows of Fall River and Hat Creek before weaving west across the southern Cascades Range. The river is checked and held by several dams and reservoirs but eventually drains into Lake Shasta. Unique fish and invertebrates have evolved in isolated springs and segments of the Pit River watershed and over 24 endemic species depend on the lower Pit River for their survival (TNC 2015). Fourteen native fish species are found in various associated fish communities in segments of the watershed's rivers and creeks. Endemic species include the Modoc sucker, the Goose Lake redband trout, Goose Lake tui chub, Goose Lake lamprey, and Shasta crayfish (Ellis and Cook 2001; Moyle et al. 2002). Management issues within the Pit River watershed include threatened wild trout production, degraded forest health because of heavy fuels, degraded aquatic and riparian habitat, degraded water quality, unsustainable water supply, increased erosion and natural stream function, and invasive plant and animal species (Sacramento River Watershed Program 2025).

Eagle Lake is one of the few alkaline lakes in California, and the Eagle Lake watershed is an important watershed within the province that spans two states (California and Nevada). Tributaries of Eagle Lake are Cleghorn Creek, Papoose Creek, Merrill Creek, and Pine Creek. Pine Creek, the main tributary of Eagle Lake, is about 39 miles long and considered an intermittent stream. Pine and cedar forests surround the south shore of Eagle Lake, while juniper and sage dominate the north side. The endemic Eagle Lake rainbow trout, as well as the Lahontan redside, Tahoe sucker, and tui chub thrive in the waters of Eagle Lake and its Basin. Western grebes, eared grebes, buffleheads, many diving ducks and cormorants, terns, ospreys, and bald eagles fish along its productive waters. Marshy areas near the shoreline provide available forage for American white pelicans, cinnamon teal, and other waterfowl, in addition to egrets and muskrats.

Creeks of the northern Modoc Plateau, or Lost River watershed, drain to Clear Lake in Modoc County from the Lost River Diversion located in southern Oregon. The outlet of Clear Lake is the Lost River, which circles north into Oregon farmland and then joins the

Klamath River system. The Lost River watershed encompasses an area of approximately 3,000 square miles in Klamath and Lake Counties in Oregon, and Modoc and Siskiyou counties in California. Sixty-miles-long, the Lost River winds through forests, meadows, and fields providing important habitat for aquatic and terrestrial species, including 22 endemic species (TNC 2015). Endemic aquatic fish and invertebrates include the federally endangered Lost River sucker, shortnose sucker, and Klamath pebblesnail.

Sixty percent of the Modoc Plateau is federally managed: U.S. Forest Service (USFS) manages 30 percent, U.S. Bureau of Land Management (BLM) manages 26 percent, and U.S. Fish and Wildlife Service (USFWS) and the U.S. Department of Defense (DOD) each manage about 2 percent of the lands. CDFW manages 1 percent of the Modoc Plateau as wildlife areas. About 37 percent of the land is privately owned or belong to municipalities.

Southern Cascades

The Cascade Mountain Range starts in southern British Columbia and runs south through Washington and Oregon into northern California, merging just south of Mount Lassen with the northern reaches of the predominantly granitic Sierra Nevada. The most recent volcanic eruptions in conterminous United States have occurred in the Cascades, with eruptions of Mount Lassen in 1914-1915 and eruptions of Mount St. Helens in Washington in the 1980s and continuing. Within Northern California, the mostly volcanic southern Cascades contain two of the most active volcanoes in the state, Mount Shasta and Mount Lassen, both of which are considered active. The southern Cascades are bordered by the Klamath Mountains on the west side, bounded by the foothills of the Tuscan Formation to the southwest, by the Sierra Nevada Mountains to the south, and to the east they grade into the Modoc Plateau. Elevations range from about 2,000 feet in the adjacent foothills to 14,179 feet, the peak of Mt. Shasta which is the second highest peak in the Cascade Range. (The highest peak in the Cascade Range is Mount Rainer in Washington.) The mountain elevations then drop off gradually to the east.

In the Cascades, hundreds of creeks and streams of the western slope drain via a dozen major river basins to merge with the Klamath, Pit, McCloud, and Sacramento rivers. On the eastern slope, creeks and rivers drain east onto the Modoc Plateau and Great Basin region. Battle Creek, which empties into the Sacramento River, has headwaters in the Mount Lassen area and its flows are primarily derived from the Southern Cascades. Battle Creek has been the focus of major anadromous fish restoration projects because it has very cold, clean waters and excellent fish habitat. Battle Creek historically supported all four runs of Chinook salmon: fall-run, late fall-run, spring-run, and winter-run. Within the southeast boundary of the Southern Cascades Mill Creek, Deer Creek, and Antelope Creek flow west from the high elevation montane headwaters providing important spawning, rearing, and holding habitat for Chinook salmon and Central Valley steelhead, including some of last remaining occupied spring-run Chinook habitat in California. A network of wet meadow habitat occurs downstream of the headwaters of Mill Creek southwest of the Lassen National Park area.

This critical habitat provides suitable conditions for the Cascades frog and foothill yellow-legged frog. Springs and creeks of the southern Cascades support unique species or subspecies of fish such as the Modoc red-band trout, and invertebrates such as Shasta crayfish and endemic springsnails. These mountains receive substantial rainfall and snowfall, with Mount Lassen having the highest known winter snowfall amounts in California. The endangered willow flycatcher finds breeding and nesting habitat in the wet meadow valleys and broad meadow floodplains of mountain creeks. Because 40 percent of the state’s surface water runoff flows from the Sierra Nevada and the Cascades, maintaining and restoring the ecological health of the Cascade watersheds and aquatic systems is important to ensure clean water for California.

Bold topography, the large elevation gradient, and varied climatic conditions of the Cascades support diverse plant communities. North of Mount Shasta, the Klamath Mountains absorb precipitation coming from the west, resulting in dry west slopes in the Cascades. Soils, like the Modoc Plateau, are generally volcanic in origin. These varied conditions, and floristically and structurally diverse plant communities, provide a large array of habitats important for maintaining California’s wildlife diversity and abundance. Communities common to the Cascade area are conifer habitats dominated by ponderosa pine, Douglas fir, white fir, red fir, and lodgepole pine. In general, mixed ponderosa pine, Douglas fir, and white fir forests occur on the western slopes at elevations below approximately 5,600 feet. Canyon live oak stands favor large, rocky canyons at mid to low elevations. On the xeric, east slopes of the Cascades, ponderosa pine and Jeffrey pine form open stands on flats and mild slopes. At the highest elevations, lodgepole pine, white fir, and red fir are dominant. Big sagebrush and western juniper dominated habitats are more common on the eastern slopes and valleys of the ecoregion.

Common large mammalian inhabitants of the ecoregion include black bear, mountain lion, Rocky Mountain and Roosevelt elk, pronghorn antelope, and mule deer. Species of Greatest Conservation Need (SGCN) include the Northern spotted owl, Sierra Nevada red fox, Pacific fisher, gray wolf, American marten, American badger, and coastal tailed frog.

Fifty-two percent of the Southern Cascades ecoregion in California are federally owned and managed with principal management by the USFS, BLM, and National Park Service (NPS). One percent is owned and managed by other governmental (state, tribal, and county) entities. Thirty-two percent is privately owned and managed with the majority of private ownership being among several large timber companies.

5.2.2 Conservation Units and Targets

The conservation units associated with the Cascades and Modoc Plateau Province include the Southern Cascades, Modoc Plateau, and Northern Basin and Range ecoregions (Figure 5.2-2), as well as portions of the North Lahontan hydrologic unit (HUC 1808) and the Sacramento hydrologic unit (HUC 1802; Figure 5.2-3).

Ecoregion Summaries

The Southern Cascades consist of scattered mountains of low to high elevations. While there is no distinct range, the crest of the mountain chain is aligned toward the north-northwest between the Sierra Nevada and Mt. Shasta and toward the north from Mt. Shasta northward. Slow and moderately rapid rivers and streams are common throughout the ecoregion. Major rivers and lakes include the Klamath and Pit rivers, Lake Almanor. Nearly level basins and valleys are bordered by long, gently sloping alluvial fans with linear mountain ranges. Soils are formed mostly from rocks of volcanic origin. Moderately slow rivers and streams flow through deeply incised canyons with bedrock-controlled channels (higher elevations) to alluvial channels (lower elevations). A few large lakes, such as Honey Lake, occur here. Vegetation consists of sagebrush and desert shrub cover types. Climate is dry with cold winters and annual precipitation from 4 to 20 inches. Summers are hot and dry. Elevations range from 4,000 to over 14,000 feet.

Hydrologic Unit Summaries

North Lahontan Hydrologic Unit (HUC 1808): Includes the eastern slopes of the Warner Mountains and the Sierra Nevada. Major watersheds in the North Lahontan Basin include the Eagle Lake and Susan River/Honey Lake watersheds. Dominant vegetation ranges from sagebrush to pinyon-juniper and mixed conifer forest at higher elevations. Wetland and riparian plant communities, including marshes, meadows, bogs, riparian deciduous forest, and desert washes. Elevation range: 4,000 to 7,600 feet.

Sacramento Hydrologic Unit (HUC 1802): The Sacramento River Basin covers 27,210 square miles, a large part of northern California and includes the entire area drained by the Sacramento River. All tributaries to the Sacramento River that are north of the Cosumnes River watershed are included in this watershed. The major lakes and streams of this watershed included in the Cascade-Modoc Plateau Province are Goose Lake, Lake Almanor, and the Pit River. The geology, climate, and associated vegetation are similar to those described for the North Lahontan watershed. Elevation range: 0 to 9,000 feet.

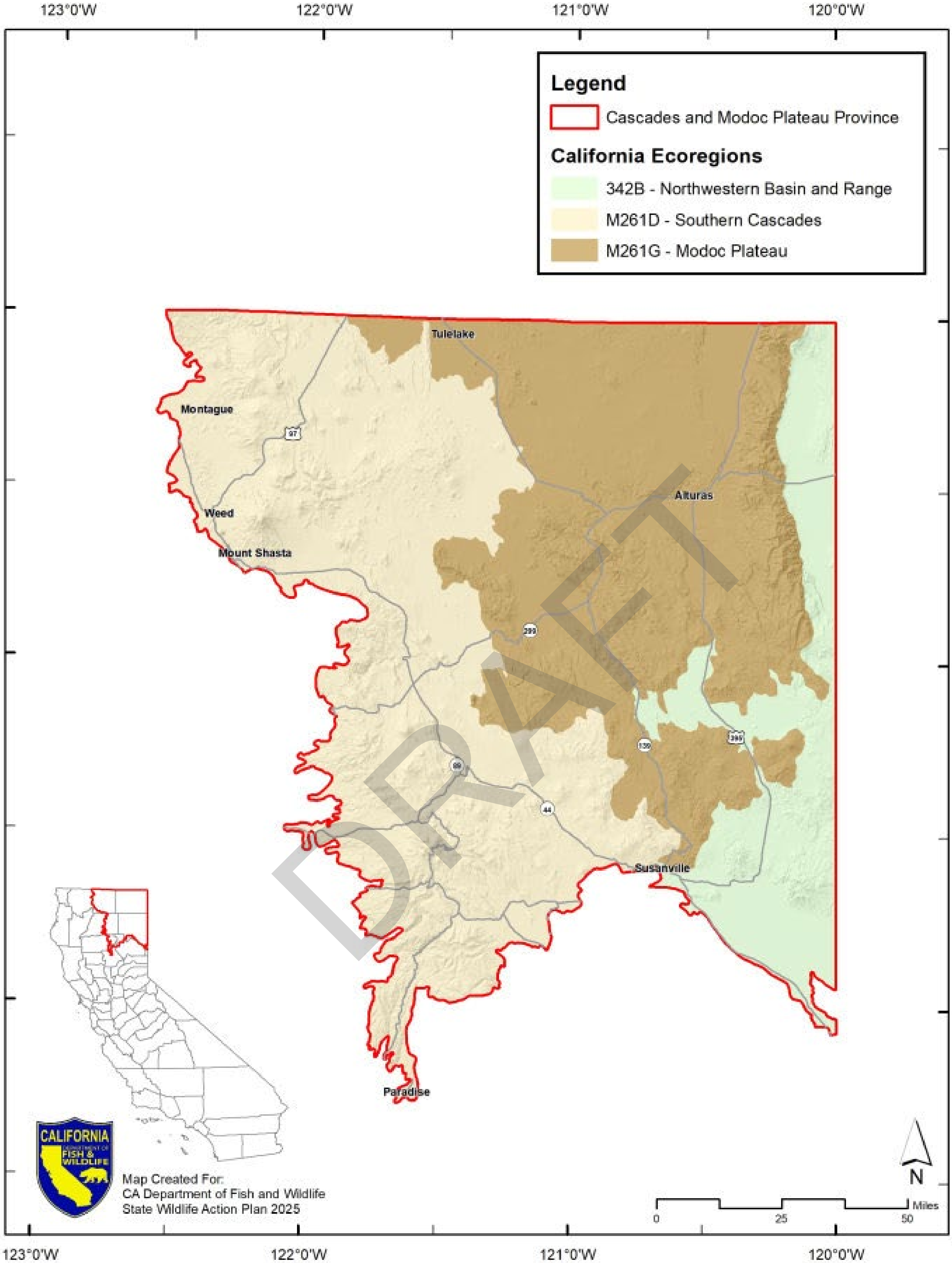
Conservation Targets

Conservation targets were selected in this province as priorities for conservation planning within the conservation units; targets are listed in a searchable, sortable table (Table 5.0). The conservation targets are summarized in Section 5.2.6 along with the strategies for each. The conservation targets include:

- Aspen Forests
- Big Sagebrush Scrub
- Great Basin Dwarf Sagebrush Scrub
- Great Basin Pinyon-Juniper Woodland
- Great Basin Upland Scrub
- North Coastal Mixed Evergreen and Montane Coniferous Forests
- Western Upland Grasslands Wet and Dry Forested Meadows
- Eagle Lake Native Fish Assemblage
- Goose Lake Native Fish Assemblage

While analyses identified numerous targets in this province, conservation strategies were only developed for the targets supporting the greatest number of SCGN and those most immediately under threat. Other potential targets, such as conifer forests, riparian, grasslands, and vernal pool, were not selected because these habitat types have smaller distributions within the province. Some pinyon-juniper and sage habitats are a high priority habitat for conservation by many agencies, organizations, and private landowners, so were not selected. It is expected that additional key targets will be identified during future conservation planning efforts. Information about the methods used to prioritize conservation targets is presented in Appendix D.

Figure 5.2-4 shows the distribution of the plant communities within the province. Some of the plant communities identified as conservation targets occur in areas smaller than the mapping unit and do not appear on the figure.



Data Source: USDA Forest Service (ecoregions); US Geological Survey (hillshade)

Figure 5.2 -2 Ecoregions of the Cascades and Modoc Plateau Province

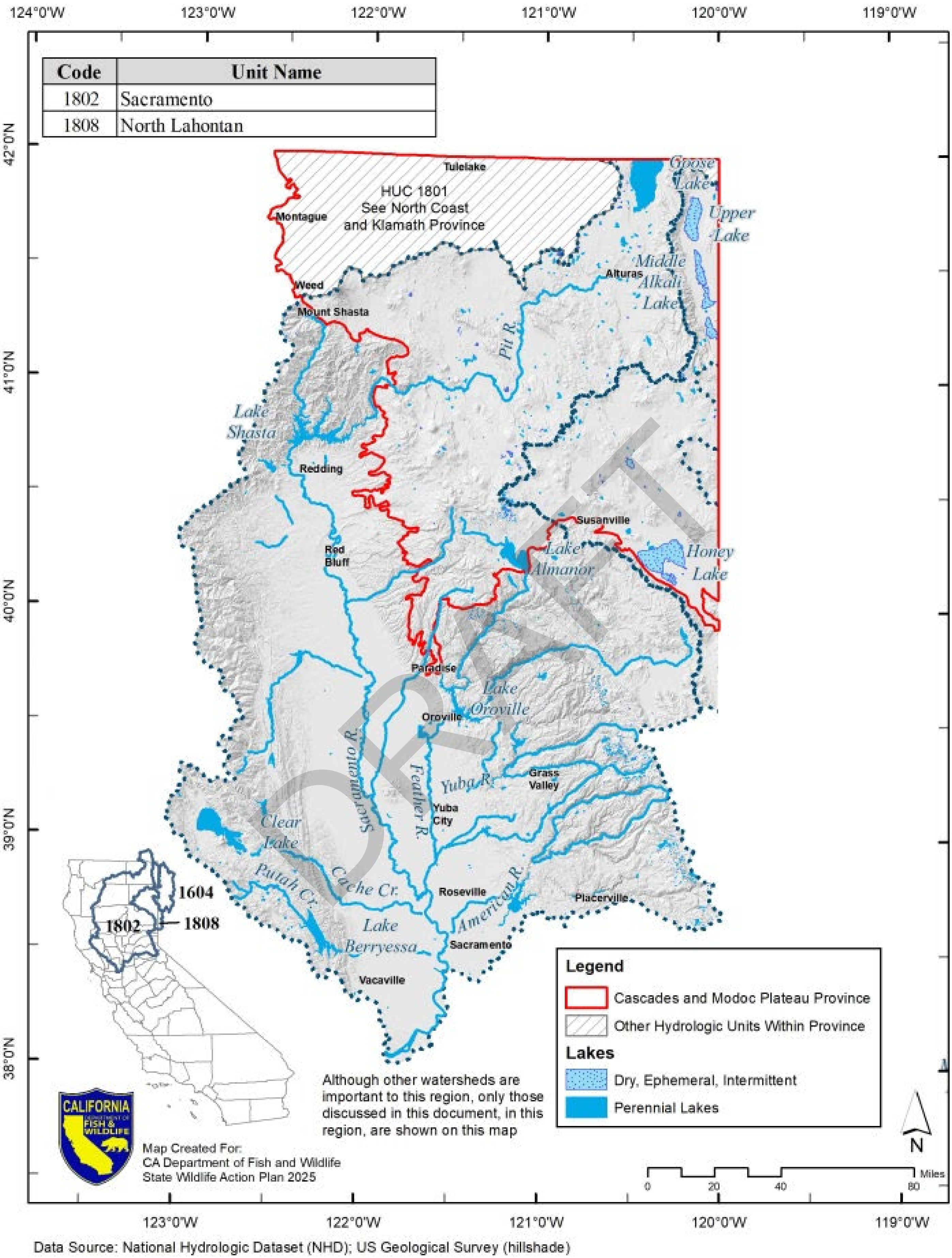


Figure 5.2- 3 Hydrologic Units of the Cascades and Modoc Plateau Province

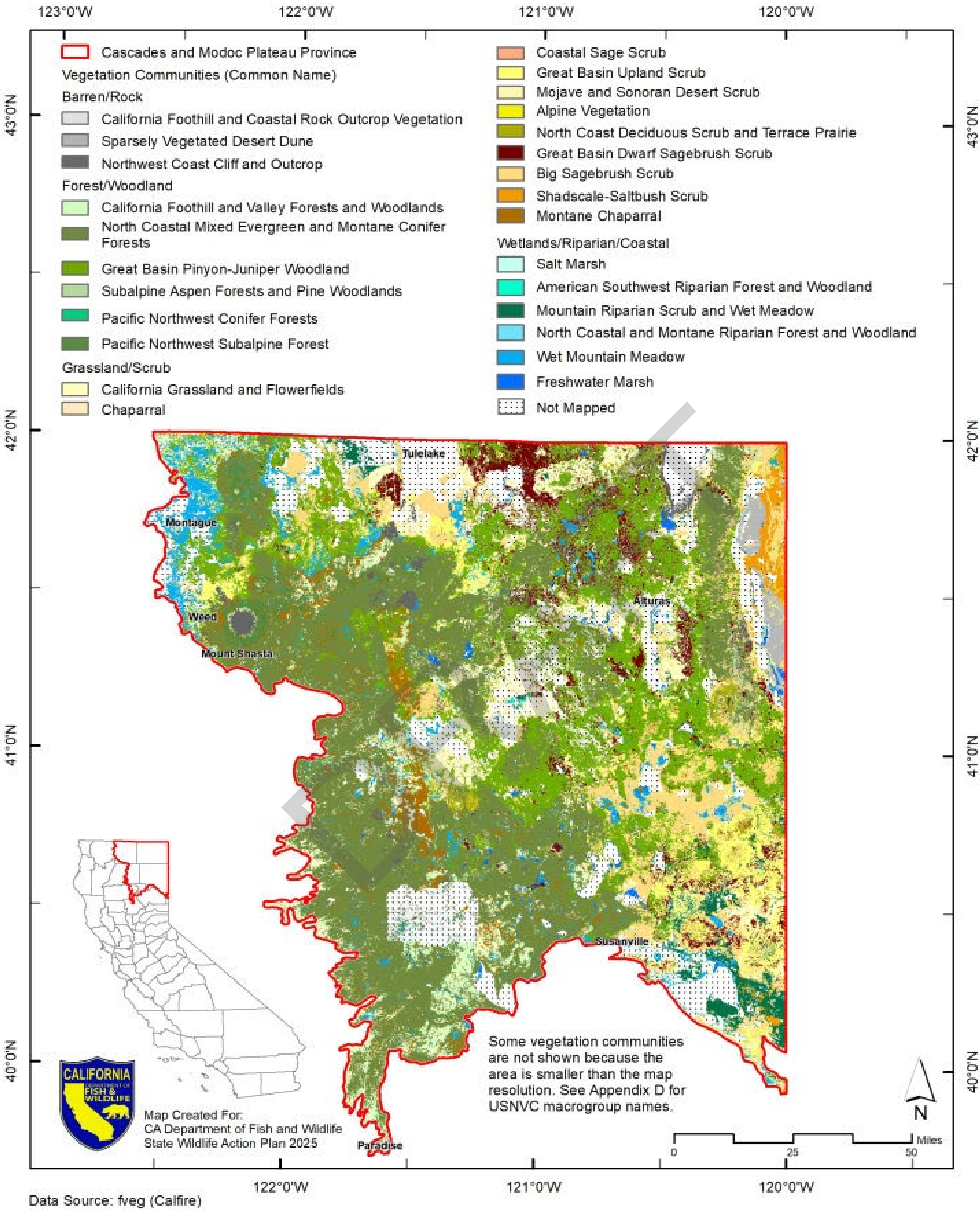


Figure 5.2-4 Plant Communities of the Cascades and Modoc Plateau Province

5.2.3 Key Ecological Attributes

Key ecological attributes (KEAs) were identified for each conservation target (Table 5.0). These attributes are considered the most important for the viability of the targets and their associated species. The most commonly identified attributes for the Cascade and Modoc Plateau Province are the following:

- Area and extent of community
- Fire regime
- Successional dynamics
- Community structure and composition
- Soil quality and sediment deposition regime

5.2.4 Species of Greatest Conservation Need in the Cascades and Modoc Plateau Province

The SWAP identified the Species of Greatest Conservation Need (SGCN) for the entire state and identified ecoregion(s) and province(s) associated with each SGCN; data is summarized in Appendix C. The conservation strategies are aimed at benefiting the SGCN via the conservation targets.

For those SGCN that do not occur within the conservation targets identified for the province, conservation actions that target SWG funding should align with existing recovery plan documents where applicable, or demonstrate they address a critical conservation need for the species.

5.2.5 Pressures on Conservation Targets

Using the Open Standards of Conservation, a stress is an impaired aspect of a conservation target, equivalent to a degraded KEA (Conservation Measures Partnership 2020). Pressures are primarily human activities, or natural phenomena influenced by humans, that amplify environmental stress and further degrade conservation target(s). The pressures identified in the Cascades and Modoc Plateau are the most significant pressures to the conservation targets but do not constitute a complete list of pressures in the province. Some principal pressures in the province are discussed in more detail below.

Annual and Perennial Non-Timber Crops

Rugged terrain, limited precipitation, and thin, rocky soils limit farming in the province. In the Shasta Valley, there are some 500 square miles of wheat, barley (dry farming), and other crops on irrigated land. In the Butte and Fall River Valleys, strawberry plant production has become a major source of agricultural income replacing cereal grain crops and impacting fall food sources for migrating waterfowl. Dairies have existed in the province since the 1920s to bring milk to local markets in the Pit River and Goose Lake watersheds. Habitat in valleys and watersheds that was once meadows, shrublands, grasslands, and foothill woodlands have been converted to farmland. The local extinction of sharp-tailed grouse is attributed to the conversion of lands to farming and ranching and the subsequent loss of riparian habitat (Williams 1986; Shilling et al. 2002).

Nutrient runoff from farms has degraded creeks and rivers, negatively affecting ecosystems that support aquatic and riparian species. Grazing and farm waste runoff have increased water temperature and polluted the Fall and Pit river drainages and the Bear Creek drainage with excessive nutrients, lowering dissolved oxygen. Many Pit River tributaries suffered similar degradation from land-use practices. Agricultural water use has resulted in low flows and has dried upriver segments within the province. Pesticide drift has been speculated to have contributed to declines in Cascades frogs in the Modoc Plateau (Davidson 2004).

Cannabis cultivation also degrades habitat for fish and wildlife in this province. Most recently, Siskiyou County has seen an exponential increase in illegal cannabis cultivation. According to the Siskiyou County's Sherrif's office, from 2016 to 2019, roughly 2,000 people moved to Siskiyou County for the exclusive purpose of illegally cultivating cannabis. Many illegal and legal cannabis growing sites include illegal water diversions that reduce tributary stream flows to inhospitable levels for fish and other aquatic organisms (Bauer et al. 2015). The use of concentrated fertilizers that leach into streams can be toxic to amphibians, fish, or invertebrates at high concentrations or promote excessive algal growth leading to reduced oxygen levels. The excessive use of herbicides and their surfactants used on these farms can also be toxic to these organisms. Use of pesticides and rodenticides kill target and non-target animals indiscriminately and even bio-accumulate in predators leading to illness or death. For details on impacts of cannabis cultivation, see the North Coast and Klamath Province section.

Dams and Water Management/Use

Dams and diversions for hydroelectric power and agricultural diversions disrupt normal flow patterns, increase water temperatures, and block spawning migrations in the province waterways. Hydropower operations cause seasonal fluctuations in river water flows impacting fish, reptiles, amphibians, invertebrates, and plants. Rapid reductions in flows strand spawning salmon and trap young salmon in pools on their journey to the sea. Rapid increases in flow from dam releases scours away amphibian egg masses and tadpoles and inundates turtle nests. Radical stream flow fluctuations and higher-than-normal flows from peaking hydropower projects impact wildlife and their habitats if high-flow releases are improperly timed with migratory or reproductive seasons (Wilcove et al. 1998; Graf 2006).

Hydropower project operations have major consequences for rivers and riverine ecosystems of the Cascades, contributing to the decline of endangered salmon, steelhead, and other fish populations. Thousands of miles of rivers and streams in the province no longer support salmon and steelhead because their migration is blocked by hydropower dams. Large and small dams fragment creeks and rivers, permanently isolating subpopulations of aquatic species such as the Shasta crayfish, Eagle Lake rainbow trout, and Lost River sucker. Increased water temperatures that result from hydropower operations provide suitable habitat conditions for introduced/exotic warm water fish species that compete and prey on native fish and amphibian species. Many locally endemic fish within this province are now either listed as threatened or as species of special concern, such as the Eagle Lake and Goose Lake rainbow trout and tui chubs.

Major dams in the province include those within the Pit River and Lost River watersheds; See Chapter 6 for a description of the Klamath River Dam Removal Project. The lower Pit River is one of California’s most significant hydroelectric rivers because of its perennial flow and steep elevation drop near Shasta Lake. It generates 13 percent of California’s hydropower through a series of dams. Hat Creek and Fall River further up the watershed also house powerhouse dams. Fall River emerges as spring water in the southern Cascades, receives the Bear Creek drainage, and then joins the Pit River.

Although Fall River is known for its premiere wild trout fishery, sediment runoff from past land-use practices in the Bear Creek watershed has polluted Fall River (SWRCB 2016). Large sediment loads, erosion, and declining water quality have degraded habitat essential to the Shasta crayfish and has led to its extremely reduced current range. The several dams and reservoirs within the watershed have degraded the main stem and tributaries of the Pit River. SWRCB listed the Pit River and Fall River as impaired in 2002 for failing to meet state water quality standards (SWRCB 2003).

Clear Lake Dam on the Lost River provides storage for irrigation and reduces flow into the reclaimed portion of Tule Lake and the restricted Tule Lake Sumps in Tule Lake National Wildlife Refuge. Surface waters in the Lower Lost River and its tributaries are listed as impaired for nutrients and impaired for high pH levels (suggesting that biological functions of species are negatively affected by a high pH) as per the 2008-2010 Section 303(d) List (North Coast RWQCB 2015). The combined effects of damming of rivers, instream flow diversions, draining of marshes, dredging of Upper Klamath Lake, and other water manipulations have threatened both the endangered Lost River and shortnose sucker species with extinction (CA Department of Pesticide Regulation 2015). Additionally, water quality degradation in the Klamath Basin watershed through inappropriate grazing and logging techniques, levees, channelization, roads, and other activities has led to large-scale fish kills related to algal bloom cycles. The Klamath Dams Removal Project is described in Chapter 6.

Watershed Fragmentation and Fish Barriers

Aquatic species depend upon the ability to move within watersheds to survive temperature changes and catastrophic events, and access varying habitats at different life-stages. Upstream tributary habitats offer breeding and rearing grounds, and downstream habitats usually provide expanded nurseries with an abundance of nutrients. Annual mixing and migration allow for recolonization of tributary and downstream habitats following catastrophic events, such as floods or fires.

Aquatic connectivity is an important part of overall watershed function, one that has been disrupted by many activities. Present populations of numerous fish species are confined below or above dams or separated by other fish barriers such as poorly designed culverts. These artificial barriers prevent genetic mixing between populations and block recolonization of areas within the watershed. Within these fragmented watersheds, native minnows and other fish and amphibian populations are listed either as threatened or endangered or as species of special concern. Improving fish passage is of particular concern in the Eagle and Goose Lake watersheds within this province.

The Goose Lake watershed is home to four endemic species of fish: Goose Lake redband trout, sucker, tui chub, and lamprey. Goose Lake tributaries are important refugia for these species during extensive dry periods when the lake dries up. The removal of water diversions and fish passage barriers from roads, diversions for livestock and agriculture, levees, and other human activities are critical for maintaining these fish populations without human intervention (e.g., trapping and hatchery production). Because of apparent declines in these native fish populations and the concern over federal and state endangered species listings, the Goose Lake Watershed Council was formed to protect habitat and fish species in the basin. The 1996 Goose Lake Fishes Conservation Strategy continues to guide management priorities for this watershed that include protecting and restoring aquatic and terrestrial habitat and native fish populations. The Council has facilitated habitat improvement projects, riparian fencing, grazing management projects, diversion replacements, fish passage improvements, and installations of fish screens throughout the watershed basin (Lake County Umbrella Watershed Council 2015).

Small-Scale Diversions and Groundwater Use

The cumulative effects of small-scale surface water diversions have substantial consequences for some of the province's river systems including Goose Lake, Eagle Lake, and Lost River watersheds. Agricultural and domestic water use has resulted in low flows and has dried upriver segments. Small-scale diversions to provide livestock water sources have depleted instream flows in some waterways, such as the Eagle Lake and Goose Lake watersheds. These changes will be compounded by longer, drier summers brought on by the effects of climate change.

Eagle Lake rainbow trout are a management priority; they require the removal of water diversions and impoundments along Pine Creek, one of their major spawning areas. The Eagle Lake rainbow trout is uniquely adapted to tolerate the high levels of alkalinity and only occurs naturally in Eagle Lake. Current and ongoing water management pressures to the species include a hatchery weir that blocks access to Pine Creek, water diversions for livestock grazing, and other uses along Pine Creek that dewater the lower reaches. Local wells may also reduce groundwater, drawing water from the aquifer and lower Eagle Lake during extensive dry years and increase the salinity of the water. These pressures threaten the survival of the native trout and other fish species in the lake.

Information on the Klamath Dam Removal Project is found in Chapter 6.

Fire and Fire Suppression

Wildfire is a natural ecosystem process and an ecologically important disturbance in much of the Cascades and Modoc Plateau Province. Prior to European colonization, fire events in this province were caused by lightning and Native American cultural burning practices, both of which contributed to vegetation communities that are adapted to specific fire regimes. While the frequency of fire and annual acreage burned in some vegetation communities remains lower than pre-colonization levels, the size and severity of wildfires has increased over the past three decades. Accurate records of California's wildfire history began in 1932 when detailed records of California's wildfire history became available. Since that time, 18 of the 20 largest wildfires occurred in the last 20 years, and three of those occurred within the Cascades and Modoc Plateau Province (CAL FIRE 2024).

Specific plant communities or habitats in the Cascades and Modoc Plateau Province have evolved within a variety of ranges of fire-return intervals. At higher elevations, vegetation communities of northeastern California are generally adapted to fire return intervals between 12 and 30 years. At lower elevations, and drier sites dominated by shrubs with less dense fuel, natural fire return intervals are generally believed to be 30 to 100 years (Brooks and Pyke 2001). For the past 150 years, land-use activities such as selective harvest of large trees, road building, and intensive grazing, have contributed to altered fire regimes in the province. These land-use activities combined with fire suppression, including the removal of cultural burning on the landscape, and native and non-native plant invasions have decreased fire frequency and increased fire intensity and thus dramatically reshaped forest structure and altered ecosystems throughout the province (Arno and Fiedler 2005).

The proliferation of invasive vegetation can create a vicious cycle of altered fire regime. For example, overgrazing in native shrub-grass communities between the 1860s and the 1930s reduced native perennial grasses, providing conditions beneficial for invasive annual grass and shrub expansion. The proliferation of flammable annual grasses such as cheatgrass and medusa's head have led to increased fuel availability and fire frequency in many areas. A shorter fire return interval has reduced populations of less fire-tolerant shrubs, such as big sagebrush, mountain mahogany, and lower-elevation bitterbrush. More-frequent fire disturbance has facilitated additional invasions of non-native plants, further transforming the plant community to a monoculture of invasive grasses less suitable for native wildlife (Brooks and Pyke 2001).

Fire suppression can also have negative consequences for sagebrush ecosystem responses to wildfire. Where fire occurrence has been reduced on the landscape, native junipers have encroached into the once treeless sagebrush shrublands. When fires do occur in these altered landscapes, the higher density of juniper trees increases the intensity of fires, which enhances the ability of invasive annual grasses to outcompete native shrubs on the post-fire landscape.

Emergency and exemption salvage operations have increased on private timber lands in this province over the past two decades due to recent catastrophic wildfire events. Megafires that have occurred in the province including the North Complex Fire (2020), which burned 318,935 acres, and the Dixie Fire (2021), which burned 963,309 acres and resulted in severely burned mature forested habitats, including portions of the upper Mill Creek and Deer Creek watersheds. Post fire erosion effects are a major concern for the Sacramento and Feather River headwaters. The loss of mid-to-late seral habitats due to extreme wildfire, and their associated sensitive habitats and species, has been catastrophic and unprecedented. Eight California spotted owl activity centers (a documented area of spotted owl use) occurred within the footprint of the Dixie Fire within the Mill Creek and Deer Creek watersheds. Impacts to critical mid and late seral forested habitats result in harmful effects to suitable vegetation structure and cover for sensitive species including Pacific fisher, great gray owl, and Sierra marten. Loss of the mid and late seral habitats also has an impact on cover for mule deer and Columbian black-tailed deer fawning and migration grounds.

One of the major management challenges for this province is sustaining ecosystem functionality, including those provided by historic fire regime (timing, frequency, intensity, and extent), while ensuring safety and avoiding catastrophic events. One strategy needed is to continue working with partner stakeholders to update Best Management Practices (BMPs) for work and projects occurring in native ecosystems with practices that benefit fish and wildlife. To restore native vegetation communities in the Cascades and on the Modoc Plateau, ecologists generally agree that returning fire to forests and shrublands at intervals consistent with historical fire regimes is an important strategy to consider. However, excessive fuel loads created by past forest management practices, effects on air quality and conflicts with clean-air laws, concerns of potential expansion of invasive plants, and liability all impose constraints on the increased use of prescribed fire and allowing natural fires to burn. Even with the development and implementation of California's Wildfire and Forest Resilience Action Plan (CNRA et al. 2021) , which calls for treating 1,000,000 acres of state and federal land annually by 2025, the use of prescribed fire is currently applied to relatively few acres of the state. In areas with excessive fuel loads, other treatment types such as mechanical and manual removal of vegetation are typically necessary before prescribed burns can be implemented. When prescribed burning is not feasible, selective timber harvest, and other fuels reduction methods may serve as the surrogate for natural fire, to begin the process of restoring ecological diversity to vegetation communities in the province. However, these other fuel reduction methods will not provide all of fire's ecological benefits in fire adapted vegetation communities.

Photoload Monitoring at Dutch Flat Wildlife Area

Dutch Flat Wildlife Area is a 160-acre property located about 7 miles north of Adin in Modoc County. The property is managed for the protection of the California Endangered Modoc Sucker, and is also a Type C Wildlife Area. In 2017, the 30,772-acre Cove Fire burned the Dutch Flat Wildlife Area and surrounding areas, resulting in death of most of the overstory conifers present, and damage to the fencing that keeps cattle out of the Modoc sucker habitat. Hazardous fuels reduction needs were identified. Project activities include cutting down the remaining standing dead trees, using equipment to pile the woody debris, and pile burning. After woody debris and dangerous standing dead trees are removed, CDFW will partner with our US Forest Service neighbors to repair fencing needed to protect the Modoc sucker habitat.

Since reduction of hazardous fuels is the goal of the project, the US Forest Service Photoload Sampling Technique was the monitoring data collection method selected. This method estimates the amount of dead, down, and woody fuel present. This information is useful in determining the level of wildfire hazard associated with the present fuel load. Data is collected by selecting sample locations, and matching fuel load conditions within the sample points, to photoload pictures selected for that fuel component. Data was collected prior to the cut, pile and burn fuel reduction operation, and will be compared with post-fuels reduction conditions when the fuels reduction treatment has been completed.

Housing and Urban Areas

Pressures with growth and development have occurred in the lower elevations of the province within the Southern Cascades ecoregion. Rural development has included subdivisions of one to twenty acres on the margins of larger urban and suburban zones around cities outside the ecoregion. The most growth and development has occurred in the mostly privately owned western foothills, such as those east of Redding, and along the foothill river corridors near these cities.

Ranchette and residential communities are expanding from the metropolitan area of Redding in the Cascades region. New development along highway corridors is displacing wildlife habitat and creating barriers in important wildlife migration areas. Key wildlife corridors in the region are crossed by highways. Major highways, such as State Routes 44, 89, 97, and 299, and Interstate Hwy 5, traverse the Southern Cascades and are seeing increased levels of vehicle traffic each year. As development expands on the private lands adjacent to these highways, traffic increases, migrating mule deer, elk, and antelope will be less able to move between seasonal ranges and are impacted by increasing levels of road mortality. Increased traffic loads also increase the frequency of bird, small mammal, reptile, and amphibian mortalities as they attempt to cross the highways. Without conservation planning, future development along these corridors will likely have a significant impact on the region's wildlife distribution and abundance.

In the Southern Cascades ecoregion, development is also expanding into the forest. New golf courses, single-family homes, commercial properties, ski resorts, industrial sites, and new roads are replacing and fragmenting wildlife habitat. Where development occurs, fire is suppressed, preventing regeneration of fire-dependent vegetation and altering plant communities. Development also requires new water diversions and creates new sources of pollution. Mountain meadows, oak woodlands, and riparian streams are places of high wildlife diversity, and they are also preferred sites for development. As seasons change, the survival of many mammals, birds, amphibians, reptiles, and fish species depends on their ability to migrate between higher and lower elevations. Because of development and roads, species are cut off from necessary uplands or aquatic habitats. For instance, turtles and garter snakes inhabiting streams leave to nest and overwinter in the uplands, and pond-breeding amphibians migrate en masse from the uplands to aquatic habitat when winter rains commence. Opportunities to migrate successfully have been compromised by dams, reservoirs, highways, altered stream flows, residential community development, and predation by free-roaming domestic pets.

Invasive Plants/Animals

Invasive Plants

Numerous invasive plants, like perennial pepper weed, cheatgrass, medusahead, red brome, and various non-native thistles and aquatic weeds, such as Eurasian watermilfoil, have displaced native plants and altered local plant communities. Northeastern California has the highest number of species listed by the California Department of Food and Agriculture (CDFA) as noxious weeds in the state. Many weeds come into California from the Great Basin, so management strategies need to consider the regional landscape. Preventing the spread of invasive species through education and early detection are important to maintaining healthy ecosystems. Many of the conservation actions described below address prevention, early detection, and rapid response to new invasive plants to prevent them from becoming widespread. Distribution maps and summary reports for invasive plants, as well as regional strategic plans for prioritized invasive plant species can be found on CalWeedMapper. Some of the invasive species affecting the province are discussed below. Invasive species are discussed in more detail in Appendix E.

One species, cheatgrass, has had a particularly dramatic impact on native shrub and grassland communities on the Modoc Plateau. Native to southern Europe, North Africa, and southwestern Asia, cheatgrass was first dispersed in northeastern California sometime in the early 1900s, probably via contaminated grain seeds. Cheatgrass displaces native grasses and forbs by more effectively tapping soil moisture and hinders seedling establishment of native shrubs by reducing moisture and nutrients in surface soils (Norton et al. 2004). Once established and abundant, cheatgrass facilitates frequent fires by providing a carpet of fine fuels, which carries fire more efficiently than well-spaced native perennial grasses and native shrubs (Pellent 1996). Plant species slow to recolonize following fire, like bitterbrush and sagebrush, decline with increased fire frequencies. Cheatgrass has converted native vegetation to fire-prone grasslands, destroying sagebrush, bitterbrush, and mountain mahogany plant communities. The invasion of cheatgrass, medusahead, and other invasive plants has contributed to the wholesale conversion of thousands of acres of sagebrush, bitterbrush, and mountain mahogany plant communities to annual grasslands less supportive of native wildlife (Miller et al. 1994; Young 2000; Hemstrom et al. 2002; Schaefer et al. 2003).

In the Modoc Plateau ecoregion, the annual grass medusahead is also invading dry shrublands, causing changes in vegetation diversity and fire frequency. Medusahead competes and replaces other annual invasives, such as cheatgrass, leading to monocultural stands of medusahead that are avoided by most native species of terrestrial animals. Medusahead plants are palatable to livestock when the plants are young but become unpalatable as they mature, and silica concentrates in their inflorescence. The high silica content causes the dead plants to resist decay, leading to build up of dense thatch that is composed primarily of medusahead plants. Other plant species cannot germinate beneath this thatch, proliferating the cycle of an ever-expanding monoculture of medusahead. This dense thatch and monoculture is very susceptible to fire and increases fire risk and frequency within these lands. Once burned, the seed bank is composed primarily of medusahead seeds which resprout vigorously and repeat the cycle. Native animal and plant diversity is reduced and threatened in these areas.

Introduced Non-Native Fish

The introduction of non-native fish to lakes and streams has dramatically affected the aquatic life in the province. Specifically, non-native brown and brook trout that prey upon or compete with the native species such as Goose Lake redband trout, have reduced populations of native fishes. Brook trout and brown trout in Davis and Pine creeks have been particularly problematic to the native aquatic assemblages. Brook trout are problematic in Pine Creek in the Eagle Lake Watershed and brown trout within Davis and Pine creeks in the Goose Lake Watershed. In Pine Creek with the Eagle Lake Watershed specifically, brook trout limit populations of Eagle Lake rainbow trout through competition and predation. Brook and brown trout are present in many of the cold-water streams and creeks within the region and CDFW has begun an eradication program within this province to remove these fish from critical native fish spawning and rearing habitat (CDFW et al. 2015). Other species, both native and non-native, such as largemouth bass, blue chub, yellow perch, fathead minnows, and rainbow trout may reduce recruitment of other SGCN such as the Lost River and shortnose suckers. These and other non-native aquatic species may reduce or extirpate populations of sensitive endemic crayfish, amphibians, and fish within the province.

Problematic Native Species – Western Juniper Expansion

Livestock grazing between 1880 and 1930 and fire suppression beginning in the early 20th century, likely facilitated the expansion of native western juniper. Grazing consumed fine fuels, decreasing fire frequency and reducing competition from herbaceous species. (This process began 30 to 50 years before invasive grasses increased fire frequencies in the early 1900s.) The reduced fire frequency allowed western juniper to expand its coverage into sagebrush, bitterbrush, mountain mahogany, riparian, and aspen plant communities (Miller and Rose 1999; BLM 2004). Juniper has flourished by outcompeting other vegetation for water and nutrients and altering ecosystems to such an extent that other once-abundant native plants and wildlife are now scarce in these areas. In the last 130 years, juniper has increased its coverage in the plant communities tenfold and now covers more than 2.5 million acres of northeastern California (USFS 2004; Oregon State University 2005).

The expansion and increased density of this tree reduces shrubs, herbaceous cover, and plant diversity, decreasing habitat for shrub-affiliated native wildlife (Miller et al. 2000; Miller 2001). As juniper crowds out shrubs and forbs, ground- and shrub-nesting birds become absent or exist in low numbers. With the increase in juniper dominance and the decline of sagebrush communities on the Modoc Plateau, greater sage-grouse populations have plummeted. Juniper expansion in the sagebrush biome has also facilitated predation of pronghorn antelope by mountain lion as the availability of cover increases within formerly open pronghorn antelope habitat (Hudgens et al. 2015).

There have been limited efforts to reduce western juniper to encourage the growth of shrubs and grass for forage. The Big Sage Fire Management Unit, which overlies portions of the Devil's Garden and Doublehead Forest Districts of the Modoc National Forest, has a fire plan that allows lightning caused fires to burn with minimum suppression effort. This practice has reduced juniper on several hundred acres. Since 1980, the Doublehead Ranger District has removed about 150 acres per year of western juniper through firewood sales (USFS 1991a). The Cooperative Sagebrush Steppe Restoration Initiative, launched by a coordinated effort of BLM and USFS, is preparing plans for landscape treatments to reestablish the shrub communities that are more important for wildlife. Reestablishing native shrubs and grasses where juniper now dominates is not as simple as cutting down or burning acres of juniper. Invasive annual grasses, rather than native plant communities, are likely to replace the juniper unless conditions are appropriate to benefit the native plants. Conversion of juniper to alternate native plant communities will require careful field testing and analysis of results, followed up with adaptive management (Belsky 1996; Miller et al. 2011).

Livestock, Farming, and Ranching

Livestock Grazing

Livestock production is a major economic activity of northeastern California. The Modoc Plateau and the adjacent forested lands have been grazed since the late 1800s. While livestock grazing practices have improved over the last few decades, excessive grazing continues to degrade shrublands, riparian plant communities, and aquatic ecosystems in the province (USFS 1991b, 2000, 2004). Today, there are very few areas in the province that are not grazed. Grazing allotments cover nearly all public forest and rangelands that can support large herbivores. For example, the Warner Mountain Range is currently managed as rangeland for cattle and sheep, with

28 grazing allotments covering nearly the entire landscape, including much of the South Warner Wilderness Area (USFS 2000).

According to the U.S. Department of Agriculture (USDA) 2013 agricultural statistics, approximately 146,600 cattle are produced within Lake, Lassen, Modoc, Plumas, and Shasta counties; this includes rangeland cattle and feed cattle (USDA 2014). Approximately 50,000 cattle graze in Lassen County on the grasses in the sagebrush areas and on irrigated pasture (DWR 2023). Livestock in the region are typically grazed on private lands in the winter and moved to BLM and USFS lands in the spring and summer. Grazing continues to occur throughout USFS and BLM lands throughout the region.

Livestock grazing can be positive or negative depending on the timing, duration, and intensity of occurrence. There are numerous examples of the importance of private grazing lands to wildlife. For example, over 60 percent of threatened greater sandhill cranes breed on private lands in this region (Ivey and Herziger 2001) where grazing is favorable to wetlands, forbs, and plains that support sandhill cranes. Private lands support relatively high densities of breeding and migrating waterfowl and many other wildlife due to absence of predators and availability of alternative food sources. The Intermountain West Joint Venture is focused on habitat conservation on private lands in the Southern Oregon Northeastern California region to maintain high migratory bird values.

Excessive livestock grazing has both short-term and long-term impacts. Seasonally, grazing reduces available herbaceous vegetation required by native herbivores, and it reduces nesting and escape cover for birds and other wildlife. As upland grasses and forbs dry in the summer, livestock grazing intensifies around riparian and meadow habitats and browsing shifts to other higher-protein sources such as bitterbrush, mountain mahogany, and aspen; annual bitterbrush leaders and willow and aspen shoots are consumed (USFS 1991b; Menke et al. 1996; Loft et al. 1998; Young and Clements 2002). Excessive grazing removes vegetation and causes erosion along springs, creeks, meadows, and riparian corridors of the Modoc Plateau Ecoregion (Moyle et al. 2002).

Decades of excessive livestock grazing have also contributed to long-term ecosystem and habitat changes in the region. Since the late 1800s, overgrazing has triggered change in composition and abundance of grasses, herbs, shrubs, and tree species. Livestock carried seeds of invasive species such as cheatgrass into the region. Grazing pressure created conditions for invasive grasses to outcompete native species and facilitated shrub growth over perennial grasses. Invasive annual grasses, particularly cheatgrass, carpet the landscape with fine fuels conducive to more frequent fires in shrub-grass plant communities (Pellant 1996). Intentional clearing of sagebrush stands to improve range conditions for livestock also contributed to the transformation of shrub habitats.

This combination of grazing-associated pressures has caused landscape-level changes, resulting in steep declines in the sagebrush, bitterbrush, and mountain mahogany plant communities that once supported abundant populations of greater sage-grouse and other shrub-dependent species. Grazing has also degraded wildlife habitat in areas like the sagebrush steppe on the Devil's Garden, the forestlands of the Warner Mountains, and the forest meadows throughout the region, reducing habitat values for native species (Miller et al. 1994; Menke et al. 1996; Young and Clements 2002). Non-wildlife friendly livestock fencing impacts the connectivity of landscapes with migratory ungulates, functioning as barriers for pronghorn antelope movements and predator traps for a species that did not evolve with this infrastructure. Reduced fire frequency and incompatible livestock grazing throughout the growing season have contributed to the decline of aspen communities in the region. Livestock consume aspen suckers and shoots and compact soft soils, preventing the successful regeneration of aspen stands. Like riparian habitats, aspen stands represent a small area of the landscape, but they are very important for supporting wildlife diversity. The multilayered vegetative structure found in the understory of aspen stands consists of herbs, shrubs, and woody debris which provides abundant food and shelter for wildlife. Cottontail rabbit, snowshoe hare, porcupine, beaver, mule deer, blue grouse, quail, flycatchers, bluebirds, and Northern goshawk are among the animals that utilize and rely on aspen communities (Loft et al. 1998; CAL FIRE: FRAP 2003).

Riparian and aquatic ecosystems are particularly affected by livestock grazing today (USFS 1991b). Sedimentation caused by over-grazing on stream or erosion from trampling has caused water quality issues in many of the watersheds within the province including Eagle and Goose Lake watersheds. Water diversions to allow livestock access to fresh water have also caused dewatering of streams of creeks important to critical aquatic species such as those in the Eagle and Goose Lake fish assemblages. Various public and private efforts are under way in the region to restore stream habitats or to prevent further damage from livestock. The Central Modoc Resource Conservation District and the Pit River Watershed Alliance are working with landowners on stream restoration projects. USFS has fenced some streams to protect the endangered Modoc sucker and other species. Rotational grazing systems that provide periodic cessation of grazing pressure on a regular basis have been implemented to restore riparian habitats on many grazing allotments on the Modoc National Forest. The Goose Lake Watershed Council has worked on many habitat improvement projects toward this goal of reducing livestock impacts such as riparian fencing, grazing management projects, and diversion replacements (Lake County Umbrella Watershed Council 2015).

Excessive Feral Horse Grazing

While grazing by feral horses is very limited compared to cattle and sheep grazing in the region, it adds to the total impact of livestock and wildlife grazing. Since the arrival of settlers in the late 1800s, horses have escaped or been released, and today horses roam as wild herds throughout the Modoc Plateau Region. Between 2000–3000 feral horses graze year-round in northeastern California and along border areas of Nevada on BLM and USFS land in 17 California Herd Management Areas. Feral horses graze riparian and aquatic plant communities in late season, when these habitats are most vulnerable to damage (Beever 2003). One of the largest herds in the region is on the Modoc National Forest's 236,000-acre Devil's Garden Wild Horse Territory, overlapping 10 livestock-grazing allotments. Many of the Devil's Garden horses are descendants of draft horses, large animals with big hooves. The heavier animals consume more forage and likely cause more trampling damage to delicate soils and creek beds than smaller horses.

For the past 30 years, USFS, with the help of BLM, has tried to maintain horse numbers in the Wild Horse Territory within appropriate management levels. Excessive horse numbers contribute to overgrazing in the region, leaving less forage and outcompeting wildlife for forage and water resources, degrading range condition, and adding to grazing impacts on seeps, springs, riparian habitat, and aspen stands. The lack of resources to maintain limited horse herd sizes means horses contribute to overgrazing of the region; thus, the combined grazing of livestock and horses far exceeds grazing levels that are compatible with maintaining wildlife diversity and abundance.

Logging and Wood Harvesting

For the last century, forest management practices have adversely affected wildlife and plant communities of the Sierra Nevada, Cascades, and the Modoc Plateau regions. The cumulative effects of even-aged timber-harvest practices, elimination of older trees, snags and brush, logging-road construction, and fire suppression have changed forest plant communities and ecosystem processes. Old-forest conditions (old-growth and late-seral forest) has been drastically reduced throughout the Sierra, Cascades, and Modoc regions (Powell and Blackwell 2001). Fire suppression has allowed denser forests to develop with more shade tolerant trees in the understory causing heightened fire risk and risk of larger, catastrophic fires. While some of these pressures have been reduced in recent years, they all continue to affect the forests' ecosystems and wildlife.

Maintaining diverse wildlife requires forests that contain, in adequate distribution, all sizes and ages of trees, areas of open and closed canopies, and a varied landscape shaped by natural disturbance. Much of the Sierra Nevada, Cascades, and Modoc mixed-conifer forests need to be thinned to restore complex forest structure, improve conditions for wildlife, and reduce the risk of catastrophic fires (Smith 2001).

In addition to treatments of forest stands, regeneration practices following timber harvests or fire are very important in shaping the future forest structure. While timber harvest strategies on public lands are beginning to incorporate wildlife and habitat needs, regeneration practices have generally not made similar changes. In some national forests, regeneration treatments clear shrubs and herbaceous vegetation to promote growth of tree species. Yet shrubs and herbaceous vegetation are particularly important for wildlife. These kinds of post-harvest treatments are more common on private forest lands. The National Forest Management Act and federal regulations prescribe the method and speed of reestablishing the next generation of trees on federal lands (Tappeiner and McDonald 1996). State Forest Practice Rules have similar prescriptions for private forest lands. These regeneration prescriptions are generally designed to enhance timber production and do not generally support regeneration practices specifically to benefit wildlife and restore diverse native plant communities.

Recent additions to state Forest Practice Rules allow for fuel break, meadow restoration and aspen restoration prescriptions within the timber harvest process. These prescriptions provide more tools for private landowners to minimize catastrophic wildfire risk and increase forest stand and landscape diversity. Habitat retention areas and wildlife escapement trees included within an even age harvest can incorporate wildlife and habitat needs and provide habitat diversity as the future stand develops. Approval and implementation of large-scale conservation plans, such as Habitat Conservation Plans, Safe Harbor Agreements, Candidate Conservation Agreements with Assurances, combined with third party forest certification programs, have resulted in much greater retention and recruitment of legacy forest elements on private industrial timberlands and have contributed greatly to the conservation of many listed and sensitive species.

Renewable Energy

While at a slower pace compared to the more populous and industrially developed regions of the state, the Cascade and Modoc Plateau Province renewable energy development is increasing. While the northern part of the state has vast natural resources—such as wind, solar, and geothermal potential, its energy development has been somewhat limited to small-scale residential and agricultural solar and wind projects. Inland areas of the Cascade and Modoc Plateau Province are anticipated to have an increase in renewable energy projects over the next decade, with recent policies like the California Renewable Portfolio Standard, California Assembly Bill 205, and the Bureau of Land Management’s Western Solar Plan. Such initiatives are anticipated to expand renewable energy infrastructure into more rural parts of northern California.

The expansion of renewable energy infrastructure throughout the Cascade and Modoc Plateau Province may pose significant risks to local ecosystems and biodiversity. Large-scale projects, including solar and wind farms, may lead to habitat fragmentation, displacement of species, and direct mortality, particularly of birds, bats and pollinators (Organisation for Economic Co-operation and Development 2024). It's estimated that tens to hundreds of thousands of bats die at wind turbines each year in North America alone (USGS 2020). The United States Fish and Wildlife Service notes two of California's migratory tree-roosting bat species are of particular vulnerability from wind development including the hoary bat (*Lasiurus cinereus*) and silver-haired bat (*Lasionycteris noctivagans*). Hydroelectric developments have been found to disrupt aquatic habitats, affecting fish migration and water quality (U.S. Energy Information Administration 2022). Additionally, construction and infrastructure development may disturb sensitive plant communities and introduce non-native species, furthering the degradation and integrity of the ecological functions of our natural environments (CNPS 2024). Increased human activity in previously undisturbed areas could also lead to disturbances like noise and light pollution and long-term habitat degradation. Without careful planning and mitigation, the growth of renewable energy infrastructure could significantly impact the regions biodiversity.

Climate Change

The climatic changes presented below will likely affect all conservation targets identified in this province. Climate change has only been included as a pressure for a subset of targets that are considered more vulnerable to climate impacts, and/or in instances where it was determined that interactions between climate change and other pressures could be addressed in a meaningful way through a conservation strategy.

The climate projections that follow are presented as averages across the entire province, except where otherwise indicated. While these projections provide more insight into the expected magnitude and direction of change in important climate variables compared to the statewide estimates in Chapter 2, climate change will not in fact unfold uniformly across the province. For additional information on regional variability in climatic change and associated vulnerabilities within the Cascades and Modoc region, refer to the following resources (not an exhaustive list):

- Modoc National Forest Climate Change Trend Summary (USDA Forest Service 2022)
- Sierra Nevada Summary Report: California's Fourth Climate Change Assessment (Dettinger et al., 2018)
- Observed and projected changes in snow accumulation and snowline in California's snowy mountains (Shulgina et al., 2023)

Temperature

Climatic changes in the Cascades and Modoc Plateau Province are expected to include increased mean maximum temperatures of approximately 5.8°F by mid-century (2035–2064, centered on the year 2050) and 9.9°F by end-of-century (2070–2099, centered on the year 2085), compared to a historical baseline period (1961–1990); minimum temperatures are projected to increase across the province on average by 5.3°F by 2050 and 9.1°F by end-of-century (Pierce et al. 2018). Projections were generated based on a high-end greenhouse gas emissions scenario (RCP 8.5) and multiple climate models. Seasonally, these impacts will likely translate to earlier warming in the spring and later cooling in the fall.

Precipitation and Snowpack

Within the Cascades and Modoc Plateau Province, changes in annual precipitation will vary geographically, but average precipitation rates are projected to increase slightly throughout the century (Pierce et al. 2018).

April snow water equivalent, a common measure of snowpack in California, is expected to decline across the state. A loss of snowpack in this region would suggest a potential decrease in duration and magnitude of stream flows, as well as shifts in timing of runoff. Changes in temperature and precipitation, coupled with shifts in hydrologic regimes, may degrade aquatic habitat for some species. Remaining cold-water ecosystems will likely become areas of refugia as climate change impacts unfold on the landscape.

Wildfire Risk

Wildfire risk is determined using several factors. Acres burned and re-burned, fire regime, and probability of ignition, are some of those factors. Over the last 20 years approximately 19%, or 1,725,000 of 9,000,000 acres, have burned and reburned in the Cascades and Modoc Plateau Province in California (2004 – 2023, CALFIRE FRAP fire perimeters). These fires have occurred throughout the province, but some of the largest fires (Antelope, Dixie, Caldwell, and W-5 Cold Springs; totaling approximately 714,000 acres in the province) occurred in 2020 and 2021 alone. In areas that have burned at high severity or at a higher frequency, there has been a conversion of vegetation communities, in part, due to inadequate funding for restoration.

Based on a climate adaptation planning analyses conducted in 2012, a "…substantial increase in wildfire probability was projected in most of the region, especially in Shasta and Siskiyou counties where risks were projected to multiply by 6 to 14 times by the end of the century" (CalEMA and CNRA 2012). Additionally, according to the Projected Effects of Climate Change in California, area burned was projected to increase by up to 50 percent in the northern portion the Southern Cascades (PRBO Conservation Science 2011).

This projection has been updated using the more recent 2018 Cal-Adapt wildfire data from California's Fourth Climate Assessment. Annual area burned across the footprint of this province is expected to increase by approximately 37% by mid-century and 59% by the end of the century under a high-end emissions scenario, compared to a 1961-1990 baseline (Westerling 2018). The Fourth Climate Assessment regional report for the Sierra Nevada indicates that the eastern counties of Modoc and Lassen are projected to have a decrease in annual area burned and consistent average annual wildfire probability of 20% from both 2025 to the mid-century average (2035–2064) and 2025 to the end-century average (2070–2099). In contrast, in Siskiyou County, a 39% and 76% increase in annual area burned is projected from 2025 to the mid-century average and from 2025 to the end-century average, respectively. Similarly, in Shasta County, a 33% and 84% increase in annual area burned is projected from 2025 to the mid-century average and from 2025 to the end-century average, respectively. Both Siskiyou and Shasta counties also have a projected increase in average annual wildfire probability from 20% to 30% from 2025 to the end-century average; however, more concentrated increases in wildfire probability are projected in the Southern Cascades ecoregion. Based on these datasets, wildfire will continue to significantly affect fish and wildlife and their habitats in the Cascades and Modoc Plateau provinces for the foreseeable future.

5.2.6 Conservation Strategies

SWAP 2025 presents conservation strategies, including strategy objectives and targeted pressures, for the Cascades and Modoc Plateau Province. Actions that were identified for specific conservation units are listed with the strategy. Table 5.0 summarizes conservation targets for the province.

Target: North Coastal Mixed Evergreen and Montane Conifer Forests

Representative of cool-temperate forests of northern California. These range inland from the immediate coast and experience warm, relatively dry summers and cool rainy to cool snowy winters. The interior mixed evergreen forests contain madrone, tan oak, Oregon oak, and drier Douglas-fir with canyon-live oak mixes. At higher elevations, ponderosa pine mixes with incense-cedar. Further up in elevation are mixed white fir, sugar pine, and Jeffrey pine communities. The eastern slopes have open ponderosa and Jeffrey pine stands.

Conservation Strategy 1 (Land Acquisition/Easement/Lease): Protect and develop habitat and species conservation appropriate adaptive management plans for conserved land through acquisition and conservation easements.

Objective(s):

- Increase the amount of key conifer areas protected through purchase or conservation easement. Key conifer areas are old-growth forest, wet meadows-, watercourse zones, and nest sites within forest complexes

Targeted pressure(s): Logging and wood harvesting

Conservation action(s):

- Identify and prioritize potential key conifer areas for purchase or conservation easement.
- Develop a habitat conservation plan
- Develop database to track acquisition
- Develop protection criteria for conservation easement language: standardize, complete, doable, executable, legally enforceable, protection criteria
- Complimentary to every acquisition and conservation easement, develop a compliance expectation for resource assessment (data collection), resource management, restoration, monitoring and adaptive management

Conservation Strategy 2 (Data Collection and Analysis): Conduct research, data analysis and management to identify areas with restoration potential to allow prioritization for protection (Conservation Strategy 1) and/or restoration. Work with other agencies doing restoration throughout the region. Map vegetation following standard protocol and fill information gaps into what has already been mapped. Prioritize for restoration areas of encroachment that have not crossed over to juniper woodland.

Objective(s):

- Understand the efficacy of different silviculture techniques to manage forest and reduce catastrophic fire
- Create a record of response of wildlife post-fire and to different types of silviculture treatments
- Document baseline conditions and monitor trends of SGCN using occupancy as a metric
- Document baseline conditions and monitor trends of the conifer forest ecosystem

Targeted pressure(s): Fire and fire suppression; logging and wood harvesting

Conservation action(s):

- Work with federal agencies and add wildlife component to ongoing/funded wildfire research
- Document the response of wildlife post-fire

- Research and document response of wildlife to different types of silviculture methods, fire severity and return intervals
- Document baseline conditions and monitor trends of SGCN using occupancy as a metric
- Document baseline conditions and monitor trends of the conifer forests ecosystem

Conservation Strategy 3 (Outreach and Education): Provide outreach and education for the conservation of natural resources

Objective(s):
- Educate public on the ecological effects of fire severity and frequency and on recent landscape changes within the province
- Relate fire management to beneficial uses of wildlife and biodiversity

Targeted pressure(s): Fire and fire suppression

Conservation action(s):
- Conduct field trips and workshop
- Develop brochures and web content
- Encourage small landowners to do proper fuels (fire prone vegetation) treatment

Conservation Strategy 4 (Law and Policy): Advocate for laws and policies that protect and enhance natural resources

Objective(s):
- Coordinate with agencies to allow fires to burn where it is safe to do so.
- Coordinate with agencies and other partners on policies and resources to reduce the threat of catastrophic wildfire and improve wildfire resiliency.

Targeted pressure(s): Fire and fire suppression

Conservation action(s):
- Prioritize areas for prescribed burning

Conservation Strategy 5 (Law and Policy; Partner Engagement): Engage in decision-making process, through cooperation with federal agencies and private landowners on where prescribed burns and forest thinning would be most beneficial to wildlife; Coordinate with state and federal agencies, tribal governments, the non-governmental organization community and other partners to establish a decision-making process to achieve shared objectives and broader coordination across overlapping areas

Objective(s):
- Cooperate with federal agencies and private landowners on where prescribed burns and forest thinning would be most beneficial to wildlife
- Coordinate with partners to prevent intense wildfires to protect wildlife habitat, water quality, and recreation opportunities

Targeted pressure(s): Fire and fire suppression

Conservation action(s):

- Coordinate with Fire Science Centers
- Engage in forest treatment priorities and elevate wildlife to a higher priority
- Work with USFS to identify possible forest and vegetation treatment areas
- Establish ways to identify and prioritize high value wildlife habitat

Conservation Strategy 6 (Management Planning; Partner Engagement): Develop management plans to improve existing fire management plans and identify high value wildlife habitat

Objective(s):

- Improve existing fire management plans by identifying high value wildlife habitat

Targeted pressure(s): Fire and fire suppression

Conservation action(s):

- Coordinate with state and federal agencies
- Engage USFWS with respect to listed species and management indicator species
- Identify high value forested wildlife habitats

Target: Western Upland Grasslands

Dominated by perennial grasses that are found in moist, lightly grazed, or relic prairie areas. Can be up to 100 percent cover. Includes native grasslands of Idaho fescue, blue wild rye, Great Basin wild rye, ashy ryegrass, Sandberg blue grass, big and bottlebrush squirreltail, one-sided bluegrass. Also includes the non-native grasslands such as creeping bentgrass, velvetgrass, Kentucky bluegrass, Harding grass, and cheat-grass.

Conservation Strategy 1 (Land Acquisition/Easement/Lease): Protect and restore land through acquisitions or conservation easements

Objective(s):

- Restore perennial grasslands

Targeted pressure(s): Annual and perennial non-timber crops

Conservation action(s):

- Conduct assessment of CDFW parcels for potential restoration of perennial grassland, and expand to other landownerships once this objective is met
- Set a restoration target for CDFW lands and other landownerships
- Develop an acquisition plan for perennial grasslands
- Complete management and restoration plan for CDFW lands and expand to other landownerships

Conservation Strategy 2 (Data Collection and Analysis): Baseline data collection and analysis on effect of fire on grasslands

Objective(s):

- Collect and analyze data to understand the optimal fire return interval to promote perennials, control invasive species using fire (timing, intensity), and understand dynamic of fire disturbance regime

Targeted pressure(s): Fire and fire suppression

Conservation action(s):

- Collaborate with USFS Fire Laboratory
- Develop study design for fire response in grassland habitat
- Coordinate with CAL FIRE and USFS to conduct study

Conservation Strategy 3 (Economic Incentives): Provide economic incentives by providing restoration grants, collaborating with federal agencies to identify opportunities to implement joint conservation actions, develop a habitat conservation plan or voluntary local program, or implement candidate conservation agreement to protect candidate species that are vulnerable

Objective(s):

- Provide restoration grants to incentivize landowners to conserve and restore habitat
- Collaborate with federal agencies and identify opportunities to implement joint conservation actions
- Develop a Habitat Conservation Plan (HCP) or voluntary local program such as a Candidate Conservation Agreement. The Candidate Conservation Agreement would focus on protecting candidate species that are vulnerable

Targeted pressure(s): Annual and perennial non-timber crops; livestock, farming, and ranching

Conservation action(s):

- Coordinate development of Private Land Management Plans between CDFW and private landowners
- CDFW develop and enter into excess vegetation disposal agreements or other agricultural leases that benefit wildlife and their habitats

Conservation Strategy 4 (Law and Policy): Advocate for laws and policies by influencing land use policies and coordinating with federal agencies to reduce grassland conversion

Objective(s):

- Coordinate with federal agencies to influence land use policies to reduce grassland conversion

Targeted pressure(s): Livestock, farming, and ranching; fire and fire suppression

Conservation action(s):

- Partner with California Rangeland Conservation Coalition
- Provide input on federal regulation governing grazing allotments
- Engage USFS in review of current BMPs
- Identify laws and regulations governing perennial grasslands and work with governing agencies to apply
- Evaluate the efficacy of creating new policies and regulations protecting grasslands
- Make recommendations to enhance enforcement of existing laws and regulations

Conservation Strategy 5 (Land Use Planning): Provide input on local planning regarding the conservation of natural resources

Objective(s):

- Influence local planning by commenting on general plan updates

Targeted pressure(s): Strategy acts directly on target

Conservation action(s):

- Engage county planning staff on local land use policy

Conservation Strategy 6 (Direct Management): Manage invasive species

Objective(s):

- Control or eradicate invasive species

Targeted pressure(s): Invasive plants/animals

Conservation action(s):

- Conduct assessment of number and species of invasive species
- Develop plan to control invasive species
- Implement management plan to control invasive species

Conservation Strategy 7 (Direct Management): Manage grazing.

Objective(s):

- Improve community composition of perennial grasslands

Targeted pressure(s): Livestock, farming, and ranching

Conservation action(s):

- Conduct pilot project for implementation of grazing BMPs
- Compile recent existing research and management recommendations for management of invasives

Target: Big Sagebrush Scrub; Great Basin Dwarf Sagebrush Scrub; Great Basin Upland Scrub

Big Sagebrush Scrub: Emblematic of the valleys and lower slopes of the Great Basin Desert. It enters the province in the Modoc Plateau and continues south and east of the Cascades. Occupies dry slopes and flat areas within the ecoregion where annual precipitation is usually 16 inches or less. Dominated by shrubs. Most stands are dominated by big sagebrush and mountain sagebrush. Where the soil remains saturated through the spring, silver sagebrush dominates. On low flats with shallow soils and restricted drainage low sagebrush is dominant. Black sagebrush dominates sites with soils high in gravel and carbonates.

Great Basin Dwarf Sagebrush Scrub: Low subshrub sagebrush species. These species form stands on poor soils, or exposed slopes and ridges where larger sagebrush species are unable to grow. The main species in this macrogroup include low sage (Lahontan sagebrush and black sagebrush). Each of these species has different ecological requirements from calcareous shallow soils, deep clay-rich soils, and shallow rocky upland soils.

Great Basin Upland Scrub: Shrublands with cool desert affinities but has been segregated from sagebrush species. Predominant species include fire-sensitive, long-lived species such as blackbrush and mountain mahogany; species which recover well from disturbance include spiny hop-sage, winter-fat, Mormon-tea, and some species of bitterbrush. Shorter fire intervals are conducive to emphasizing perennial grass cover such as desert needlegrass, or Indian rice grass (in sandy areas).

Conservation Strategy 1 (Data Collection and Analysis): Conduct research (data management) on restoration to inform prioritization of potential restoration areas

Objective(s):

- Restoration potential of sagebrush habitat is known
- Coordinate data management efforts between agencies
- Utilize mapping by CDFW and federal agencies to inform prioritization for restoration activities

Targeted pressure(s): Invasive plants/animals (native species encroachment)

Conservation action(s):

- Fill gaps in current mapping to inform prioritization for restoration activities

Conservation Strategy 2 (Outreach and Education): Advocate for wildlife-friendly fire management

Objective(s):

- Develop management practices with USFS that include measures to reduce invasive species by including post-fire treatments
- USFS post-fire treatments prioritize restoring native vegetation to increase fire resistance

Targeted pressure(s): Fire and fire suppression; invasive plants/animals (native species encroachment)

Conservation action(s):
- Coordinate with fire agencies to develop BMPs for active and post-fire treatment
- Review and provide input on firefighting practices
- Develop comprehensive sage habitat map identifying quality and recommended action during fire

Conservation Strategy 3 (Outreach and Education): Provide education and outreach for the ranching public and CDFW staff; educate staff on rangeland science; educate ranching public on the availability of existing BMPs, and the need and status of implementing those BMPs.

Objective(s):
- Provide education and outreach for the ranching public and CDFW staff
- Educate CDFW staff on rangeland science
- Work with the ranching public on the availability of BMPs and the need to properly implement those BMPs

Targeted pressure(s): Livestock, farming, and ranching

Conservation action(s):
- Coordinate with Natural Resource Conservation Service (NRCS) and the California Rangeland Conservation Coalition

Conservation Strategy 4 (Economic Incentives): Provide economic incentives for improved resource management

Objective(s):
- Provide incentives for implementing grazing BMPs on private and public lands

Targeted pressure(s): Livestock, farming, and ranching

Conservation Strategy 5 (Economic Incentives): Obtain funding for resource management

Objective(s):
- Obtain funding for restoration on public and private lands for NRCS sage-grouse initiative

Targeted pressure(s): Invasive plants/animals (native species encroachment)

Conservation Strategy 6 (Law and Policy): Develop BMPs for improved resource conservation.

Objective(s):

- Co-develop BMPs with land management agencies, California Cattleman's Association, California Farm Bureau, and landowners
- Put policies in place that benefit wildlife and sustain sage habitats

Targeted pressure(s): Livestock, farming, and ranching

Conservation action(s) include:

- Create a sagebrush steppe working group
- Identify and review existing grazing management policies
- Develop Memorandum of Understanding (MOU)/Memorandum of Agreement (MOA) between partners
- Provide input to land management agencies on grazing policies

Conservation Strategy 7 (Direct Management): Conduct prescribed burns for fire/fuel reduction and habitat management in conifer/sagebrush areas (like those encroached by pinyon-juniper)

Objective(s):

- Treat higher elevation mountain big sage habitat for cheatgrass and medusahead

Targeted pressure(s): Invasive plants/animals (non-native)

Conservation action(s):

- Coordinate with land management agencies and CAL FIRE to remove cheatgrass and medusahead
- Identify and prioritize candidate treatment areas

Conservation Strategy 8 (Direct Management): Implement habitat restoration and enhancement

Objective(s):

- Restore sagebrush steppe habitat to be functional

Targeted pressure(s): Strategy acts directly on the target

Conservation action(s):

- Protect "wet spots" in the high desert (e.g., springs, seeps, riparian zones, meadows) through fencing or other means
- Select appropriate methodology for priority restoration sites
- Coordinate with local Resource Conservation District, BLM, and USFS

Conservation Strategy 9 (Direct Management): Manage invasive species

Objective(s):

- Agencies and landowners remove pockets of invasive grasses from otherwise intact sagebrush steppe habitat

Targeted pressure(s): Invasive plants/animals (non-native); fire and fire suppression

Conservation action(s):

- Coordinate with land management agencies to reduce spread of invasive grasses such as cheatgrass and medusahead
- Use tools to guide restoration and enhancement efforts
- Set priorities for treatment of invasive species

Conservation Strategy 10 (Management Planning): Provide input on grazing management plans, including review and comment on California Environmental Quality Act (CEQA) and National Environmental Policy Act (NEPA) documents for grazing management plans to help slow or reverse habitat degradation because of the negative impacts of certain grazing practices

Objective(s):

- USFS management plans address how to reduce negative impacts from allotment grazing practices
- USFS grazing allotments are issued with requirements for sustainable grazing practices

Targeted pressure(s): Livestock, farming, and ranching

Conservation action(s):

- Build capacity within CDFW in range sciences
- Identify rangeland experts
- Coordinate with federal agencies
- Conduct review of proposed allotment leases
- Coordinate with development of Total Maximum Daily Loads (TMDL)

Conservation Strategy 11 (Partner Engagement): Implement management partnership/coordination

Objective(s):

- Restore highest priority sagebrush habitat areas
- By 2025, funding and management is pooled across agencies for habitat restoration and sage-grouse management

Targeted pressure(s): Invasive plants/animals (native species encroachment)

Conservation action(s):

- Coordinate with potential partners to agree on objectives and priorities for habitat restoration and sage-grouse management
- Identify areas needing restoration from annual grasses or invasive juniper

Target: Great Basin Pinyon-Juniper Woodland

Found on virtually all exposures and slopes but is common on level to gently rolling topography. Dominated by Utah or western juniper stands. Very little, if any single-leaf pinyon or California juniper, are present. Shrub species include sagebrush, mountain mahogany, bitterbrush and other cool-desert shrubs and grasses. Denser stands are associated with a grassier understory while more open stands have shrubs.

Conservation Strategy 1 (Data Collection and Analysis): Conduct research on climate change

Objective(s):

- Conduct research on climate change impacts to Great Basin pinyon-juniper woodland within the ecoregion and increase CDFW knowledge on climate change/greenhouse gas emissions
- Within three years of the start of research, land management agencies, NGOs, and research scientists are able to access the data
- Within five years of the start of research, areas have been prioritized for restoration, protection or fuels treatments
- By the end of research, data are being used to prioritize areas of restoration, rehabilitation and protection
- Within 10 years of research, findings are used to design management action

Targeted pressure(s): Climate change

Conservation action(s):

- Develop or collect additional information needed on climate change projections for target habitat health and distribution within the Northwestern Basin and Range ecoregion
- Collect data to answer relevant questions on climate change impacts on the conservation target within the Northwestern Basin and Range ecoregion.
- Prepare white papers on research of underlying mechanisms and climate change impacts

Conservation Strategy 2 (Direct Management): Identify highest priority areas for restoration and rehabilitation to protect from annual grass or weed invasion

Objective(s):

- Implement restoration on burn areas

- Treat invasive species

Targeted pressure(s): Climate change; invasive plants/animals

Conservation action(s):
- Restore areas of burned pre-settlement habitats by planting native shrub, forbs and grasses to restrict invasion by annual invasive species
- Treat and control invasive species

Conservation Strategy 3 (Direct Management): Identify highest priority areas for restoration and rehabilitation to lower or eliminate fire risk; conduct prescribed burns and managed thinning in areas of post-settlement (1860) pinyon-juniper and juniper expansion or old growth stands with high canopy cover and fire risk; protect old growth juniper and pinyon-juniper; and continue implementation of Bi-state Action Plan

Objective(s):
- Implement the following management actions:
- Identify and remove priority areas of post-settlement habitat that threaten other macrogroup habitats
- Identify and thin pre-settlement habitat and old growth that require thinning to protect them from high intensity fire
- Identify areas of old growth pinyon-juniper and juniper stands
- Place fuels treatments around identified old growth stands for protection from fire
- Prioritize the highest areas for fire risk of the pinyon-juniper for management

Targeted pressure(s): Fire and fire suppression

Conservation action(s):
- Identify and remove target vegetation in post-settlement sagebrush and scrub target habitat that threaten other sagebrush and scrub target habitats
- Identify and thin target vegetation that was sagebrush and scrub target habitat pre-settlement and areas of old growth pinyon-juniper and juniper that require thinning to protect them from high intensity fire
- Identify areas of old growth pinyon-juniper and juniper and place fuels treatments around them for protection

Conservation Strategy 4 (Partner Engagement): Maintain partnerships through the Bi-state Action Plan, BLM, USFS, NPS, and US Geological Service (USGS) to help coordinate data collection and implement a management plan

Objective(s):
- Maintain current partnerships such as the Bi-State Action plan, a management plan is being implemented and data is being collected for the plan
- Prioritize areas of removal, restoration or protection of pinyon-juniper vegetation are prioritized and implemented with data collected

Targeted pressure(s): Climate change; invasive plants/animals; fire and fire suppression

Conservation action(s):

- Prioritize and implement areas of removal, restoration or protection of sagebrush and scrub target habitat
- Collect data and coordinate with partnership groups

Target: Eagle Lake Native Fish Assemblage

Lake habitats consist of closed basins with large, shallow alkaline water of high pH and warm summer water temperatures. Stream habitats are composed of low gradient, intermittent, streams that cross pine forest and sagebrush flats. The Eagle Lake Native Fish Assemblage consists of five species: Eagle Lake rainbow trout, Eagle Lake tui chub, Tahoe sucker, Lahontan speckled dace, Lahontan redside.

Conservation Strategy 1 (Data Collection and Analysis): Prepare groundwater assessment.

Objective(s):

- Identify location, direction of movement, and quantity of groundwater

Targeted pressure(s): Dams and water management/use

Conservation action(s):

- Coordinate with USFS, DWR, Regional Water Quality Control Board, and private landowners
- Conduct groundwater assessment

Conservation Strategy 2 (Outreach and Education): Provide education and outreach by educating the public on the development, status, and need for BMPs and about invasive species

Objective(s):

- Educate the public on the need for BMPs and keep them informed on development and status of BMPs
- Educate the public about invasive species

Targeted pressure(s): Livestock, farming, and ranching; invasive plants/animals

Conservation action(s):

- Coordinate with NRCS
- Coordinate with USFS and Pine Creek Coordinated Resource Management Process

Conservation Strategy 3 (Economic Incentives): Provide economic incentives for grazing on public lands to follow BMPs.

Objective(s):

- Grazing on private and public lands is incentivized to follow BMPs

Targeted pressure(s): Livestock, farming, and ranching

Conservation action(s):

- Design or support existing incentive programs

Conservation Strategy 4 (Law and Policy): Develop or update grazing BMPs for managed grazing, including barriers to sensitive areas, fencing timing, and grazing rotations

Objective(s):

- Co-develop BMPs with land management agencies, California Cattleman's Association, California Farm Bureau Federation, and landowners
- Have policies that benefit wildlife and sustain habitats

Targeted pressure(s): Livestock, farming, and ranching

Conservation action(s):

- Develop MOU/MOA between partners
- Develop or update BMPs including adding an enforcement policy
- Provide input to land management agencies on grazing policies

Conservation Strategy 5 (Direct Management): Improve road maintenance to reduce sediment from roads entering streams

Objective(s):

- Reduce sediment from roads entering streams (Sediment degrades stream habitat by filling interstitial spaces in gravel affecting fish spawning habitat and invertebrate production, and filling pools.)
- When Caltrans is currently implementing BMPs, look for opportunities for alignment of BMPs through the implementation of SWAP strategies and existing processes such as those in place at Caltrans

Targeted pressure(s): Roads and railroads

Conservation action(s):

- Coordinate with USFS
- Conduct road inventory and evaluation

Conservation Strategy 6 (Direct Management): Manage dams and other barriers by installing control structures (gate or gate valve) to allow more bypass flows and fish passage.

Objective(s):

- Allow more bypass flows to improve in-stream flows
- Allow fish passage on CDFW lands
- Have management plan with BMPs
- Remove Pine Creek Weir and old USGS gauging station

Targeted pressure(s): Dams and water management/use

Conservation action(s):
- Coordinate with USFS
- Identify dams or other barriers to modify or remove to improve fish passage
- Coordinate with USFS to remove USGS gauging weir

Conservation Strategy 7 (Direct Management): Manage invasive species

Objective(s):
- Remove brook trout from Pine Creek

Targeted pressure(s): Invasive plants/animals

Conservation action(s):
- Update data on extent of brook trout in Pine Creek
- Develop strategy for removal of brook trout from Pine Creek
- Coordinate with USFS and private landowners

Conservation Strategy 8 (Direct Management): Manage grazing

Objective(s):
- Reduce grazing impacts to stream(s)/corridor

Targeted pressure(s): Livestock, farming, and ranching

Conservation action(s):
- Construct exclusionary fencing in highly impacted areas to reduce grazing impacts to streams or their corridors
- Coordinate with USFS and private landowners
- Consult with University of California, Extension
- Identify ways to achieve better compliance of BMPs

Conservation Strategy 9 (Direct Management): Encourage use of alternative water sources (wells if sufficient ground water is present), water conservation practices, and reduce the impacts of water loss at water treatment sites.

Objective(s):
- Identify best locations to locate wells and develop wells to replace stream diversions
- Large diversions can be switched from direct use of stream water to wells, improving in-stream flow
- Stock water ponds using streamflow could be switched to wells

Targeted pressure(s): Dams and water management/use

Conservation action(s):

- Coordinate with local districts and USFS on the use of alternative water source (wells)
- Identify problematic sites and candidate alternate water sources

Conservation Strategy 10 (Management Planning): Develop BMPs for water management and conservation in the Pine Creek watershed; Coordinate with USFS to create enhanced wetlands and multi-use management (wildlife, livestock, and fish) policy; Managed water could better be used for fish as there are alternative water sources for wildlife and livestock in the Pine Creek watershed

Objective(s):

- Co-develop BMPs with USFS for enhanced wetland management and agree to the best use of the water

Targeted pressure(s): Dams and water management/use

Conservation action(s):

- Engage Pine Creek Coordinated Resource Management Process working group
- Identify and review existing enhanced wetland management policies.
- Develop or update and implement BMPs
- Develop MOU/MOA between partners

Conservation Strategy 11 (Management Planning): Promote domestic water efficiency and conservation through reducing water use by increased efficiency from residence and businesses

Objective(s):

- Reduced water use by increased efficiency from residences and businesses

Targeted pressure(s): Dams and water management/use

Conservation action(s):

- Coordinate with local and state water management agencies and stakeholders
- Review available information on potential water savings for the North Lahontan watershed
- Develop water conservation campaign

Conservation Strategy 12 (Partner Engagement): Engage in decision-making processes with other public and private entities (including tribal governments) to determine or implement strategies

Objective(s):

- Reduce grazing pressure by animal numbers and duration
- Influence grazing allotment and management plans to reduce livestock impacts on streams

Targeted pressure(s): Livestock, farming, and ranching

Conservation action(s):

- Coordinate with USFS on allotment management plans to reduce grazing impacts on streams and reduce grazing pressure within the watershed

Conservation Strategy 13 (Direct Management): Implement the Eagle Lake Rainbow Trout Conservation Strategy (ELRTCS), which was developed amongst the USFWS, USFS, and CDFW

Objective(s):

- Conserve and enhance the sustainability of the Eagle Lake Fish Assemblage

Targeted pressure(s): Livestock, farming, and ranching; dams and water management/use; invasive plants/animals; climate change

Conservation action(s):

- Improve passage into and through Pine Creek for migration and spawning of Eagle Lake rainbow trout
- Remove or control of the brook trout population in the headwater reaches of Pine Creek and the subsequent establishment and management of a stream-based population of Eagle Lake rainbow trout
- Provide improved passage through the trap/weir structure at the mouth of Pine Creek as well as effective coordination with hatchery operations
- Implement artificial spawning program and monitor genetic integrity to ensure retention of adequate genetic diversity to maintain lake and creek populations
- Implement effective habitat restoration projects and management strategies to improve watershed function and riparian and aquatic habitat conditions: Adaptive management and monitoring of land use activities in coordination with ELRT conservation objectives
- Develop and support research projects to inform adaptive management and success criteria of conservation actions outlined in the plan
- Expand outreach and education programs relating to Eagle Lake rainbow trout and the conservation of its habitats

Target: Goose Lake Native Fish Assemblage

Lake habitats consist of semi-closed basins with large, shallow alkaline water of high pH and warm summer water temperatures. Stream habitats consist of high gradient mountain streams that enter low gradient meadows and grasslands or agricultural lands. Eight fish species are included in the Goose Lake Native Fish Assemblage. Four of these are endemic species unique to the Goose Lake Watershed: Goose Lake redband trout, Goose Lake sucker, Goose Lake tui chub, Goose Lake lamprey.

These species are highly dependent upon stream habitat as refugia during drought and resilient to adverse water conditions. Tributary streams also provide important refuge habitat for these species during drought and low lake levels. The other four species are primarily stream-dwelling: Pit-Klamath brook lamprey, Speckled dace, Northern roach, and Pit sculpin.

Conservation Strategy 1 (Data Collection and Analysis): Design and implement inventory and assessment of fish populations and fish habitat

Objective(s):

- Collect baseline information on fish populations and fish habitat for the Goose Lake Native Fish Assemblage

Targeted pressure(s): Strategy acts directly on target

Conservation action(s):

- Coordinate with Oregon Department of Fish and Wildlife, USFS, and the Goose Lake Fishes Working Group

Conservation Strategy 2 (Outreach and Education): Education and outreach; inform public of restoration plans and why treatment is necessary.

Objective(s):

- Raise public awareness and support by starting education and outreach before the restoration project is implemented
- Continue education and outreach after restoration
- Target landowners, anglers, and agencies for outreach

Targeted pressure(s): Invasive plants/animals

Conservation action(s):

- Coordinate with USFS, Goose Lake Fishes Working Group and with agricultural organizations in the area

Conservation Strategy 3 (Law and Policy): Develop or update grazing BMPs and conduct managed grazing

Objective(s):

- Reduce grazing impacts to streams, stream corridors, and assemblage habitat

Targeted pressure(s): Livestock, farming, and ranching

Conservation action(s):

- Coordinate with USFS, NRCS, California Cattleman's Association, California Farm Bureau Federation, and private landowners to develop or update BMPs that reduce grazing impacts to stream(s)/corridors and impacts on habitat
- Consult with University of California, Extension

Conservation Strategy 4 (Direct Management): Reduce livestock access to natural water features with wells and alternative water sources

Objective(s):

- Provide off-stream watering sources and construct exclusionary fencing (to exclude livestock)

Targeted pressure(s): Livestock, farming, and ranching

Conservation action(s):

- Coordinate with Oregon Department of Fish and Wildlife
- Coordinate with USFS and private landowners on use of alternative watering locations and exclusionary fencing
- Quantify impact of livestock having access to watercourses
- Identify alternative watering structures and water sources
- Identify locations to develop off-stream water sources and exclusionary fencing
- Update Goose Lake Conservation Strategy
- Obtain permits and conduct environmental reviews
- Implement contract for construction
- Develop budget, identify grant sources, and apply for funding

Conservation Strategy 5 (Direct Management): Manage invasive species.

Objective(s):

- Remove brown trout from Davis and Pine creeks

Targeted pressure(s): Invasive plants/animals

Conservation action(s):

- Update data on extent and distribution of native and non-native species in Davis and Pine creeks
- Initiate long-term monitoring and management plan

Conservation Strategy 6 (Direct Management): Manage dams and other barriers.

Objective(s):

- Allow more bypass flows through water conservation to improve flows in streams
- Gather and analyze data on water use and fish connectivity; gather baseline information on the current conditions of water use, water use efficiency, and fish passage, including allocating the major barriers

- Develop restoration and management plans to investigate the impact to stream flow from water diversion, including stream flow modification and fish passage barriers
- Investigate the potential to develop water conservation and fish passage barrier modification measures and evaluate the effectiveness of these measures
- Prioritize the conservation scope by deciding the timeframe of restoration and the appropriate restoration tools and methodology; Find funding to contract the plan development and implementation of restoration and management

Targeted pressure(s): Dams and water management/use

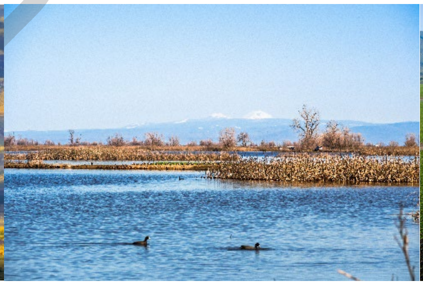
Conservation action(s):

- Coordinate with private landowners
- Inventory barriers and assess flow and water condition
- Obtain permits and conduct environmental review
- Implement water conservation flow

5.3 Bay Delta and Central Coast Province

5.3.1 Geophysical and Ecological Description of the Province

The Bay Delta and Central Coast Province contains an important geophysical and ecological complex of estuaries, coastal valleys, and coast range mountains, comprising over 300 miles of central California coast between the Southern California Bight and the North Coast and extending approximately 75 miles inland from the Pacific Ocean (Figure 5.3-1). While the Bay Delta region plays many important ecological roles on its own and is affected by most of the state's ecosystems north of the Tehachapi Mountains, incorporating the Bay Delta region with the Central Coast as one province associates it with several other critical estuarine habitat and coastal areas. Geophysically, the province is defined primarily by the Southern Coast Ranges, with many peaks in between 3,000 to over 4,000 feet elevation up to the tallest at 5,862 feet, which is Junipero Serra Peak in the Santa Lucia Range. Between mountain ranges are broad coastal valleys, such as the Santa Clara Valley and Salinas Valley. Ecologically, the province contains extensive areas of some of the most important and sensitive salt, brackish, and freshwater habitats in the state, including the San Francisco Bay system; Sacramento-San Joaquin Delta; and the Elkhorn Slough, Carmel River, and Morro Bay estuaries. Overall, the habitats of the province are highly varied, including tidal marsh, broad areas of cultivated lands in valleys, vital intact relicts of the San Joaquin Desert, valley and mountain riparian corridors, coastal grasslands, chaparral and other scrub plant communities, and large areas of forest and woodland habitats. The Bay Delta and Central Coast Province also contains two of the three core areas for recovering San Joaquin Desert species (the Carrizo Plains and Ciervo/Panoche area) and the remaining habitat and populations that link all three of the core areas.


Bay Delta

Encompassing 1,600 square miles of waterways, the San Francisco Bay and Sacramento-San Joaquin River Delta (Delta) together form the West Coast's second largest estuary and the third-largest estuary in the nation. Much of the region, combined with the Central Valley, is part of a vast hydrological system that drains 40 percent of the state's fresh water. This water, falling as either rain or snow over much of the northern and central parts of the state, drains along the Sacramento, Mokelumne, and San Joaquin rivers into the Delta. In the Delta, fresh water from these rivers mixes with salt water from San Francisco Bay, creating a rich and diverse estuarine ecosystem.

The Bay Delta has two subregions: the San Francisco Bay Area and the Delta. The San Francisco Bay Area subregion is the most densely populated area of the state outside of the Southern California metropolitan region. It consists of low-lying baylands, aquatic environments, and watersheds that drain into San Francisco Bay. Low coastal mountains surround San Francisco Bay, with several peaks rising above 3,000 feet. The region receives 90 percent of its surface water from the Sierra Nevada via major Central Valley creeks and rivers that feed the Delta. Other rivers draining into the Bay include the Napa, Petaluma, and Guadalupe rivers and Sonoma, Alameda, and Coyote creeks. The Bay Area has relatively cool, often foggy summers and cool winters, strongly influenced by marine air masses. Rain falls almost exclusively during the winter season (October to April) and averages 15 to 25 inches annually, with occasional snowfall at higher elevations. Rainwater runs off rapidly, and most of the smaller streams are dry by the end of the summer.

The topography allows for a variety of different habitats. The Bay itself has both deep and shallow estuarine (mixed fresh water and salt water) environments. In addition to estuarine species, the Bay also supports many marine species, including fish, invertebrates, sharks, seals, and even, on occasion, whales. Along the shoreline are coastal salt marsh, coastal scrub, tidal mudflats, and salt ponds. Freshwater creeks and marshes, especially those that still have patches of riparian vegetation, are home to aquatic invertebrates, and anadromous and freshwater fish. Upland areas support a mixture of grasslands, chamise chaparral, and live oak and blue oak woodlands. Small stands of redwood, Douglas fir, and tanoak grow in moister areas.

The Delta is a low-lying area that contains the tidally influenced portions of the Sacramento, San Joaquin, Mokelumne, and Cosumnes rivers. The Delta was once a huge marsh formed by the confluence of the Sacramento and San Joaquin rivers. Once described as a "terraqueous labyrinth of such intricacy that unskillful navigators have been lost for days in it" (Bryant 1849), the Delta has been extensively drained and diked for flood protection and agriculture. Exposure of the rich, organic soils behind these levees has increased oxidation rates to such an extent that the land is breaking down and much of the surface has now subsided below sea level. Because of its natural patterns of flooding, the Delta is relatively less populated than the other subregions.

The wildlife of the Bay Delta is affected by a wide variety of pressures, described below. The major problem has been the loss, degradation, and fragmentation of habitats, both terrestrial and aquatic, because of the development of agriculture, urban areas, and water management. Since the Gold Rush, significant loss of wetlands has occurred as a result of diked agricultural lands, commercial salt ponds, ports, airports, transportation, and other development. Virtually all the streams and rivers that enter the Delta have been dammed, blocking fish migration, or have severely degraded habitat for salmon and other anadromous and resident fish. Flood control structures, such as dikes, levees, and hardened embankments (riprap), have altered floodplain habitats, such as riparian forests and wetlands, throughout the region. Additionally, the biomass of the San Francisco Bay and Delta waterways is dominated by non-native species, which has shifted the food-base and reduced the aquatic biological diversity. Invasive cordgrass (*Spartina)* has become established in coastal areas, including mud flats, salt marshes and beaches, out-competing native plants. This region is primarily in private ownership, and the role of private landowners is very important for conservation. Additionally, water diversions for agricultural, industrial, and municipal uses, export of water to users south of the Delta (and shifts of flow patterns from west-east to north-south), and salinity control have dramatically altered water availability and ecosystem functions.

In many parts of the San Francisco Bay, there have been shifts in the locations of the baylands and adjacent habitats. These shifts have resulted from a combination of urbanization of moist grasslands and vernal pool complexes, reclamation of tidal habitats, and sediment deposition in subtidal habitats. Reclamation has converted much of the tidal habitats into agriculture or seasonal wetlands, while urbanization destroyed similar habitats in the adjacent uplands. Sedimentation has converted some subtidal areas to more shallow tidal habitats. The combined effect of these changes has been to shift seasonal wetlands and the baylands bay ward. The desired landscape elements sought within tidal marsh restoration projects are open water areas within the tidal marsh of both shallow (for shorebirds) and deeper (for waterfowl) depths (SF Bay Area Goals Project 1999).

The Sacramento-San Joaquin River Delta has been stressed intensively by human pressures. Its ecosystem functions have been in steep decline (e.g., pelagic organism declines), which jeopardizes the Delta’s ability to support essential habitat for its fish and wildlife species and to provide water supplies to the state.

The nontidal freshwater marsh natural community is composed of perennially saturated wetlands, including meadows, dominated by emergent plant species that do not tolerate perennial saline or brackish conditions. Conversely, the tidal freshwater marsh community (subsumed under the salt marsh natural community description) in the Delta and Suisun Marsh are dominated by emergent plant species that tolerate freshwater to brackish conditions. Nontidal freshwater perennial marsh communities occur in small fragments along the edges of the nontidal perennial aquatic and valley/foothill riparian natural communities. Soils are predominantly silt and clay, although coarser sediments and organic material may be intermixed. Tidal freshwater

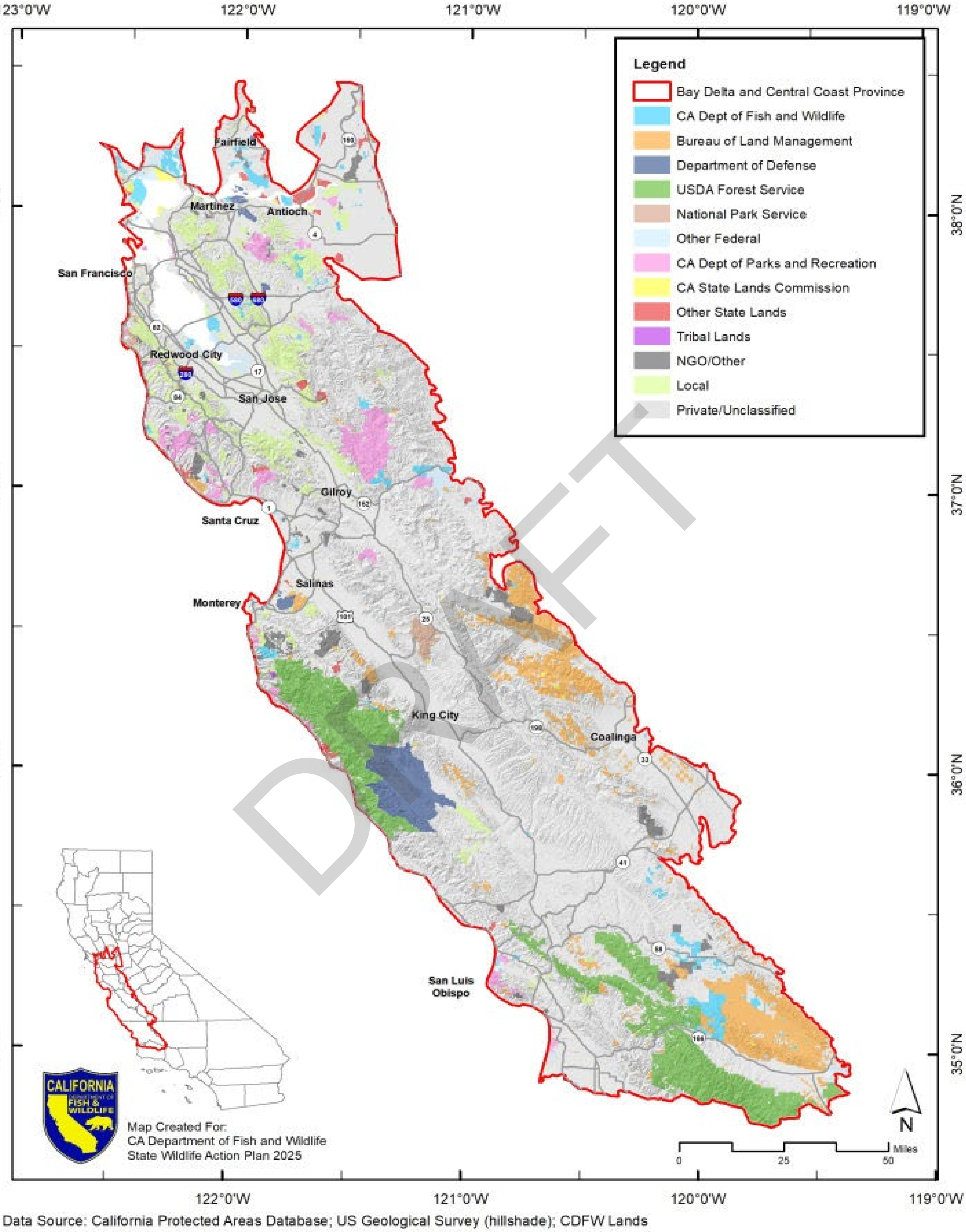


Figure 5.3 - 1 Landownership of the Bay Delta and Central Coast Province

marsh communities are similarly located in small fragments along the tidal shorelines of rivers and sloughs, scattered along the levees of reclaimed islands and tracts, and within restored and managed wetlands in the Delta and Suisun Marsh. In some areas, especially in the Delta and Suisun Marsh, organic soils (peat) may constitute the primary growth medium. The extent of tidal and nontidal freshwater perennial emergent wetland in California, including the Delta, has declined dramatically over the past century due to reclamation and conversion of the habitat to other uses, primarily agriculture (Gilmer et al. 1982; Alevizon and Vorster 2018). The extent of these natural communities in the Delta has been dramatically reduced in the past century, with a corresponding reduction in habitat function for associated fish and wildlife species (Alevizon and Vorster 2018).

Bay-Delta Live

Bay-Delta Live (BDL) is a data hub of information needed in understanding the dynamic ecosystem known as the Sacramento-San Joaquin River Delta. BDL's purpose is to expand access to data for the Delta. Members of the BDL community can view data from multiple sources with a set suite of tools such as visualizations and time series analyses to expand knowledge and reach of information to the public. BDL is supported through contributions from federal and state agencies, as well as community and agency information. Data providers include CDFW, California Department of Water Resources, U.S. Geological Survey, U.S. Fish and Wildlife Service, and U.S. Bureau of Reclamation.

Because of the conservation and management complexities and challenges facing the Bay Delta, the SWAP team implemented a focused approach to identifying pressures, conservation targets, and conservation strategies for the region during the 2015 SWAP update, which was also used for the 2025 SWAP update. An interdisciplinary team representing CDFW (from Marine Region, Bay Delta Region, Water Branch, and Fisheries Branch), Sacramento-San Joaquin Delta Conservancy, and U.S. Fish and Wildlife Service (USFWS) worked with experts from the San Francisco Bay Joint Venture and the Central Valley Joint Venture to develop 2015 conservation strategies. This SWAP regional team recognized that this task required a unique melding of regional boundaries and general habitat types, designated as the Bay Delta Conservation Unit, for the SWAP update (see Figure 1.4-5). The boundary for this conservation unit consists of the entire San Francisco Bay and portions of the San Francisco Bay (HUC 1805), Sacramento River (HUC 1802), and San Joaquin River (HUC 1804). The boundary includes areas of tidal influence, areas of salt marsh vegetation, and lowland elevations behind dikes/levees. In addition, the area was increased to roughly incorporate a 1-meter sea-level rise to account for climate change.

In addition, the SWAP regional team recognized that a critical step for developing conservation strategies for an area as broad, complex, and diverse as the Bay Delta was to first gather existing peer reviewed published literature on the San Francisco Bay and Delta. Due to broad user group interests, complex biological interactions, and diverse habitats of the Bay Delta, several organizations and agencies have published studies, reports, and restoration plans for the region. The SWAP regional team assembled a list of the most relevant environmental planning documents for review and synthesis. These documents are called "reference documents" in the discussion below.

- The SWAP regional team developed targets and conservation strategies based on discussion and reference documents. The SWAP team identified underrepresented conservation strategies from the reference documents that warranted specific attention. Furthermore, the interdisciplinary and iterative approach allowed the SWAP regional team to evaluate baseline concepts in concert with outside representatives from the scientific community, fill in areas where concepts appeared to be lacking, and develop conservation strategies for a target that provides broad ecosystem benefits. The following reference documents were reviewed and synthesized by the SWAP regional team to develop targets and conservation strategies presented in this chapter.
- Restoring the Estuary: Implementation Strategy of the San Francisco Bay Joint Venture — A Strategic Plan for the Restoration of Wetlands and Wildlife in the San Francisco Bay Area (SF Bay Joint Venture 2022)
- San Francisco Bay Subtidal Habitat Goals Report: Conservation Planning for the Submerged Areas of the Bay (CA SCC 2010)
- Bay Delta Conservation Plan (DWR and USBR 2015)
- California WaterFix
- Central Valley Joint Venture– Conserving Bird Habitat (Central Valley Joint Venture 2006)
- The Delta Plan: Ensuring a Reliable Water Supply for California, a Healthy Delta Ecosystem, and a Place of Enduring Value (DSC 2013, 2024)
- Sacramento-San Joaquin Delta Native Fishes Recovery Plan (USFWS 1995)
- Suisun Marsh Habitat Management, Preservation, and Restoration Plan (USBR et al. 2013)
- Baylands Ecosystem Habitat Goals: A Report of Habitat Recommendations Prepared by the San Francisco Bay Area Wetlands Ecosystem Goals Project(SF Bay Area Goals Project 1999)

- The Riparian Bird Conservation Plan: A Strategy for Reversing the Decline of Riparian Associated Birds in California (Riparian Habitat Joint Venture 2004)
- Conservation Strategy for Restoration of the Sacramento-San Joaquin Delta, Sacramento Valley, and San Joaquin Valley Regions (CDFW 2014)
- California Marine Life Protection Act Initiative. San Francisco Bay Options Report: Considering MPA Planning (CDFG 2011)
- Central Valley Flood Protection Plan 2022 Update (DWR 2022)
- State of the State's Wetlands: 10 Years of Challenges and Progress (CNRA 2010)
- The Baylands and Climate Change: What We Can Do. Baylands Ecosystem Habitat Goals Science Update 2015 (SF Bay Area Goals Project 2015)

Central Coast

California's Central Coast region encompasses approximately 8 million acres and extends from the southern boundary of the Los Padres National Forest north to the San Francisco Bay lowlands. Inland, the region is bounded east of the Diablo and Temblor mountain ranges. The Central Coast landscape is characterized by a rugged coastline, small mountain ranges that roughly parallel the coast, river valleys with rich alluvial soils and arid interior valleys and hills. Across the region, differences in climate, geography, and soils result in widely varying ecological conditions, supporting diverse coastal, montane, and desert-like natural communities.

Sand dunes and wetlands occur along the coast. River mouth estuaries, lagoons, sloughs, tidal mudflats, and marshes make coastal wetland communities a unique environment where marine, freshwater, and terrestrial systems meet. Coastal habitats support numerous shorebirds, including the western snowy plover, willet, whimbrel, long-billed curlew, marbled godwit, and American avocet. Coastal estuaries provide important nursery habitats for anadromous and marine fish, especially in watersheds where small or seasonally dry upper tributaries provide limited rearing capacity (CDFG 1996). Elkhorn Slough and Morro Bay are the region's two largest estuaries, with other significant wetlands found at the Pajaro, Salinas, Carmel, and Santa Maria river mouths, Devereux Slough, and Goleta Slough (Page and Shuford 2000), and Pescadero Marsh. During the last 30-year years, the salt marsh of Elkhorn Slough has been recolonized by large numbers of sea otters, and it may be their preferred habitat.

Other coastal habitats include native coastal prairie grasslands, coastal scrub, and maritime chaparral. Coastal scrub and grasslands also extend inland along river valleys, like the lower Salinas Valley, where the moist maritime climate reaches through gaps in the coastal ranges. Maritime chaparral, characterized by manzanita and California lilac species adapted to the foggy coastal climate, once dominated sandy hills along Monterey Bay, Nipomo Mesa, Burton Mesa, and Morro Bay. Maritime chaparral is now one of the region's most pressured community types, with its extent severely reduced by development. These scrub and chaparral communities provide important habitat for Morro Bay, Santa Cruz, and Pacific kangaroo rat species and the San Diego desert woodrat, as well as shrubland bird species, including California quail, sage sparrow, rufous-crowned sparrow, and the sensitive California thrasher and Costa's hummingbird. Additionally, several species of rare plants occur in maritime chaparral habitats.

The outer coastal ranges, including the Santa Cruz and Santa Lucia mountains, run parallel to the coastline. Well-watered by the moist ocean air, these slopes are drained by streams that run all year. The Santa Lucia Mountains provide most of the water supply to the Salinas River. These ranges support mixed coniferous forests and oak woodlands. The oak woodlands and savannas produce mast crops that are important seasonal resources for deer, bears, band-tail pigeons, and other wildlife. The dominant coniferous species include ponderosa pine, Douglas fir, red alder, and, in the north, redwoods. The oak woodlands are dominated by coast live oak, blue oak, and valley oak. Rarer, endemic tree species include Monterey pine and Santa Lucia fir. Wildlife inhabitants of the outer coastal mountains include wide-ranging species such as tule elk, mountain lion, and bobcat, and sensitive species that include California spotted owl, American badger, peregrine falcon, and golden eagle.

Moving inland across the Gabilan, Diablo, Temblor, and Sierra Madre mountain ranges, the climate becomes progressively drier, and the vegetation shifts to oak woodlands, grasslands, interior chaparral, and desert-like interior scrub. Interior streams are often intermittent, drying in the summer and fall, except at the higher elevations of the Sierra Madre and Diablo ranges, where streams run year-round. Additionally, many streams in San Luis Obispo and Monterey counties run year-round in their upper reaches. Biologically diverse oak woodland communities support more than 200 species of plants, 300 vertebrates, and 5,000 invertebrates (TNC 1997; Thorne et al. 2002). Inhabitants of oak woodlands include western gray squirrel, dusky-footed woodrat, Monterey dusky-footed woodrat, pallid bat, and Townsend’s big-eared bat. Large expanses of annual grasslands, now dominated by non-native grasses, are inhabited by California ground squirrel and black-tailed jackrabbit, along with sensitive species that include giant kangaroo rat, burrowing owl, San Joaquin kit fox, American badger, tule elk, and, in the southern portion of the region, reintroduced pronghorn. Interior chaparral habitats support drought-resistant woody shrubs, including manzanita, California lilac, and chamise.

The Central Coast’s largest drainages include the Salinas, Carmel, Santa Maria, Pajaro, and Santa Ynez watersheds. Riverine and riparian habitats are important to amphibian and reptile species, including California red-legged frog, Foothill yellow legged frog, and western pond turtle, and birds such as bank swallow, Lawrence’s goldfinch, and least Bell’s vireo. Steelhead and coho salmon are still present, in reduced numbers, in most of the streams where they historically occurred. Mammals that use riparian habitats include gray fox, striped skunk, mole and shrew species, and ringtail.

Higher-elevation riparian vegetation in moist coastal climates includes willow, alder, bay, maple, Douglas fir, and sometimes redwood. Valley-bottom riparian communities are dominated by sycamore, willow, alder, and cottonwood. Steep coastal streams in the forested Santa Cruz and northern Santa Lucia mountains are some of the region's most intact systems and host relatively healthy anadromous fish populations (CDFG 1996). In contrast, the majority of the region's large river-valley floodplain and riparian forests have been replaced by agriculture, and lowland fish assemblages have been severely compromised.

Seasonal vernal-pool wetland complexes are found in many parts of the region, including the Salinas River drainage and coastal dune terraces and mesas of Santa Barbara County. The San Andreas Fault and Rift Zone creates a north-south corridor of extensive, abundant, seasonal sag ponds extending from the Palo Prieto area in San Luis Obispo County into Santa Clara County. California tiger salamanders, western spadefoot, fairy shrimp species, and many endemic plant species depend on these unique seasonal pool habitats.

The San Andreas Fault runs the length of the region and shapes much of the region's geography. Most of the north-south running mountain ranges and valley depressions have been formed as a result of pressure between the two continental plates meeting at this fault zone. Compression, chemical interaction, and surfacing of ancient seabed sediments have produced serpentine soils that are rich in heavy metals such as chromium, nickel, and cobalt, but poor in nutrients, and have poor water-holding capacity. A number of plants have adapted to these harsh, near-toxic conditions, resulting in unique, island-like ecological communities largely restricted to serpentine areas.

Historically, urban centers have been located along the region's coastal lowlands, with crop production concentrated in valley-floor areas and grazing and natural lands occupying the surrounding foothills and mountainous areas. In recent years, however, population pressures have increased, and growth and development have expanded from urban centers to adjacent farmlands and rural areas both on the coast and in the interior portions of the region. Along with population growth, the greatest pressures to regional wildlife diversity are expansion of intensive types of agriculture, invasions by nonnative species, and overuse of regional water resources. Despite these significant regional pressures, large blocks of undeveloped natural lands remain, and the region presents many opportunities to accomplish conservation on a landscape-scale.

5.3.2 Conservation Units and Targets

The conservation units associated with the Bay Delta and Central Coast Province are the Central California Coast and Central California Coast Ranges ecoregions (Figure

5.3-2), Bay Delta conservation unit, which includes portions of HUC 1805, HUC 1802, and HUC 1804 (see Figure 1.4-5), and Central California Coastal (HUC 1806) hydrologic unit (Figure 5.3-3) are summarized below.

Ecoregion Summaries

Central California Coast: This ecoregion consists of mountains, hills, valleys, and plains in the southern Coast Ranges of California. Elevation range: 0 to 3,800 feet

Central California Coast Ranges: This ecoregion is the interior part of the southern Coast Ranges of California, south of the Carquinez Strait. It is inland from the coast far enough that the climate is modified only slightly by marine influence. It is bounded on the northeast by the alluvial plain of the San Joaquin Valley and on the southwest by the coastal part of the southern Coast Ranges. It extends south to the Transverse Ranges. Elevation range: 100 to 5,200

Bay Delta Conservation Unit: Includes the drainage into the Pacific Ocean from the Stemple Creek Basin boundary in Sonoma and Marin counties south to and including the Pescadero Creek Basin in San Mateo County, excluding the Sacramento and San Joaquin River Basins in California. Covers an area of 4,470 square miles. Elevation range: 0 to 3,380

Hydrologic Unit Summaries

Central California Coastal HUC 1806: Includes the drainage into the Pacific Ocean from the Pescadero Creek Basin boundary in San Mateo County south to and including the Rincon Creek Basin along the border of Ventura and Santa Barbara counties in California. Covers an area of 11,400 square miles. Elevation range: 0 to 5,900.

Conservation Targets

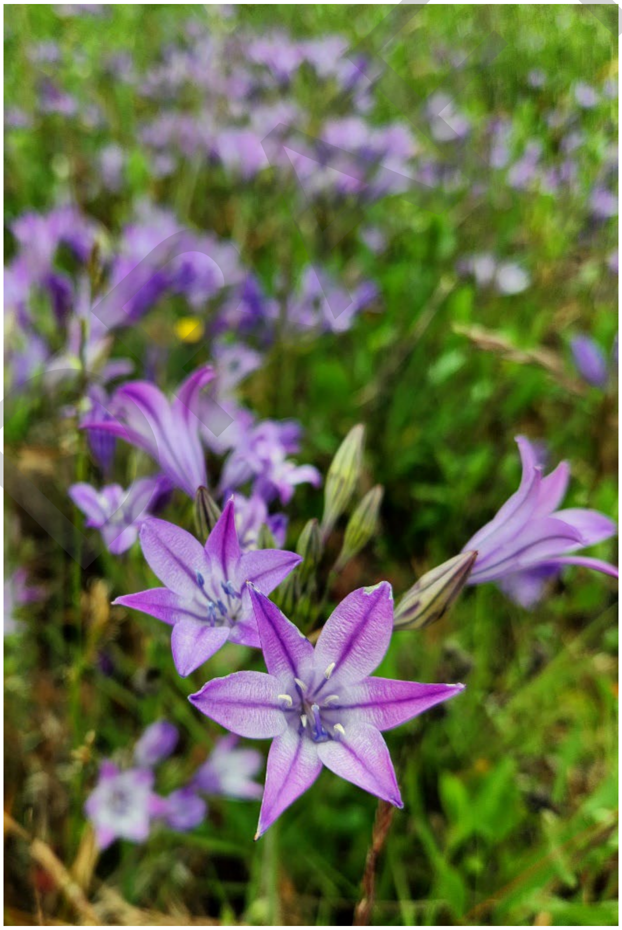
Conservation targets were selected in this province as priorities for conservation planning within the conservation units; targets are listed in a searchable, sortable table (Table 5.0). The conservation targets are summarized in Section 5.3.6 along with the strategies for each. The conservation targets include:

- American Southwest Riparian Forest and Woodlands
- California Foothill and Valley Forests and Woodlands
- California Grassland, Vernal Pool, and Flowerfields
- Chaparral
- Coastal Dune and Bluff Scrub
- Coastal Lagoons
- Coastal Sage Scrub

- Freshwater Marsh
- North Coast Deciduous Scrub and Terrace Prairie
- Northwest Coast Cliff and Outcrop
- Salt Marsh

Although numerous potential conservation targets were identified within the province, conservation strategies were only developed for the targets that contain the greatest number of Species of Greatest Conservation Need (SGCN) and that are under immediate threat. Additional key targets will be addressed through future conservation planning efforts.

Figure 5.3-4 shows the distribution of the plant communities (CWHR common names) within the province. Some of the plant communities identified as conservation targets do not appear on the figure because they exist in areas smaller than the mapping unit. Information about the methods used to prioritize conservation targets is presented in Chapter 1.4 and Appendix D.



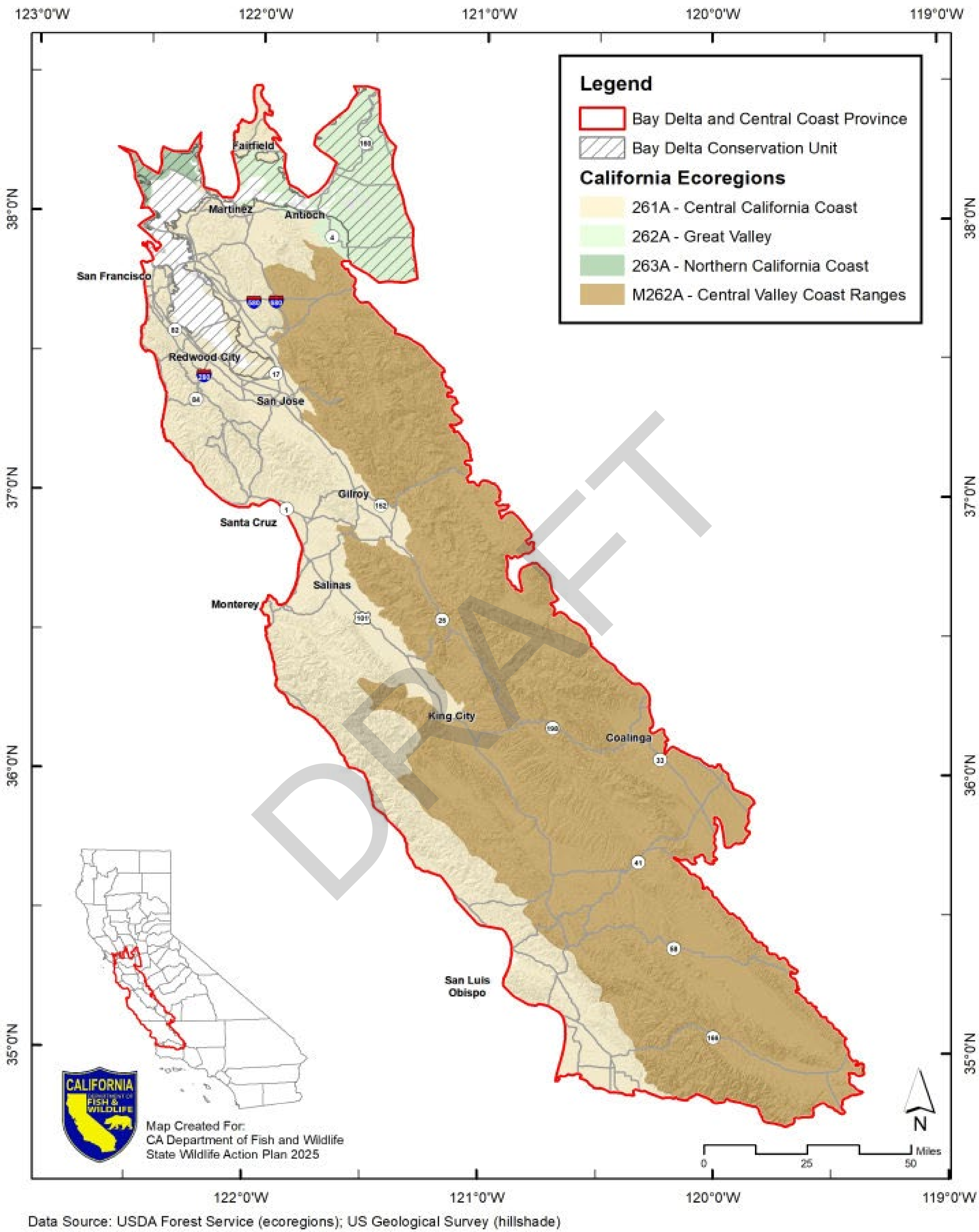
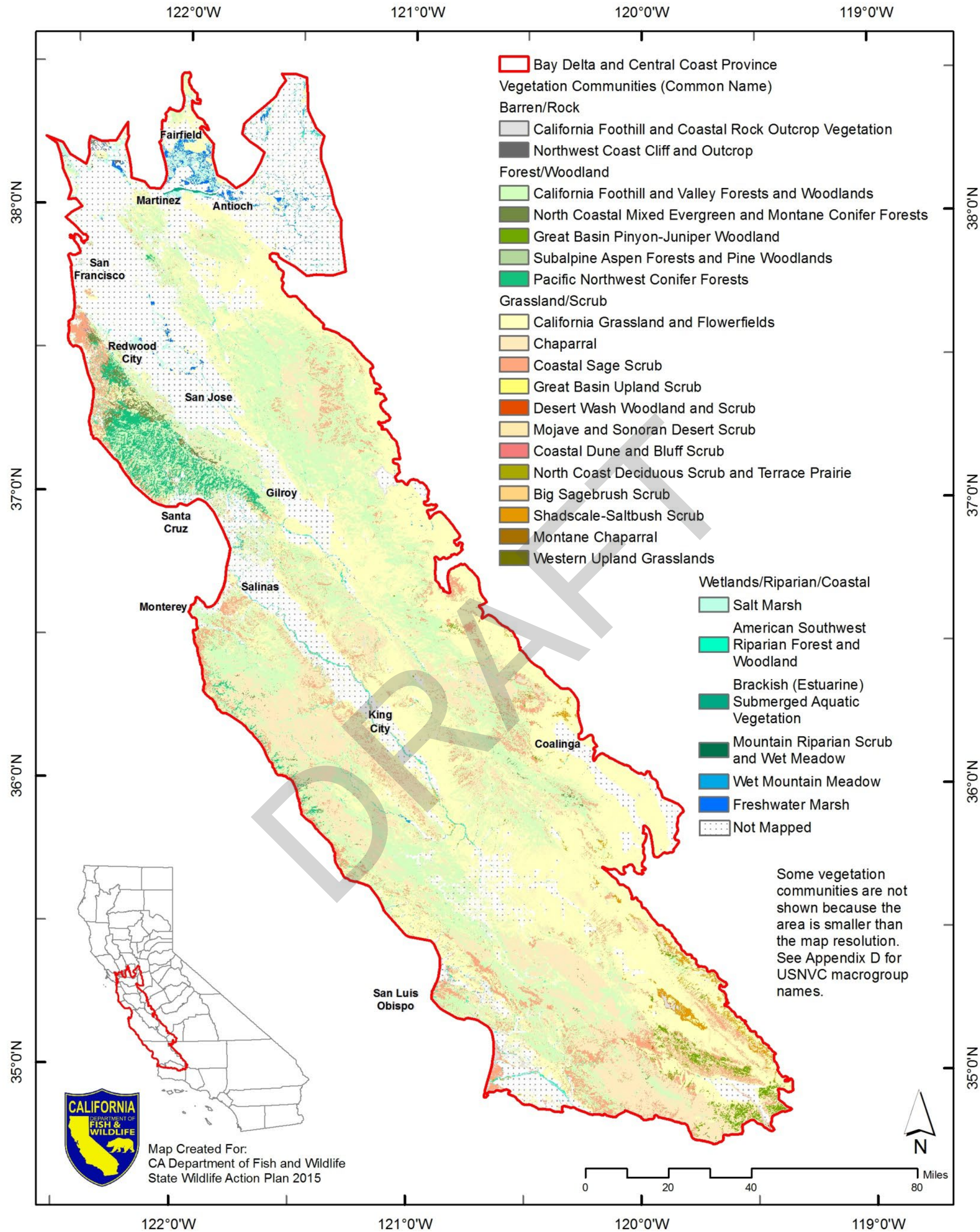


Figure 5.3 - 2 Ecoregions of the Bay Delta and Central Coast Province



Data Source: fveg (Calfire)

Figure 5.3 - 3 Hydrologic Units of the Bay Delta and Central Coast Province

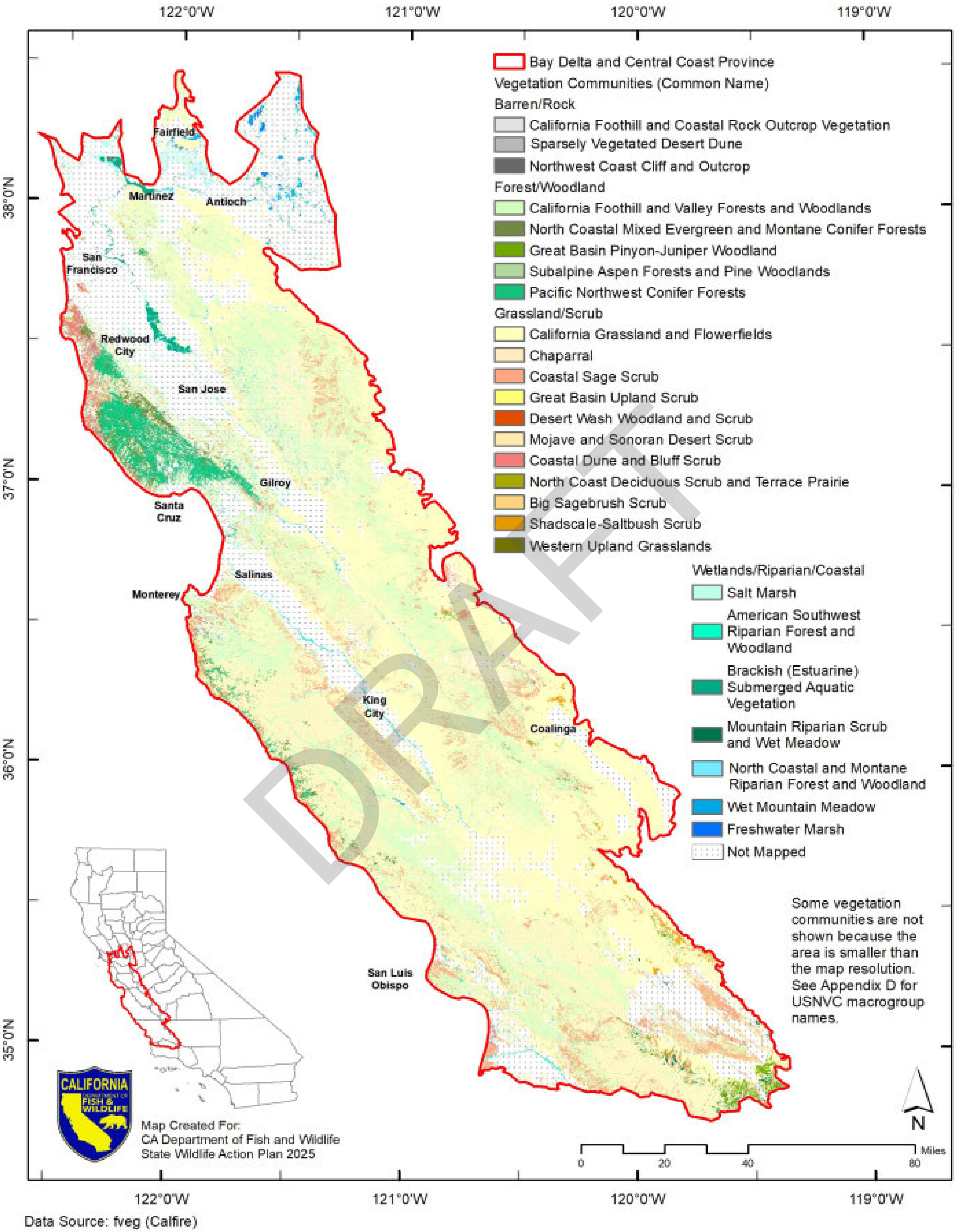


Figure 5.3 - 4 Plant Communities of the Bay Delta and Central Coast Province

5.3.3 Key Ecological Attributes

Key ecological attributes (KEAs) were identified for each conservation target (Table 5.0). These attributes are considered the most important for the viability of the targets and their associated species. The most commonly identified attributes for the Bay Delta and Central Coast Province are:

- area and extent of community
- connectivity among communities and ecosystems
- community structure and composition

5.3.4 Species of Greatest Conservation Need in the Bay Delta and Central Coast Province

The SWAP identified the Species of Greatest Conservation Need (SGCN) for the entire state and identified ecoregion(s) and province(s) associated with each SGCN; data is summarized in Appendix C. The conservation strategies are aimed at benefiting the SGCN via the conservation targets.

For those SGCN that do not occur within the conservation targets identified for the province, conservation actions that target SWG funding should align with existing recovery plan documents where applicable, or demonstrate they address a critical conservation need for the species.

5.3.5 Pressures on Conservation Targets

Using the Open Standards of Conservation, a stress is an impaired aspect of a conservation target, equivalent to a degraded KEA (Conservation Measures Partnership 2020). Pressures are primarily human activities, or natural phenomena influenced by humans, that amplify environmental stress and further degrade conservation target(s). The pressures identified in the Bay Delta and Central Coast Province (Table 5.0) are the most significant pressures to the conservation targets but do not constitute a complete list of pressures in the province. Some principal pressures in the province are discussed in more detail below.

Housing and Urban Areas; Commercial and Industrial Areas; Roads and Railroads

The primary cause of habitat loss and degradation in the Bay Delta and Central Coast Province is the increasing human population's high demand for a limited supply of land, water, and other natural resources. Natural habitats of this region have been converted to a variety of different land uses, including weedy pastureland, dryland farming, irrigated cropland, orchards and vineyards, rural residential, and high-density urban. Wildlife species have different tolerances for each of these conversions, with many of them unable to adapt to the more-developed land uses. Beyond direct habitat loss, converting land to more intensive human-related uses brings additional pressures, including invasive species, human disturbance, fire suppression, and insect control, that further degrade ecosystem health and wildlife viability.

Growth and development fragments habitats into small patches, which cannot support as many species as larger patches can. These smaller fragments often become dominated by species more tolerant of habitat disturbance, including non-native invasive species. Those native species less tolerant of disturbance often decline. Populations of less-mobile species often decline in smaller habitat patches because of reductions in habitat quality, extreme weather events, or normal population fluctuations. Natural recovery following such declines is difficult for mobility-limited species. Such fragmentation also disrupts or alters important ecosystem functions, such as predator-prey relationships, competitive interactions, seed dispersal, plant pollination, and nutrient cycling (Bennett 2003; Kennedy 2003).

Growth and development, along with associated linear structures like roads, canals, and power lines, impede or prevent movement of a variety of animals. As growth patterns include residential projects located far from existing urban centers, there is a greater need for supporting infrastructure. This impact is generally less significant than habitat loss, but roads and overpasses make it more difficult for those species that need to move large distances in search of food, shelter, and breeding or rearing habitat and to escape competitors and predators to do so. Animals restricted to the ground, like mammals, reptiles, and amphibians, face such obstacles as roads, canals, and new gaps in habitats. Attempts to cross these obstacles can be deadly, depending on the species and the nature of the gap (four-lane highways with concrete median barriers compared to narrow, rural two-lane roads, for example). Fish and other water-bound aquatic species attempting to move either upstream or downstream are blocked by lack of water due to diversions, physical barriers like dams, and by entrainment in diverted water.

Even the movement of highly mobile species like birds and bats can be impeded by such features as transmission lines and wind energy farms, particularly in focused flight corridors like Altamont Pass, and 50 new wind energy sites are currently proposed throughout the state on land managed by BLM (CDFG 2005). Such species either cannot see or do not avoid these structures, and many die as a result. Even outside the portions of the region undergoing rapid growth, unused oil-lease lands and large cattle ranches that are no longer profitable are being acquired by land investors and sold as 40-acre to 160-acre residential parcels. This rural residential development also requires additional road infrastructure and fragments the natural landscape.

Population numbers in the Bay Delta and Central Coast appear to be slowly rebounding after a steady decline between 2020-2024 (Johnson et al. 2025). Post-pandemic demographics shifted across the province in response to increasing costs of living and new teleworking options. Growth pressure in the Central Coast region continues to shift inland from the coast, with urban and rural residential development centered along the Highway 101 corridor. In the northern portion of the region, affordable housing draws commuters from San Jose to towns like Morgan Hill, Gilroy, Hollister, and Watsonville. Incorporated cities in the Salinas Valley have seen growth in recent years.

Dams and Water Management/Use

The modern era of water infrastructure in California began after the Gold Rush. In the 1850s, settlers in the Sacramento Valley constructed levees and canals to control flooding and enable agriculture (DWR 2019). By the early 20th century, however, continued development led to within the CVP and SWP provides flood control, irrigation water, and saltwater intrusion mitigation across unprecedented saltwater intrusion into the San Francisco Bay-Delta (Delta). In response, the Central Valley Project (CVP) and State Water Project (SWP) were developed between the 1930s and 1960s, constructing dams and diversions to secure and manage water resources for human use (SWRCB 2017). Today, a complex network of dams, levees, and pumps moves water throughout California. The Delta now contains over 1,150 miles of levees and an extensive network of dams and export facilities capable of moving water throughout the state. This infrastructure, while successful in meeting human demands, has come at a significant ecological cost. The Delta's natural ecosystem has been profoundly altered, resulting in disrupted water flows, degraded water quality, habitat loss, and declining native fish populations (Delta Vision 2007).

Dams and diversions have fundamentally altered the Delta's natural flow regime. Up to 48% of the total outflow can be exported, minimizing the peak runoffs that historically drove floodplain inundation, nutrient transport, and the life cycles of native species (SWRCB 2017). Water stored in large reservoirs alters the natural timing of outflow, decreasing flows between January and June and increasing them between July and December compared to unimpaired conditions (SWRCB 2017). The powerful pumps of the SWP and CVP also cause water in the Old and Middle Rivers to flow backwards, a phenomenon estimated to occur over 91% of the time between 1986 and 2005, compared to less than 15% under unimpaired conditions (Fleenor et al. 2010). Decreased outflow also impairs the Delta's ability to dilute pollutants like ammonia and ammonium, contributing to decreased water quality (Fleenor et al. 2010).

Water infrastructure development has drastically reduced and simplified available habitats. Dams and levees have caused a 97% loss of tidal habitat compared to pre-

Gold Rush conditions (Whipple et al. 2012). In the remaining waterways, meander cuts and dredging have eliminated all but the largest water channels, decreasing habitat complexity that is essential for many native species(SWRCB 2017). The low salinity zone (LSZ), a critical and dynamic mixing zone of fresh and saltwater, has also been significantly altered. The LSZ is often represented by X2, the location of the 2 parts per thousand bottom salinity). As X2 moves upstream, away from San Pablo and Suisun Bays, the amount of available low salinity habitat decreases (SWRCB 2017). Water management practices have shifted X2 further upstream, particularly during the crucial February-March reproductive period for many native fish (Hutton et al. 2016). This habitat compression increases overcrowding, predation risk, and the likelihood of entrainment into export facilities (SWRCB 2017).

The combined effects of altered flows, degraded water quality, and habitat loss have contributed to the decline of fish populations in the Delta. These include threatened and endangered species like the Delta Smelt, Longfin Smelt, Chinook Salmon, steelhead, and Green Sturgeon, as well as ecologically important species like Striped Bass and White Sturgeon (SWRCB 2017). These declines are attributed to a combination of factors, including altered flow regimes, habitat degradation, invasive species, pollution, and direct mortality caused by water diversions (SWRCB 2017; DWR 2019). Despite management efforts such as timed water releases, pumping restrictions, population supplementation, and habitat restoration, these populations remain vulnerable to the impacts of modern water infrastructures (DWR 2019).

Invasive Plants/Animals

Invasive plant and animal species are an important pressure on wildlife in this province, just as they are in other regions throughout the state. Many of the conservation actions described below address prevention, early detection, and rapid response to new invasive plants to prevent them from becoming widespread. Distribution maps and summary reports for invasive plants, as well as regional strategic plans for prioritized invasive plant species, can be found on CalWeedMapper. Some of the invasive species affecting the province are discussed below. Invasive species are discussed in more detail in Appendix E.

Invasive plants can be found in many different habitats in this region and tend to dominate brackish aquatic habitats. In grasslands, some of the more challenging plant invaders include eucalyptus, fountain grass, gorse, medusahead, tree of heaven, and yellow starthistle. In riparian and wetland areas, invading plants include edible fig, giant reed (or Arundo), Himalayan blackberry, pampas grass, Russian olive, tamarisk (or saltcedar), pennyroyal, peppergrass, and tree of heaven. Invasive spartina and perennial pepperweed is a major concern in salt marshes, and opposite leaf Russian thistle appears to be increasing in some areas. Oak woodlands are invaded by plants such as Scotch broom and French broom. Coastal habitats face alien species such as gorse, ice plant, and pampas grass. Introduced plants also invade aquatic habitats. These aquatic invaders include Brazilian waterweed, egeria, Eurasian water milfoil, hydrilla, water hyacinth, water pennywort, and parrot feather.

Numerous invasive plant species are also established in the region's beaches, dunes, sandy coastal soils, and lowland areas. Outcompeting and displacing native plant communities, these invasive species often provide inferior habitat for wildlife. Veldt grass, associated with sandy soils, can shift native shrub communities toward grasslands and is of particular concern in the southern part of the province. On beaches and dunes, ice plant species, European beach grass, and Veldt grass form monocultures and dense mats of vegetation displacing native plants that provide important habitat for invertebrates like Smith's blue butterfly. Dense growth of non-native vegetation also causes unnatural stabilization of beach and dune systems. Jubata and pampas grass are most invasive near Big Sur, Elkhorn Slough, and around the lower slopes of the Santa Cruz mountains. In timbered areas, these grasses can form dense stands that inhibit the germination of such coastal forest species as redwoods. Cape ivy chokes out native vegetation with densely growing vines. Found most commonly in shady coastal lowlands, cape ivy also invades oak woodlands, riparian forests, coastal scrub, and Monterey pine forests (CDFG 2005).

Introduced animals have invaded both terrestrial and aquatic environments. Non-native terrestrial animal species have invaded California wildlands, including brown-headed cowbirds, European starlings, domestic dogs and cats, introduced red foxes, Norway rats, nutria, mute swans, and wild pigs. Nutria have expanded into the Delta and Suisun Marsh. Nutria severely impact ecosystems by intense herbivory and burrowing, activities that can cause water-retention or flood control levees to breech (see Appendix E for details). Cowbirds can lower the reproductive success of other native birds by laying their eggs in other birds' nests, causing the targeted host birds to raise the cowbird nestlings at the expense of their own. Mute swans can impact aquatic ecosystems by consuming massive amounts of submerged aquatic vegetation and through aggressive behavior toward other birds. Native raccoons, whose populations appear to have greatly increased near housing developments and recreation facilities, pressure some native reptile species, notably western pond turtles, because of egg predation.

Not all introduced vertebrates are invasive, and they have varying effects on wildlife; many introduced species in the region parasitize songbird nests, dominate limited nesting habitat, prey on native species, or otherwise damage wildlife habitats. Introduced wild pigs are a major problem in many habitat types across the region. Wild pigs root in the soil, creating excessive soil disturbance and destroying native plant communities. In oak woodlands, wild pigs can inhibit the germination and growth of young oaks by eating acorns and oak seedlings and removing leaf litter, causing soils to dry out (CDFG 2005). In beach, dune, and salt marsh habitats, the introduced red fox increases predation rates for sensitive coastal shorebirds such as Ridgway's rail. Populations of native avian predators, such as California gulls and corvids (i.e., raven, crows, and jays) have increased and are now having negative consequences in salt marshes in San Francisco Bay.

Many non-native fish species have become established in California, dominating many of the rivers and streams in this province. These include species such as striped bass, white catfish, channel catfish, American shad, black crappie, largemouth bass, common carp, bluegill, and pikeminnow (found in the Chorro Creek Watershed). Many fish were historically introduced (via stocking) by federal and state resource agencies to provide sport fishing or forage fish to feed sport fish. Many introduced non-native fish and amphibians out-compete native fish for food or space, prey on native fish (especially in early life stages), change the structure of aquatic habitats (increasing turbidity, for example, by their behaviors), and may spread diseases (Moyle et al. 2002). However, not all non-native species are considered invasive, which typically refers to species whose introduction causes or is likely to cause economic or environmental harm.

In addition to introduced fish, native aquatic species are stressed by introduced bullfrogs, non-native tiger salamanders, red-eared sliders (a turtle), and invertebrates. While some of the province's aquatic habitats, including ephemeral streams and seasonal ponds, naturally go dry in the rainless summer months; a significant portion of aquatic habitat, water bodies, or water management practices create permanent water sources, including the creation of impoundments and some agricultural practices, which favor these invasive species. Introduced invertebrates, such as Asian clam, overbite clam, zebra mussel, and invasive mysid shrimp, are causing significant problems for native species in rivers, streams, sloughs, and the San Francisco estuary (Avila and Hartman 2020). Although prohibited by state and federal regulation, the introduction of species via discharge of ship ballast water in San Francisco Bay has created one of the most invaded estuaries in the world. There are at least 240 introduced species in the San Francisco Bay alone (Ruiz et al. 1997). Most of the clams, worms, and other bottom-dwelling invertebrates presently inhabiting the Bay-Delta have been introduced from other estuaries. This biological invasion continues, with a new species introduced roughly every 14 weeks (DWR 2023). For example, golden mussel (*Limnoperna fortunei*), an invasive, non-native freshwater/brackish bivalve, was recently discovered in the Sacramento - San Joaquin Delta. This discovery is the first known occurrence of golden mussels in North America. The species poses a significant immediate threat to the natural ecosystems, water conveyance systems, infrastructure and water quality in California and across the U.S. While not all of the introduced aquatic species are invasive or have significant consequences for native species, biologists are concerned about the sheer dominance of these new species and their current and potential effects on the structure and function of the estuarine ecosystem. Domestic cats also pose a threat to species dependent on coastal, riparian, and salt marsh habitats.

Annual and Perennial Non-Timber Crops

Approximately 763,590 acres, or 8 percent of the province's land area, are planted in irrigated row crops, vineyards, and orchards ((CAL FIRE: FRAP 2006). The most extensive agricultural areas are fertile river valleys and coastal terrace lands. Major crops include grapes, lettuce, artichokes, asparagus, and strawberries, with some areas also supporting orchard-grown fruits and nuts and dry-land, unirrigated winter grains, such as barley. While these agricultural lands provide important crops for California's food supply and for export, many of the intensive agricultural practices that have enabled such large-scale production also to result in ecological problems. Agricultural consequences for the region's wildlife and ecosystems include runoff of agricultural chemicals and sediment, consumption of over-subscribed water resources, and conversion and fragmentation of habitat. Private landowners and local conservation districts are working on numerous projects to mitigate these consequences, to improve water quality, and to enhance conditions for wildlife on the agricultural working landscapes of the region.

Many of the region's crops receive substantial applications of fertilizers, herbicides, and pesticides. In 2021, Monterey County—which encompasses two major agricultural regions, the Salinas Valley and lower Pajaro Valley—ranked sixth in the state for the total pounds of pesticide applied (CA Department of Pesticide Regulation 2021). In Monterey County, the high nitrate levels in Elkhorn Slough cause large blooms of sea lettuce (*Ulva lactuca*), which smothers mudflats and salt marsh vegetation. Exposed soils and irrigation practices make croplands susceptible to erosion. Rain and irrigation runoff carry silt and agricultural chemicals, degrading surface water quality and reaching groundwater. For example, significant amounts of nitrogen fertilizer applied through agricultural practices have contaminated groundwater supplies in agricultural communities throughout the State (Viers et al. 2012). Herbicides and pesticides can have toxic effects on aquatic plants and animals, and chemical contaminants can upset the ecological balance of aquatic systems. For example, nutrients increase aquatic plant and algal growth, resulting in lowered oxygen levels when the excessive plant matter decomposes. Elevated nutrient levels have also been implicated in amphibian deformities, because nutrient-rich environments favor the parasitic flatworm that causes deformities in many frog species (Johnson and Chase 2004). Also, pesticide drift has been shown to favor hybrid tiger salamanders over native California tiger salamanders (Ryan et al. 2013). Silt and sediment also degrade aquatic environments, increasing turbidity and shading out aquatic vegetation, along with scouring away or smothering stream-bottom sediments that are important spawning sites and invertebrate habitats. Runoff problems are particularly severe on steeply sloping, erosion-prone soils, where strawberries, artichokes, and vineyard grapes are commonly grown. Planting practices that result in large amounts of soil disturbance, such as the establishment of vineyards, strawberry, and artichoke mounds, also contribute substantially to sediment runoff.

Agricultural water consumption also pressures aquatic and riparian habitats. Irrigated agriculture accounts for about 66 percent of the Central Coast's water use and 8 percent for the Bay Area (DWR 2023). Over the last century, the increased production of water-intensive crops like strawberries, lettuce, and grapes has increased the need for water. Water is supplied to agriculture by diversion of surface water, by groundwater pumping, and through import from other regions via the State Water Project. As groundwater levels are depleted, saltwater intrusion increases and flows are also reduced in streams and rivers. Diminished flows reduce aquatic systems' capacity to dilute incoming contaminants and discharge sediment and can inhibit migration by anadromous fish (San Francisco Estuary Institute 2019). Additionally, groundwater depletion and drought have increased salinity in inland lakes and freshwater/brackish lagoons in the province, which affects habitat conditions for pond turtles and other species.

The growth of agriculture over the last century, particularly along valley-bottom floodplains and coastal terraces, has resulted in both the loss of important habitat areas and the fragmentation of larger natural landscapes. In recent decades, intensively cultivated crops (such as vineyards) have been expanding into areas formerly used for grazing and dry-land grain production. Intensive agricultural crops almost entirely eliminate wildlife habitat values and tax water resources.

Although agriculture can have adverse effects on ecosystems, some types of agricultural practices provide important habitat to many wildlife species. For example, fallow grain fields with the Sacramento-San Joaquin Delta are essential wintering habitat for greater and lesser sandhill cranes, waterfowl, shorebirds, and other waterbirds. Other avian species, including tricolored blackbird and Swainson's hawk, are strongly associated with agricultural fields where certain crops and management practices are implemented.

Renewable Energy

Renewable energy projects, including solar, wind, and battery storage projects, continue to be constructed and operated in the Bay Delta and Central Coast Province. Wind energy is a particularly important resource in the Province, with the Altamont Pass Wind Resource Area comprising approximately 50,000 acres in Alameda and Contra Costa Counties. Construction of renewable energy projects result in both temporary disturbance to and permanent loss of wildlife habitat, as well as incidental mortalities. Impacts of ongoing operations include direct mortality to bird and bat species due to collisions with turbine blades as well as degradation of foraging habitat (Smallwood and Thelander 2008).

Fire and Fire Suppression

Wildfire is a natural ecosystem process and an ecologically important disturbance in much of the Bay Delta and Central Coast Province. Prior to European colonization, fire events in this province were caused by Native American cultural burning practices and lightning strikes which have influenced the development of distinct plant communities and fire regimes within the different subregions of the province. Cultural burning practices were used extensively to promote forage crops and likely converted many areas of coastal sage scrub and chaparral to grasslands. Fire suppression practices began with Spanish colonization in the 1700s but were paused between 1800 and 1930 when logging of coastal redwoods and cattle range expansion was most prevalent. Outside of this period, the current fire regime with fire suppression has resulted in a reduction of fire frequency from every 10 to 30 years to a current frequency interval of 25 to 35 years (Greenlee and Langenheim 1990), and a reduction in the size of fires compared to the historical fire regime (Keeley et al. 2005). Accurate records of California's wildfire history began in 1932. Since that time 18 of the 20 largest wildfires occurred in the last 20 years, with two of those occurred within the Bay Delta and Central Coast Province (CAL FIRE 2024).

Specific plant communities and habitats in the Bay Delta and Central Coast Province have evolved within a variety of geographically and consistent human-influenced fire regimes that have shaped the landscape and influenced the evolution of unique plant alliances (Lambrinos 2004). Within the interior coastal ranges lightning-caused fires are uncommon, but combined with dry conditions and hot summer temperatures the result has been more frequent fires compared to the rest of the province (Greenlee and Langenheim 1990; Van Wagtendonk et al. 2018). Conversely, lightning-ignited fires are rarer along the coast where maritime chaparral and the topography contribute to more moist ecological communities that historically discouraged ignition and spread of wildfire. However, since fire suppression efforts resumed in 1930, modest increases in fire frequency and intensity have been attributed to the increase in urbanization within the province and the lack of prescribed fire widely applied to the province (Keeley et al. 2005). The two megafires that have occurred in the province were both started by lightning and escalated quickly into the WUI and urban areas due to a combination of favorable summer fire weather conditions and the buildup of fuel. The SCU Lightning Complex (2020) burned 396,625 acres and the LNU Lightning Complex (2020) burned 363,220 acres. While both wildfires were catastrophic with the speed and breadth at which they spread, and the damage that occurred as a result, they are both examples of the rare instances in which lightning-caused wildfires ignite and spread within the Bay Delta and Central Coast province.

Throughout the province increases in population and expansion into the wildland-urban interface have led to an increase in human-caused ignitions since 1930, which in turn has shifted the fire regime towards a less frequent, smaller, and more intense fire regime (Seabloom et al. 2006). Wildfire occurs mostly along roads and near the wildland-urban interface, with some locations experiencing multiple fires within a period of 15 to 20 years (CDFG 2005). Efforts to reestablish more historical fire regimes are challenging due to the air quality and safety concerns of applying prescribed fire within proximity of urban areas and the pace at which urban areas increase in size and density and continue to expand into the wildlife-urban interface.

The proliferation of invasive vegetation has created a vicious cycle of altered fire regimes that favor the non-native annual grasses introduced with the arrival of European settlers and livestock. Once established, these grasses grow in a dense-thatch pattern that choke out native species, lower habitat quality for wildlife, and provide dry fuel buildup that continues the cycle of more intense wildfires (Keeley 2004) . And while the historical fire regime depends on prescribed fire with rarer and larger lightning-caused ignitions, the proximity of fire-dependent habitats to dense population centers within the province's wildland-urban interface makes using prescribed fire to control non-native vegetation challenging (D'Antonio et al. 1993; Keeley 2002; Keeley et al. 2011). Land managers have attempted to simulate prescribed fires with mechanical methods with mixed success (Merriam et al. 2006; Keeley et al. 2011). With many rare and endemic species that are closely tied to fire regime, prescribed fires remain an under-utilized tool in the province (Keeley 2006).

Climate Change

The climatic changes presented below will likely affect all conservation targets identified in this province. Climate change has only been included as a pressure for a subset of targets that are considered more vulnerable to climate impacts, and/or in instances where it was determined that interactions between climate change and other pressures could be addressed in a meaningful way through a conservation strategy.

The climate projections that follow are presented as averages across the entire province, except where otherwise indicated. While these projections provide more insight into the expected magnitude and direction of change in important climate variables compared to the statewide estimates in Chapter 2, climate change will not in fact unfold uniformly across the province. For additional information on regional variability in climatic change and associated vulnerabilities within the Bay Area and Central Coast region, refer to the following resources (not an exhaustive list):

- San Francisco Bay Area Summary Report: California's Fourth Climate Change Assessment (Ackerly 2018)
- Central Coast Summary Report: California's Fourth Climate Change Assessment (Langridge and Myers 2018)
- North Coast Summary Report: California's Fourth Climate Change Assessment (Grantham 2018)
- Rivers, Streams, and Floodplains: Climate Change Vulnerability Assessment Summary for the Santa Cruz Mountains Climate Adaptation Project (EcoAdapt 2021)

Temperature

Climatic changes in the Bay Delta and Central Coast Province are expected to include increased mean maximum temperatures of approximately 4.6°F by mid-century (2035–2064, centered on the year 2050) and 7.7°F by end-of-century (2070–2099, centered on the year 2085), compared to a historical baseline period (1961-1990); minimum temperatures are projected to increase across the province on average by 4.1°F by 2050 and 7.3°F by end-of-century (Pierce et al. 2018). Projections were generated based on a high-end greenhouse gas emissions scenario (RCP 8.5) and multiple climate models.

Precipitation and Snowpack

Within the Bay Delta and Central Coast Province, changes in annual precipitation will vary geographically, but average precipitation rates are projected to increase slightly throughout the century, compared to a historical baseline (Pierce et al. 2018).

April snow water equivalent, a common measure of snowpack in California, is expected to decline across the state. In this province changes in snowpack and resulting impacts to streamflow regimes influencing the bay area and central coast will mean more intense winter flooding, greater erosion of riparian habitats, and increased sedimentation in wetland habitats Lower river flows will allow saltwater intrusion into the rivers, the Bay, and the Delta, increasing salinity and disrupting the complex food web of the estuary, intense winter flooding, greater erosion of riparian habitats, and increased sedimentation in wetland habitats Lower river flows will allow saltwater intrusion into the rivers, the Bay, and the Delta, increasing salinity and disrupting the complex food web of the estuary.

Wildfire Risk

Wildfire risk is determined using several factors. Acres burned and re-burned, fire regime, and probability of ignition, are some of those factors. Over the last 20 years approximately 18%, or 1,719,000 of 9,500,000 acres have burned and reburned throughout the Bay Delta and Central Coast Province (2004 – 2023, CALFIRE FRAP fire perimeters). Large fires have occurred in both the Central California Coast and the Central Valley Coast Ranges ecoregions, and some large areas of Monterey and eastern Stanislaus counties have burned multiple times.

According to Projected Effects of Climate Change in California from 2011, wildfire risk was projected to increase 4 to 6 times in the Central Coast Ranges and Central Coast regions, particularly in the eastern portion of the Central Coast Ranges. The number of escaped fires was projected to increase by 51%, while the total area burned by contained fires was projected to increase 41% despite enhancement of fire suppression efforts. The probability of large fires (>500 acres) was expected to increase by the end of the 21st century, and area burned was projected to increase from 10 to 50 percent between the 2070-2099 time period (PRBO Conservation Science 2011).

Based on a climate adaptation planning analysis conducted in 2012, inland areas of the Bay Delta, including "portions of western and northern Yolo County, northwestern Solano County, southern Contra Costa County, and San Joaquin and Sacramento counties are projected to experience limited increases in potential area burned by wildfire" (CalEMA and CNRA 2012).

This projection has been updated using the more recent 2018 Cal-Adapt wildfire data from California's Fourth Climate Assessment. Annual area burned across the footprint of this province is expected to increase by approximately 15% by mid-century and 8% by the end of the century under a high-end emissions scenario, compared to a 1961-1990 baseline (Westerling 2018). The Fourth Climate Assessment regional report on the Central Coast and San Francisco Bay Area indicates that by the foreseeable future.

Sea Level Rise

Along the coast, mean sea level will continue to rise. California recently updated its sea level rise projections for the next century, resulting in five plausible scenarios that encompass a range of possible futures for the state. At a local scale, sea level rise projections were generated for a series of NOAA tide gauges along the coast. Below are projections for the tide gauges located within the Bay Delta and Central Coast Province (CA OPC 2024). These projections are relative to a 2000 baseline and incorporate local estimates of vertical land motion.

- Port Chicago: 0.5–1.3ft (by 2050); 1.0–6.5ft (by 2100)
- San Francisco: 0.5–1.3ft (by 2050); 1.0–6.5ft (by 2100)
- Alameda: 0.3–1.1ft (by 2050); 0.6–6.2ft (by 2100)
- Monterey: 0.4–1.2ft (by 2050); 0.8–6.4ft (by 2100)
- Port San Luis: 0.3–1.1ft (by 2050); 0.6–6.3ft (by 2100)

Sea-level rise and changes in timing and volume of flow are projected to increase salinity intrusion into freshwater aquifers and the Bay Delta region. Marshes around San Francisco Bay are particularly vulnerable to the anticipated increase in sea-level rise and reductions in sediment availability. Ultimately, marshes and mudflats could be inundated, leaving only narrow, fragmented habitat patches along the shoreline. Such patches would be squeezed up against levees and seawalls with development behind them, exacerbating flooding and creating deleterious edge effects. These impacts would be additive or synergistic with other stressors that may also increase over time, like invasive species, contaminants, and reductions in freshwater inputs.

5.3.6 Conservation Strategies

SWAP 2025 presents conservation strategies, including strategy objectives and targeted pressures, for the Bay Delta and Central Coast Province. Actions that were identified for specific conservation units are listed with the strategy. Table 5.0 summarizes conservation targets for the province.

Target: American Southwest Riparian Forest and Woodland

Diagnostic species include Fremont cottonwood, black and red willow, California sycamore, California wild grape, arroyo willow, narrow-leaf willow, button-bush, spice bush. Most stands are found in permanently moist settings or riparian settings where sub-surface water is available year-round. Suitable conditions to support native fish assemblages include presence of surface water year-round, interconnected by surface flow or pools maintained by intergravel flow.

Conservation Strategy 1 (Land Acquisition/Easement/Lease): Acquire, conserve and manage habitat for SGCN that inhabit riparian forest and woodland habitats by finalizing draft conservation plans and implementing completed NCCPs, HCPs, and Conservation Strategies and other opportunities

Objective(s):

- Establish conservation and management plans for SGCN that inhabit riparian forest and woodland habitats

Targeted pressure(s): Housing and urban areas; commercial and industrial areas

Conservation action(s):

- Develop, fund and implement conservation actions, land acquisition and management plans as part of the East Contra Costa NCCP, Santa Clara Valley NCCP, East Alameda County Conservation Strategy, Solano HCP, Suisun March Habitat Plan, and other relevant conservation management plans
- Obtain funding for conservation actions, land acquisition and management plans implementation and staff
- Survey the interests from willing sellers of title fee or conservation easements.
- Identify partners for funding and management
- Coordinate with partners through Joint Ventures
- Identify willing landowners to participate in habitat enhancement programs

Conservation Strategy 2 (Outreach and Education): Implement education and outreach to the public and local agencies regarding the value of riparian habitat, development of riparian buffers along major rivers and streams, and reducing encroachment of crops into riparian buffers

Objective(s):

- Increase the knowledge of all local agencies, the public, and landowners on the value of riparian habitat
- Gain support from all local agencies and landowners for the development of riparian buffers along major rivers and streams

- Reduce encroachment of annual and perennial non-timber crops into riparian buffers

Targeted pressure(s): Annual and perennial non-timber crops

Conservation action(s):

- Fund and implement riparian habitat education and conservation actions in draft and final NCCPs, HCPs, Conservation Strategies, and Recovery Plans

Conservation Strategy 3 (Direct Management): Develop grazing best management practices (BMPs)

Objective(s):

- Co-develop BMPs with land management agencies
- Implement state and local policies that benefit wildlife and sustain habitats
- Reduce inappropriate livestock farming and ranching

Targeted pressure(s): Livestock, farming, and ranching

Conservation action(s):

- Fund and implement vegetation management actions, including grazing management practices, in draft and final NCCPs, HCPs, Conservation Strategies, and Recovery Plans

Conservation Strategy 4 (Direct Management): Manage invasive species

Objective(s):

- Eradicate or control invasive species on public and private lands by watershed

Targeted pressure(s): Invasive plants/animals

Conservation action(s):

- Fund and implement invasive species management actions in draft and final NCCPs, HCPs, Conservation Strategies, and Recovery Plans
- Conduct assessment and map invasive species occurrence by watershed
- Develop partnerships with agencies and non-governmental organizations (NGOs)
- Identify and apply for funding grant to fund control of invasive species
- Develop plan to prioritize and control invasive species
- Implement management plan to control invasive species

Conservation Strategy 5 (Direct Management): Manage dams and other barriers to allow for fish passage

Objective(s):

- Remove barriers to allow for fish passage

- Increase bypass flows through water conservation
- Achieve agreement among water management agencies on dam management and barrier removal. This objective additionally includes the following:
- improve instream flows
- gather baseline data to identify the current conditions of amount of water use and water use efficiency, fish passage conditions, and the major barriers to fish passage
- establish a baseline of candidate barriers that can be removed
- develop restoration/management plans
- investigate the impact from water diversion including stream flow modification and fish passage barriers
- investigate the potential to develop water conservation and fish passage barrier modification measures and evaluate the effectiveness of the measures

Targeted pressure(s): Dams and water management/use

Conservation Strategy 6 (Direct Management): Develop riparian buffers along major rivers and streams

Objective(s):

- Establish and restore riparian buffers along major rivers and streams
- Reduce encroachment of annual and perennial non-timber crops into buffer areas

Targeted pressure(s): Annual and perennial non-timber crops

Conservation action(s):

- Fund and implement riparian buffer management actions in draft and final NCCPs, HCPs, Conservation Strategies, and Recovery Plans
- Identify existing land use policies on riparian buffers in agricultural landscapes.
- Link to Outreach and Education strategy
- Seek to redesignate buffers as natural resource zones in county general plans
- Identify incentives for landowners
- Coordinate and provide input to cities and counties regarding buffer zones
- Review local agencies ordinances to determine whether buffers zones are adequate

Conservation Strategy 7 (Direct Management): Improve road maintenance on county and state roads to reduce sediment impacts to stream habitats

Objective(s):

- Improve maintenance of county and state roads to reduce sediment impacts to stream habitat (particularly fish spawning and invertebrate production habitat within gravels, and pool habitat)
- Reduce road maintenance impacts

- When Caltrans is currently implementing best management practices (BMPs), look for opportunities for alignment of BMPs through the implementation of SWAP strategies and existing processes such as those in place at Caltrans

Targeted pressure(s): Roads and railroads

Target: California Foothill and Valley Forests and Woodlands

This macrogroup consists of savannas, woodlands, and forests dominated by warm-temperate and Mediterranean climate endemic oak and conifer species below approximately 2500 m (8200 feet) in elevation. Characteristic taxa are warm Mediterranean and warm-temperate North American climate-adapted evergreen sclerophyllous and deciduous broad-leaved trees and evergreen needle-leaved trees: live oaks, deciduous oaks, California buckeye, closed-cone pines and cypresses, madrone, and tanoak. Also includes pinyon, juniper, and other conifer forests and woodlands (Federal Geographic Data Committee Vegetation Subcommittee 2022).

Conservation Strategy 1 (Land Acquisition/Easement/Lease): Acquire, protect, and manage foothill and valley forests and woodlands

Objective(s):

- Conserve this habitat type in large, relatively intact patches that support SGCN
- Minimize habitat loss, fragmentation, and edge effects that reduce viability of SGCN populations

Targeted pressures: Annual and perennial non-timber crops, commercial and industrial areas, housing and urban areas, invasive plants/animals, roads and railroads

Conservation actions:

- Acquire habitat for conservation
- Pursue funds for CDFW land acquisitions
- Pursue SWG grants and advocate for funding from WCB and other granting entities to support partner agency and land trust acquisition of fee title and conservation easements, and to fund land management endowments for conservation lands
- Pursue funds and projects to reduce and manage invasive plant cover

Conservation Strategy 2 (Partner Engagement): Work with landowners, land trusts, tribal governments, and other partners to identify and acquire lands available for acquisition and to foster relationships that lead to better management and conservation on private lands, including tribal managed lands

Objective(s):

- Support partner efforts to conserve and manage foothill and valley forests and woodlands

- Minimize habitat loss, fragmentation, and edge effects that reduce viability of SGCN populations
- Affect changes in private land management activities that will benefit the habitat type and the SGCN that occupy it

Targeted pressures: Annual and perennial non-timber crops; commercial and industrial areas; housing and urban areas; invasive plants/animals; livestock, farming and ranching

Conservation actions:

- Pursue SWG grants and advocate for funding from WCB and other granting entities to support partner agency and land trust acquisition of fee title and conservation easements, and to fund land management endowments for conservation lands
- Pursue funds and projects to reduce and manage invasive plant cover on private lands
- Work with landowners to keep large patches intact and, where appropriate, as working landscapes that can support livelihoods and therefore incentives to prevent habitat conversion

Conservation Strategy 3 (Data Collection and Analysis): Collect and analyze data on extent of habitat type, changes in composition over time, and SGCN occupancy and population viability

Objective(s):

- Monitor status of the habitat type and the wildlife populations it supports, in order to inform conservation and management needs

Targeted pressures: Annual and perennial non-timber crops; commercial and industrial areas; housing and urban areas; invasive plants/animals; livestock, farming and ranching

Conservation actions:

- Establish and implement long-term vegetation and SGCN monitoring programs on CDFW and other conservations lands. Collaborate with The Nature Conservancy and other partners that are already doing long-term monitoring of woodland habitat types in the same ecoregions
- Conduct and support research on SGCN within this habitat type.
- Conduct and support research on vegetation management, fire effects, and other aspects of this habitat type that will better inform long-term conservation of the type and the SGCN that occupy it

Conservation Strategy 4 (Direct Management): Protect, restore, and enhance woodland habitats for SGCN

Objective(s):

- Manage woodlands for SGCN benefit, long-term viability, and preventing type conversion

Targeted pressures: Fire and fire suppression; invasive plants/animals; livestock, farming and ranching

Conservation actions:

- Implement ecological restoration and fuels management to benefit SGCN on CDFW lands
- Pursue funding for ecological restoration and fuels management that will benefit SGCN on non-CDFW lands
- Promote recruitment of tree species for which recruitment is lower than necessary to maintain the habitat type for SGCN
- Manage invasive species

Conservation Strategy 5 (Management Planning): Develop and update management plans for SGCN and their habitat

Objective(s):

- Develop and/or update management plans for woodlands for SGCN benefit, long-term viability, and preventing type conversion

Targeted pressures: Fire and fire suppression; invasive plants/animals; livestock, farming and ranching

Conservation actions:

- Develop and/or update management plans for ecological restoration and fuels management to benefit SGCN on CDFW lands
- Pursue funding for developing and/or updating management plans for ecological restoration and fuels management that will benefit SGCN on non-CDFW lands
- Develop and/or update management plans to manage invasive species

Conservation Strategy 6 (Economic Incentives): Development and delivery of economic incentives to private landowners, partners, and other stakeholders to implement responsible stewardship of landscapes, ecological processes and conditions, and SGCN

Objective(s):

- Develop and deliver economic incentives to private landowners, partners, and other stakeholders to implement responsible stewardship of landscapes, ecological processes and conditions, and SGCN

Targeted pressures: Annual and perennial non-timber crops, commercial and industrial areas, housing and urban areas, invasive plants/animals, fire and fire suppression

Conservation actions:

- Develop and assist landowners in enrolling in wildlife-dependent economic activities and programs, including passive and consumptive uses
- Assist agency partners and other stakeholders in developing wildlife-dependent economic incentives for landowners

Conservation Strategy 7 (Land Use Planning): Participating in and funding planning activities that will result in conserving forests and woodlands

Objective(s):

- Participate in funding planning activities that will result in conserving forests and woodlands

Targeted pressures: Annual and perennial non-timber crops, commercial and industrial areas, housing and urban areas, invasive plants/animals, roads and railroads, fire and fire suppression

Conservation actions:

- Collaborate with land use agencies (e.g., cities and counties) on their land use planning efforts
- Pursue funding to assist partners and agencies in developing land use plans that will benefit forest and woodland conservation

Conservation Strategy 8 (Outreach and Education): Participating in and funding planning activities that will result in conserving forests and woodlands

Objective(s):

- Develop and implement outreach and education programs; Participate in outreach and education with partners and stakeholders

Targeted pressures: Annual and perennial non-timber crops, commercial and industrial areas, housing and urban areas, invasive plants/animals, roads and railroads, fire and fire suppression

Conservation actions:

- Develop and implement education and outreach programs

- Engage the public about stewardship of natural resources
- Conduct demonstration management projects

Target: California Grassland, Vernal Pools, and Flowerfields

Includes all annual forb/grass vegetation native and non-native, as well as native perennial grasslands growing within the California Mediterranean climate. This does not include the cool-moist north coastal terrace prairies, the montane meadow/upland grasslands, and non-native perennial pasture grasses. Native perennial grasslands include needle grass species, melicgrass and giant wild rye. Annual native forb and wildflower fields including species of poppy, goldfields, popcorn flowers, fiddleneck, and others. Target also includes vernal pools within grasslands. Non-native annual grasslands such as wild oat, brome, annual fescue, star-thistle, mustards, fennel, and others are also present in grassland habitats and affect the habitat function of this target.

Conservation Strategy 1 (Land Acquisition/Easement/Lease): Acquire, conserve, and manage habitat for SGCN that inhabit grassland habitats by finalizing draft conservation plans and implementing completed NCCPs, HCPs, and Conservation Strategies and other opportunities

Objective(s):

- Establish conservation and management plans for SGCN that inhabit grassland habitats

Targeted pressure(s): Housing and urban areas; commercial and industrial areas

Conservation action(s):

- Develop, fund and implement conservation actions, land acquisition and management plans as part of the East Contra Costa NCCP, Santa Clara Valley NCCP, East Alameda County Conservation Strategy, Solano HCP, and other relevant conservation management plans
- Obtain funding for conservation actions, land acquisition and management plans implementation and staff
- Survey the interests from willing sellers
- Identify partners for funding and management
- Identify willing landowners

Conservation Strategy 2 (Data Collection and Analysis): Identify and conduct research on high-priority study questions for grassland habitat/conservation areas; conduct research to inform coordination with Caltrans and county transportation agencies on wildlife-friendly transportation corridors; implement and fund monitoring and research components of completed and draft NCCPs, HCPs, and Conservation Strategies

Objective(s):

- Reflect the research and data analysis needs of the province
- Identify high priority research/study questions regarding grassland habitat/conservation areas
- Use research to inform coordination with Caltrans and County Transportation Agency on wildlife-friendly transportation corridors
- When Caltrans is currently implementing best management practices (BMPs), look for opportunities for alignment of BMPs through the implementation of SWAP strategies and existing processes such as those in place at Caltrans

Targeted pressure(s): Livestock, farming, and ranching; annual and perennial non-timber crops; roads and railroads

Conservation action(s):

- Conduct surveys and monitoring as part of the East Contra Costa NCCP, Santa Clara Valley NCCP, East Alameda County Conservation Strategy, and draft Solano HCP
- Obtain funding for research, surveys and monitoring for developing and existing conservation plans and recovery plans
- Gather and/or review existing information
- Utilize existing conservation plans and recovery plans to establish prioritization
- Identify inventory protocol
- Coordinate with landowners
- Utilize existing conservation plan partnerships and identify new partners.
- Obtain funding for program implementation
- Analyze spatial distribution using Geographic Information Systems (GIS)
- Coordinate with Caltrans on siting of roads, and design and siting of wildlife crossings

Conservation Strategy 3 (Land Use Planning): Develop statewide strategies on renewable energy development location siting; identify renewable energy development zones and obtain the Renewable Energy Action Team (REAT) approval

Objective(s):

- Identify and approve renewable energy development zones by REAT

Targeted pressure(s): Renewable energy

Conservation Strategy 4 (Land Use Planning): Provide input on project planning and decision-making processes; ensure that city and county planning departments consider the conservation of grassland and vernal pool habitat

Objective(s):

- City and county planning departments account for the conservation of grassland and vernal pool habitat

Targeted pressure(s): Renewable energy; housing and urban areas

Conservation Strategy 5 (Direct Management): Manage invasive species, with focus on controlling or eradicating them in grassland habitats in the Central California Coast Ecoregion

Objective(s):

- Eradicate or control invasive species in grassland habitats in the Central California Coast Ecoregion

Targeted pressure(s): Invasive plants/animals

Conservation action(s):

- Fund and implement invasive species management actions in draft and final NCCPs, HCPs, conservation Strategies, and Recovery Plans
- Coordinate with the California Invasive Plant Council
- Identify sites for eradication of non-native tiger salamanders and bullfrogs
- Obtain funding for management actions

Conservation Strategy 6 (Partner Engagement): Coordinate with Caltrans and county transportation agencies to use information on high-priority wildlife corridors in the design of wildlife-friendly transportation corridors

Objective(s):

- Transportation agencies use information on high priority wildlife corridors to design wildlife-friendly transportation corridors

Targeted pressure(s): Roads and railroads; invasive plants/animals

Conservation Strategy 7 (Partner Engagement): Coordinate with fire agencies and local landowners, including tribal land managers, to develop and implement fire management BMPs in grassland habitats

Objective(s):

- Fire management BMPs to improve grassland habitat are co-developed with fire agencies and local landowners

Targeted pressure(s): Fire and fire suppression

Target: Chaparral

Represented by a wide variety of floristic alliances, but in general can be grouped into coastal (maritime), xeric (dry, sunny slopes), mesic (cooler, shady slopes), and lower montane (somewhat frost sensitive) types. All of these groupings have different characteristic species and fire regimes. The core diagnostic species are shrubs with evergreen thickened leaves including many species of manzanita, Ceanothus, scrub oaks, and other characteristic shrubs, including: toyon, chamise, flannel-bush, silk-tassel bush, and many others. Many shrubs can be categorized by their fire responses, including obligate-seeding and resprouting strategies.

Conservation Strategy 1 (Land Acquisition/Easement/Lease): Acquire, protect, and manage chaparral

Objective(s):

- Conserve this habitat type in large, relatively intact patches that support SGCN
- Minimize habitat loss, fragmentation, and edge effects that reduce viability of SGCN populations

Targeted pressures: Annual and perennial non-timber crops; commercial and industrial areas; housing and urban areas; invasive plants/animals; roads and railroads

Conservation actions:

- Acquire habitat for conservation, especially maritime chaparral
- Pursue funds for CDFW land acquisitions
- Pursue SWG grants and advocate for funding from WCB and other granting entities to support partner agency and land trust acquisition of fee title and conservation easements, and to fund land management endowments for conservation lands
- Pursue funds and projects to reduce and manage invasive plant cover

Conservation Strategy 2 (Partner Engagement): Work with landowners, land trusts, tribal governments, and other partners to identify and acquire lands available for acquisition and to foster relationships that lead to better management and conservation on private lands, including on tribal managed lands

Objective(s):

- Support partner efforts to conserve and manage chaparral
- Minimize habitat loss, fragmentation, and edge effects that reduce viability of SGCN populations
- Affect changes in private land management activities that will benefit the habitat type and the SGCN that occupy it

Targeted pressures: Annual and perennial non-timber crops; commercial and industrial areas; housing and urban areas; invasive plants/animals; livestock, farming and ranching

Conservation actions:

- Pursue SWG grants and advocate for funding from WCB and other granting entities to support partner agency and land trust acquisition of fee title and conservation easements, and to fund land management endowments for conservation lands
- Pursue funds and projects to reduce and manage invasive plant cover on private lands
- Work with landowners to keep large patches intact and, where appropriate, as working landscapes that can support livelihoods and therefore incentives to prevent habitat conversion

Conservation Strategy 3 (Data Collection and Analysis): Collect and analyze data on extent of habitat type, changes in composition over time, and SGCN occupancy and population viability

Objective(s):

- To monitor the status of the habitat type and the wildlife populations it supports, in order to inform conservation and management needs

Targeted pressures: Annual and perennial non-timber crops; commercial and industrial areas; housing and urban areas; invasive plants/animals; livestock, farming and ranching

Conservation actions:

- Establish and implement long-term vegetation and SGCN monitoring programs on CDFW and other conservations lands; Collaborate with partners that are also doing long-term monitoring of chaparral in the same ecoregions
- Conduct and support research on SGCN within this habitat type
- Conduct and support research on vegetation management, fire effects, and other aspects of this habitat type that will better inform long-term conservation of the type and the SGCN that occupy it

Conservation Strategy 4 (Direct Management): Protect, restore, and enhance chaparral

Objective(s):

- Manage chaparral for SGCN benefit, long-term viability, and preventing type conversion

Targeted pressures: Fire and fire suppression; invasive plants/animals; livestock, farming and ranching

Conservation actions:

- Implement ecological restoration and fuels management to benefit SGCN on CDFW lands
- Pursue funding for ecological restoration and fuels management that will benefit SGCN on non-CDFW lands
- Promote succession necessary to support rare plants and SGCN that may be in decline due to anthropogenic causes, such as fire suppression
- Manage invasive species

Conservation Strategy 5 (Management Planning): Develop and update management plans for SGCN and their habitat

Objective(s):

- Develop and/or update management plans for chaparral for SGCN benefit, long-term viability, and preventing type conversion

Targeted pressures: Fire and fire suppression; invasive plants/animals; livestock, farming and ranching

Conservation actions:

- Develop and/or update management plans for ecological restoration and fuels management to benefit SGCN on CDFW lands
- Pursue funding for developing and/or updating management plans for ecological restoration and fuels management that will benefit SGCN on non-CDFW lands
- Develop and/or update management plans to manage invasive species

Conservation Strategy 6 (Economic Incentives): Development and delivery of economic incentives to private landowners, partners, and other stakeholders to implement responsible stewardship of landscapes, ecological processes and conditions, and SGCN

Objective(s):

- Develop and deliver economic incentives to private landowners, partners, and other stakeholders to implement responsible stewardship of landscapes, ecological processes and conditions, and SGCN

Targeted pressures: Annual and perennial non-timber crops, commercial and industrial areas, housing and urban areas, invasive plants/animals, fire and fire suppression

Conservation actions:

- Develop and assist landowners in enrolling in wildlife-dependent economic activities and programs, including passive and consumptive uses

- Assist agency partners and other stakeholders in developing wildlife-dependent economic incentives for landowners

Conservation Strategy 7 (Land Use Planning): Participating in and funding planning activities that will result in conserving chaparral

Objective(s):

- Participating in and funding planning activities that will result in conserving chaparral

Targeted pressures: Annual and perennial non-timber crops, commercial and industrial areas, housing and urban areas, invasive plants/animals, roads and railroads, fire and fire suppression

Conservation actions:

- Collaborate with land use agencies (e.g., cities and counties) on their land use planning efforts
- Pursue funding to assist partners and agencies in developing land use plans that will benefit chaparral conservation

Conservation Strategy 8 (Outreach and Education): Participating in and funding planning activities that will result in conserving forests and woodlands

Objective(s):

- Develop and implement outreach and education programs; Participate in outreach and education with partners and stakeholders

Targeted pressures: Annual and perennial non-timber crops, commercial and industrial areas, housing and urban areas, invasive plants/animals, roads and railroads, fire and fire suppression

Conservation actions:

- Develop and implement education and outreach programs
- Engage the public about stewardship of natural resources
- Conduct demonstration management projects

Target: Coastal Sage Scrub; Northwest Coast Cliff and Outcrop; Coastal Dune and Bluff Scrub; and North Coast Deciduous Scrub and Terrace Prairie

Coastal Sage Scrub: Along with chaparral, coastal sage scrub is the main community type of California shrublands. It differs from chaparral by being composed of drought-deciduous shrubs, which typically are smaller with less extensive root systems and shorter life spans. California sagebrush, a true sage species, shrubby buckwheats, deer-weed, and several other shrubs are characteristic. These shrubs are typical of relatively hot and dry slopes and occupy finer textured soils than most chaparrals. Some members of this target are disturbance specialists, colonizing burns or clearings, and giving-way to longer lived chaparral and other vegetation a few years after disturbance. Non-native invasive broom species are also present in coastal sage scrub.

Northwest Coast Cliff and Outcrop: Includes the barren coastal cliffs on headlands and islands of the north coast. This target has not been well-described.

Coastal Dune and Bluff Scrub: Stands of coastal dune and bluff vegetation are limited to salty, rocky or sandy settings immediately adjacent to the open coast. Adaptations to salt spray, wind and shifting sands, result in several lifeforms including succulent or hairy leaves, long underground roots and stolons (adaptation to shifting sands), and good colonization of relatively unstable and sterile substrates.

North Coast Deciduous Scrub and Terrace Prairie: This target includes a combination of grasses and shrubs, which tend to intermix in stands. Cool foggy summers and rainy winters, coupled with salty winds tend to preclude forest development along the immediate coast, but inland these stands only persist through regular disturbance such as clearing, grazing/browsing. Stands also commonly occur adjacent to upland coastal dune and bluff scrub; however, that community is characterized by more evergreen shrubs, which occur in well-drained exposed settings (exposed bluffs and dunes), dominated by mostly winter-deciduous shrubs in association with perennial cool-season grasses. Shrub indicators include the following: California blackberry, thimbleberry, salmonberry, hazel, and poison-oak. Grasses include Pacific reedgrass, California oat-grass, red fescue, and tufted hair-grass. In most stands there is a combination of grasses and shrubs, but more regularly disturbed (grazed, salt-spray-blasted, etc.) tend to have grass dominance.

Conservation Strategy 1 (Land Acquisition/Easement/Lease): Protect priority habitats through fee title acquisition, permanent conservation easement, or other means; purchase land in a corridor connecting two protected areas to provide connectivity of habitat

Objective(s):

- Ensure that funds are in place and priority sites are placed in easements; and, at each annual review, ensure that easements or leases are in compliance

Targeted pressure(s): Tourism and recreation areas; annual and perennial non-timber crops; housing and urban areas; commercial and industrial areas

Conservation Strategy 2 (Land Acquisition/Easement/Lease): Designate conservation areas with emphasis on sites or landscapes that have unique and important value to wildlife

Objective(s):

- Designate 5,000 acres for conservation area status

Targeted pressure(s): Roads and railroads; housing and urban areas; commercial and industrial areas

Conservation Strategy 3 (Data Collection and Analysis): Collect biological and ecological data to address key information gaps on SGCN, habitats, and pressures

Objective(s):

- Ensure that: the proposal includes clear management needs and outcomes that have been identified with input from relevant data users
- Research provides answers to relevant questions
- Appropriate audiences are accessing data
- Research provides recommendations for conservation actions
- Data are being used to inform conservation actions
- Ensure that conservation strategies are implemented, based on research, to reduce any pressures to conservation targets that may be cumulative to climate change (e.g., recreation, grazing)

Targeted pressure(s): Housing and urban areas; commercial and industrial areas; tourism and recreation areas; annual and perennial non-timber crops; fire and fire suppression; invasive plants/animals; airborne pollutants; climate change

Conservation Strategy 4 (Law and Policy): Develop or influence law and policy that addresses vehicle emissions, timber harvest cumulative impacts, critical habitat, and marine species with ranges that overlap jurisdictional boundaries

Objective(s):

- Adopt policies that address vehicle emissions, no net loss of critical habitat, timber harvest cumulative impact standards, and interstate enforcement for marine species with ranges that cross jurisdictional boundaries

Targeted pressure(s): Airborne pollutants; climate change

Conservation Strategy 5 (Land Use Planning): Provide input to land use planning decisions

Objective(s):

- Ensure that: local land use planners receive input on land use plans; a land use plan is approved that is consistent with input provided; the plan is implemented in a manner consistent with the input; and, at each annual review, the behavior of local entities is consistent with input

Targeted pressure(s): Housing and urban areas; commercial and industrial areas; annual and perennial non-timber crops; roads and railroads; airborne pollutants

Conservation action(s):

- Provide comments on documents such as City and County general plans, California Environmental Quality Act (CEQA) and National Environmental Policy Act (NEPA) documents, timber harvest plans, Integrated Natural Resource Management Plans (INRMPs) on military lands, etc.

Conservation Strategy 6 (Direct Management): Conduct direct resource management

Objective(s):

- Management actions are implemented. Examples of applicable actions include the following: restore or enhance degraded habitats, monitor populations, and remove barriers to species movement; conduct prescribed burns, wet burns, fire hazard abatement, and periodic burning in wildland areas; conduct managed thinning; enhance partnerships in private lands to increase direct management of natural resources; conduct managed grazing; manage invasive species; remove non-native species; conduct resource assessments to inform management decisions; and establish BMPs to implement across partnerships

Targeted pressure(s): Fire and fire suppression; invasive plants/animals

Conservation action(s):

- Coordinate with CAL FIRE
- Coordinate with Weed Management Areas (WMAs)
- Apply for funding

Conservation Strategy 7 (Management Planning): Develop and implement management plans

Objective(s):

- Develop management plans for target areas; Examples of applicable management planning actions include: work with partners on the development of large landscape conservation planning; develop or update management plans to integrate the effects of climate change; development of management plans for species, habitats and natural processes; develop a management plan for habitat of SGCN; reintroduction, relocation or stocking of native animals or plants or animals to an area where they can better adapt; translocate/breed in captivity SGCN to establish new populations in suitable habitat; and restore SGCN to historically occupied habitats

Targeted pressure(s): Invasive plants/animals

Conservation action(s):

- Coordinate with WMAs

Conservation Strategy 8 (Partner Engagement): Establish and engage in partner relationships, including with tribal governments

Objective(s):

- Engage state and federal agencies, tribal governments, NGOs, and other partners to achieve shared objectives and broader coordination across overlapping areas
- Establish partnership to co-monitoring species/habitats on federally managed lands
- Establish decision-making processes with other public and private entities to determine or implement strategies
- Convene an advisory committee to assist with implementation of strategies.
- Implement and expand existing BMPs

Targeted pressure(s): Housing and urban areas; commercial and industrial areas; annual and perennial non-timber crops; tourism and recreation areas; fire and fire suppression; invasive plants/animals; climate change

Conservation Strategy 9 (Environmental Review): Implement environmental review, with focus on the following: non-conservation oriented policies; projects and plans to help ensure impacts to wildlife are minimized and benefits maximized; infrastructure development projects to ensure they are designed and sited to avoid impacts on species and habitat; state highway plans; forest management plans; and plans for transmission corridor siting

Objective(s):

- Review appropriate plans (i.e., EIRs, EISs, Negative Declarations, Biological Opinions, Land use changes, General Plans)

Targeted pressure(s): Housing and urban areas; commercial and industrial areas; roads and railroads; dams and water management/use; renewable energy

Target: Coastal Lagoons

Coastal lagoons are bodies of water that are permanently or seasonally separated from the ocean by sand bars and are also known as "bar-built estuaries." Lagoons are characterized by estuarine species when open to the ocean periodically and may be characterized by freshwater species when permanently separated from the ocean.

Lagoons are surrounded by riparian vegetation providing habitat for amphibians, reptiles, birds, and mammals.

Conservation Strategy 1 (Land Acquisition/Easement/Lease): Protect riparian areas by acquiring land adjacent to lagoons and reduce water diversion from the critical lagoons and tributary streams during late spring to summer

Objective(s):

- Protect riparian areas by acquiring land adjacent to lagoons and reduce water diversion from the critical lagoons and tributary streams during late spring to summer

Targeted pressure(s): Livestock, farming, and ranching; wood and pulp plantations; dams and water management/use; commercial and industrial areas; housing and urban areas; tourism and recreation areas

Conservation action(s):

- Develop Conceptual Area Protection Plan (CAPP)
- Obtain funding for implementation and staff
- Survey the interests from willing sellers
- Identify partners for funding and management
- Identify willing landowners

Conservation Strategy 2 (Data Collection and Analysis): Conduct baseline surveys for SCGN/habitat and pressures of coastal lagoons within the ecoregion

Objective(s):

- Conduct baseline surveys for SCGN/habitat and pressures in coastal lagoons within the ecoregion

Targeted pressure(s): Housing and urban areas; commercial and industrial areas; tourism and recreation areas; annual and perennial non-timber crops; livestock, farming, and ranching; wood and pulp plantations

Conservation Strategy 3 (Law and Policy): Influence the drafting of laws and policies that promote conservation of lagoon habitat

Objective(s):

- Influence the drafting of laws and policies that promote conservation of lagoon habitat
- Ensure that riparian function and processes are maintained to provide desired conditions and manage riparian buffers

Targeted pressure(s): Housing and urban areas; commercial and industrial areas; tourism and recreation areas; annual and perennial non-timber crops; livestock, farming, and ranching; wood and pulp plantations

Conservation action(s):

- Develop CDFW policy for protecting riparian and watercourse zones tributary to lagoons
- Participate in interagency working group to advocate for lower order stream protection
- Advocate for compliance monitoring

Conservation Strategy 4 (Direct Management): Manage dams and other barriers to improve fish passage and stream ecosystem function

Objective(s):

- Using the Passage Assessment Database, Fish Passage Forum Barrier Optimization Model, and CDFW's internal prioritization team, establish a candidate list of small diversion dams that can be modified or removed to improve fish passage
- Quantify needed bypass flows to support biological requirements and geomorphology

Targeted pressure(s): Dams and water management/use; other ecosystem modifications

Conservation action(s):

- Coordinate with private landowners
- Inventory barriers and assess flow and water condition
- Develop plan for prioritization and construction or retrofits
- Identify funding sources-apply
- Permits, environmental review
- Perform conservation-oriented construction or retrofits
- Implement water conservation strategies
- Identify location of barriers

Conservation Strategy 5 (Direct Management): Develop an interagency direct management plan for coastal lagoons

Objective(s):

- Develop an interagency direct management plan for coastal lagoons

Targeted pressure(s): Annual and perennial non-timber crops; livestock, farming, and ranching; wood and pulp plantations

Conservation action(s):

- Coordinate with private and public landowners
- Inventory lagoons to assess flow and water condition and other important parameters for SGCN

- Identify groups/organizations to participate in interagency working group to establish priorities for restoration
- Develop plan for management prioritization, including restoration needs.
- Identify funding sources
- Secure permits and complete environmental review
- Perform conservation-oriented management and restoration actions
- Implement strategies to enhance functions for SGCN critical life history needs
- Conduct or acquire existing assessments of parcels to determine restoration potential and biological value

Conservation Strategy 6 (Training and Technical Assistance): Provide training and technical assistance, including training interagency staff in fish identification and invasive species management/control techniques

Objective(s):

- Train interagency staff on fish identification (native and non-native) and invasive species management/control techniques

Targeted pressure(s): Invasive plants/animals; annual and perennial non-timber crops; livestock, farming, and ranching; wood and pulp plantations; household sewage and urban wastewater; agricultural and forestry effluents; garbage and solid waste; climate change

Target: Salt Marsh

Salt marshes are generally tied to coastal tidally influenced wetlands in California. They have salinities similar to ocean water and do not develop the higher concentrations of salts characteristic of the salt marsh meadow community. Many salt marsh species are widespread, and species diversity is relatively low. Individual vegetation alliances within the macrogroup tend to sort out based on inundation frequencies and maximum water depths. Tidal freshwater wetlands in the Delta consist of freshwater to brackish marshes that are scattered along the shorelines of rivers and sloughs, along the levees of reclaimed islands and tracts, and within restored and managed wetlands in the Delta and Suisun Marsh. These habitats are subject to daily tidal inundation. Dominate species include: tules, hardstem bulrush, broadleaf cattail, common reed, sedges, Baltic rush, saltgrass, and pickleweed.

Conservation Strategy 1 (Land Acquisition/Easement/Lease): Protect and restore land acquired through fee title or conservation easement, with focus on the following: acquire, protect, enhance, or restore salt marsh habitat; support the Delta Conservancy to establish restoration priorities; and increase connectivity among salt marsh habitats

Objective(s):

- Restore salt-marsh habitat; acquire, protect, enhance, or restore salt-marsh habitat in the Bay Delta
- Support the Delta Conservancy to establish priorities for restoration in the Bay Delta
- Support for the Coastal Conservancy and others to implement established priorities and conservation goals in San Francisco Bay
- Increase connectivity among salt-marsh habitats in the Bay Delta

Targeted pressure(s): Housing and urban areas; commercial and industrial areas; annual and perennial non-timber crops; livestock, farming, and ranching; climate change

Conservation action(s):

- Develop, fund, and implement conservation actions, land acquisition, and management plans as part of the East Contra Costa NCCP, Santa Clara Valley NCCP, East Alameda County Conservation Strategy, draft Solano HCP, other relevant conservation management plans, the South San Francisco Bay Salt Pond Restoration Project, the Invasive Spartina Project, the San Francisco Baylands Ecosystem Habitat Goals Update, Suisun Marsh Habitat Management, Preservation, and Restoration Plan, and the San Francisco Bay Subtidal Habitat Goals Project
- Update conservation targets based on upcoming bay-wide strategies addressing ecosystem needs, challenges and restoration opportunities
- Conduct or acquire existing assessments of parcels to determine restoration potential and biological value, as well as gain information on transition zones and connectivity with upland habitats
- Write Land Acquisition Evaluation (LAE) or CAPP for high priority parcels. Acquire lands or easements to allow for future marsh migration
- Identify groups/organizations, such as the San Francisco Bay Joint Venture, to participate in interagency working group to establish priorities for restoration of salt-marsh habitat
- Establish priorities for restoration of salt-marsh habitat in San Francisco Bay Delta
- Link to strategy that advocates for legislation that supports acquisition and restoration of degraded habitat
- Identify and summarize available grant funding for acquisition and restoration.
- Coordinate with private landowners
- Restore CDFW lands
- Develop or support conservation strategies that focus on subtidal and open water habitats

Conservation Strategy 2 (Data Collection and Analysis): Conduct research regarding effective salt marsh management and restoration

Objective(s):

- Coordinate with the Delta-Science Program, Delta Conservancy, and the Coastal Conservancy in the coordination of research efforts and data sharing
- Continue ongoing long-term studies (baseline and monitoring)
- Identify and prioritize data gaps for future investigation/research

Targeted pressure(s): Housing and urban areas; commercial and industrial areas; annual and perennial non-timber crops; livestock, farming, and ranching

Conservation action(s):

- Obtain funding and implement research and monitoring described in the USFWS Recovery Plan for Tidal Marsh Ecosystems of Northern and Central California and the Suisun Marsh Plan
- Obtain funding for plan implementation
- Coordinate with state, federal, and local agencies, universities, and NGOs
- Identify existing/ongoing research/data-gathering efforts
- Create central repository for data, research tracking, and coordination
- Participate in science tracking database
- Develop data needs database/conceptual model
- Evaluate and prioritize existing long-term baseline data gathering efforts
- Continue participation in the San Francisco Estuary Wetlands Regional Monitoring Program for regional-scale monitoring (USFWS 2013)

Conservation Strategy 3 (Outreach and Education): Implement education and outreach focused on educating local agencies and the public on the biological values of Bay Delta habitats and existing pressures that affect fish and wildlife, and promote effective and coordinated conservation strategies for the Bay Delta

Objective(s):

- Educate local agencies and the public on the biological values of the Bay Delta habitats and the existing pressures affecting fish and wildlife
- Promote effective and coordinated conservation strategies for the Bay Delta

Targeted pressure(s): Housing and urban areas; commercial and industrial areas; annual and perennial non-timber crops; livestock, farming, and ranching; invasive plants/animals

Conservation action(s):

- Identify existing outreach and education strategies for the Bay Delta

- Participate in existing partnerships for developing an outreach and education strategy for the Bay Delta
- Coordinate with stakeholders
- Develop outreach messages
- Identify target audience
- Obtain funding for strategy implementation and staffing
- Develop and implement outreach plan

Conservation Strategy 4 (Economic Incentives): Provide economic incentives for improved resource management

Objective(s):

- Support Resource Conservation Districts on existing incentive programs (e.g., incentivize landowners to conserve and restore habitat)
- Collaborate with state, federal, and local agencies to identify opportunities to implement joint conservation actions
- Provide landowner assistance with cost share requirements to receive incentives
- Work with agencies providing incentives to lengthen enrollment limits

Targeted pressure(s): Housing and urban areas; commercial and industrial areas; annual and perennial non-timber crops; livestock, farming, and ranching

Conservation action(s):

- Identify willing landowners to participate in incentive programs
- Identify priorities based on conservation potential
- Obtain funding for strategy implementation
- Identify partnership opportunities
- Make recommendations based on program criteria
- Coordinate with federal agencies
- Develop pilot projects and case studies to demonstrate success
- Promote good-neighbor policies

Conservation Strategy 5 (Law and Policy): Advocate for laws and policies, with a focus on the following: influence land use policies to reduce impacts on salt marsh habitat; streamline permitting process for restoration; enhance law enforcement capacity for protection of restoration sites; develop programmatic permits; and prepare for climate change

Objective(s):

- Influence land use policies to reduce impacts on salt-marsh habitat
- Improve the effectiveness of the local, state, and federal permitting processes for restoration. For example, the Bay Restoration Regulatory Integration Team is made

up of three federal and three state regulatory agencies that permit Measure AA-eligible voluntary multi-benefit San Francisco Bay shoreline restoration projects
- Enhance law enforcement capacity for protection of restoration sites
- Reduce vandalism (e.g., pumps) and dumping
- Develop programmatic permits

Targeted pressure(s): Recreational activities

Conservation action(s):

- Identify conservation partners
- Coordinate with state, federal, and local agencies
- Evaluate the efficacy of creating new policies and regulations protecting salt-marsh habitat
- Make recommendations to enhance enforcement of existing laws and regulations
- Advocate for changes in regulations to allow streamlining
- Develop legislative and regulatory proposals for streamlining permitting process
- Develop advocacy message for habitat restoration
- Link to outreach and education strategy to inform decision makers
- Obtain funding for strategy implementation

Conservation Strategy 6 (Direct Management): Control invasive species

Objective(s):

- Comprehensively assess and map plant and animal invasive species distributions
- Develop an integrated control plan for each
- Coordinate update and implementation of landscape level invasive species monitor and control plan

Targeted pressure(s): Invasive plants/animals

Conservation action(s):

- Collaborate with existing agencies or groups involved with invasive species monitoring and treatment
- Identify and compile existing invasive species strategies
- Conduct additional mapping as necessary to fill gaps
- Develop control plans for priority species
- Implement priority species eradication efforts, i.e. nutria
- Implement top priority controls plans, i.e. spartina and Phragmites
- Monitor invasive species and continue removal efforts as needed to keep populations in check
- Link to outreach and education plan

Conservation Strategy 7 (Management Planning): Implement integrated resource management

Objective(s):

- Coordinate and integrate ongoing management activities (e.g., grazing BMPs, invasive species, water management, land use)
- Enhance working landscapes to benefit fish and wildlife
- Participate and contribute to working committees, management boards, and projects of each of the California Joint Ventures, such as the San Francisco Bay Joint Venture

Targeted pressure(s): Dams and water management/use; shipping lanes; roads and railroads; recreational activities

Conservation action(s):

- Fund and implement water and habitat management strategies on existing large-area habitat lands to enhance fish and wildlife population and increase water conservation for multi-benefits and uses
- Fund and implement salt marsh resource management actions as described in draft and final NCCPs, HCPs, Conservation Strategies, and Recovery Plans, including the Suisun Marsh Habitat Plan, and USFWS Tidal Marsh Recovery Plan
- When Caltrans is currently implementing BMPs, look for opportunities for alignment of BMPs through the implementation of SWAP strategies and existing processes such as those in place at Caltrans
- Coordinate with state, federal, local agencies, and private landowners, including the California Water Fix process
- Participate in California Biodiversity Council integration process
- Participate in Dredged Material Management Office, incorporate Delta
- Implement invasive species strategy
- Create common set of biological/ecological indicators
- Develop common methods/priorities for habitat restoration and management
- Coordinate cross-jurisdictional activities

Conservation Strategy 8 (Partner Engagement): Partner for joint advocacy

Objective(s):

- Create high-level multi-agency, NGO, and tribal government partnerships to coordinate conservation actions
- Through partnerships, leverage political awareness of need to conserve salt marsh habitat in the Bay Delta
- Solicit additional funding through grants or political advocacy

Targeted pressure(s): Dams and water management/use; shipping lanes; roads and railroads; recreational activities

Conservation action(s):

- Coordinate with local agencies and non-governmental organizations (NGOs) with large-area draft and completed conservation plans
- Coordinate with entities involved in Bay Delta conservation
- Develop MOU/Charter for partnership
- Review and synthesize existing conservation strategies
- Establish process for prioritizing conservation actions
- Advocate science-based decisions and process
- Develop coordinated/unified conservation plan
- Pool or leverage funding for conservation

Target: Freshwater Marsh

This vegetation type consists of freshwater emergent marshes and coastal/tidal marshes and meadows. It can be found surrounding streams, rivers, lakes and wet meadows. These habitats occur on virtually all exposures and slopes, provided a basin or depression is saturated or at least periodically flooded. Dominant species are generally perennial monocots including graminoids such as rushes, reeds, grasses and sedges. Dominant species include the following: common reeds, hardstem bulrush, small-fruited bulrush, water parsley, slough sedge, soft rush, salt rush, and pacific silverweed.

Conservation Strategy 1 (Outreach and Education): Provide outreach and education

Objective(s):

- Influence public awareness of proper land management for freshwater marshes by providing information to landowners regarding BMPs and proper wetland management.
- Coordinate with local landowners to determine what conservation efforts they are engaged with and determine how CDFW may assist in their efforts

Targeted pressure(s): Livestock, farming, and ranching

Conservation action(s):

- Target Buckeye Conservancy and RCDs
- Design and produce brochures with wetland conservation message
- Employ web-based media to provide information to public

Conservation Strategy 2 (Land Acquisition/Easement/Lease): Purchase land and conservation easements

Objective(s):

- Improve land management by removing invasive species and creating better grazing practices

Targeted pressure(s): Livestock, farming, and ranching; annual and perennial non-timber crops

Conservation action(s):

- Prioritize with Conceptual Area Protection Plan (CAPP) and Environmental Site Assessment

Conservation Strategy 3 (Law and Policy): Advocate for laws and policies

Objective(s):

- Strengthen regulatory authority over wetlands and integrate beaver ecology into wetland restoration activities

Targeted pressure(s): Livestock, farming, and ranching; annual and perennial non-timber crops

Conservation action(s):

- Evaluate and update Wetlands Policy
- Implement wetland and riparian technical memorandum
- Review and modify CDFW policy on beaver depredation
- Update wetlands implementation policy

Conservation Strategy 4 (Management Planning): Develop management plans

Objective(s):

- Develop BMPs for ecosystem management on CDFW lands
- BMPs would provide guidance on managing CDFW lands for multi-species use and benefit both recreation and conservation of native species

Targeted pressure(s): Invasive plants/animals; livestock, farming, and ranching; annual and perennial non-timber crops; climate change

Conservation action(s):

- Revise Land Management Plan (LMP) guidelines to include ecosystem management
- Update LMPs to be consistent with new guidelines for managing at an ecosystem level
- Develop policy on ecosystem management on public lands

Conservation Strategy 5 (Economic Incentives): Provide economic incentives for improved resource management.

Objective(s):

- Provide economic incentives through restoration grants

Targeted pressure(s): Livestock, farming, and ranching; annual and perennial non-timber crop

5.4 Central Valley and Sierra Nevada Province

5.4.1 Geophysical and Ecological Description of the Province

The Central Valley and Sierra Nevada Province is the largest province within the state (Figure 5.4-1) and is composed of two of California's major geographic and ecological regions. Although the Central Valley and the Sierra Nevada Range are very distinct physically and ecologically, together they contain most of the state's major watersheds and form an important elevation and ecological gradient that drives much of California's biodiversity patterns. Elevations in the province range from less than 300 feet throughout most of the Central Valley to over 14,500 feet in the Sierra Nevada. The types, distribution, and functions of vegetation and wildlife resources in the province are strongly influenced by variations in geology, climate, topography, and hydrology along this elevation gradient, as well as development and land use patterns. These physical and ecological conditions support a diverse mix of vegetation communities, wildlife habitats, and conservation challenges.

Central Valley

The Central Valley comprises most of the low-lying lands of central California. Much of the region is part of a vast hydrological system that drains much of the state's water. This water, falling as either rain or snow over much of the northern and central parts of the state, culminates in the Sacramento and San Joaquin rivers and then into the Sacramento River and San Joaquin River Delta (Delta).

The Central Valley has two distinct subregions: the Sacramento Valley to the north and the San Joaquin Valley to the south. Each subregion has unique combinations of climate, topography, ecology, and land use patterns. Together, they form a vast, flat valley, approximately 450 miles long and averaging 50 miles wide. The Sutter Buttes, a circle of 2,000-foot-high hills left over from the eroded remains of a volcano, rise from the middle of the Sacramento Valley (promoted locally as the "Smallest Mountain Range in the World") and is the only topographic feature that exceeds the valley floor elevation. The Central Valley is surrounded by the Sierra Nevada Mountains on the east, the coastal ranges on the west, the Tehachapi Mountains on the south, and the Klamath and Cascade mountains on the north. Less influenced by marine air than San Francisco Bay, the valley's climate has hot, dry summers and foggy, rainy winters. Annual rainfall averages from 5 to 25 inches, with the least rainfall occurring in the southern portions and along the west side (in the rain shadow of the coastal mountains).

Agriculture dominates land uses in the Central Valley, with very few natural habitats remaining. The major natural upland habitats are annual grassland, valley oaks on floodplains, and vernal pools on raised terraces. The more arid lands of the southern San Joaquin Valley contain desert habitats which include alkali sink and saltbush shrublands. Slow-moving rivers along the valley floor provide habitat for fish and invertebrates and help maintain adjacent riparian, freshwater wetland, and floodplain habitats.

Hydrology is the main difference between the two Central Valley subregions. The Sacramento Valley contains the Sacramento River, the largest river in the state. This river historically overflowed into several low-lying areas, particularly in its lower reaches. The lower 180 miles of the river, below Chico Landing, are now constrained by levees, and excess floodwaters are diverted into large bypasses to reduce risks to human populations. The San Joaquin Valley has two separate drainages. In the northern portion, the San Joaquin River flows north toward the Delta. It captures water via several major rivers that drain the central Sierra Nevada. The southern portion of the valley is isolated from the ocean and drains into the closed Tulare Basin, which includes the beds of the Tulare, Buena Vista, and Kern lakes. These lakes and vast wetlands historically were fed by the rivers that drain the southern Sierra Nevada (the Kings, Kaweah, Tule, and Kern). These lakes are now dry in most years because water has been diverted to upland agriculture. Runoff during the wettest years will occasionally flood out of river channels and temporarily refill some of these lakebeds. The California Aqueduct extends along the entire western edge of the valley, delivering water from the Delta to farmers in the Tulare basin and over the Tehachapi Mountains to Southern California. Major changes to hydrology are projected to hydrology due to climate change, as discussed in Section 5.4.5.

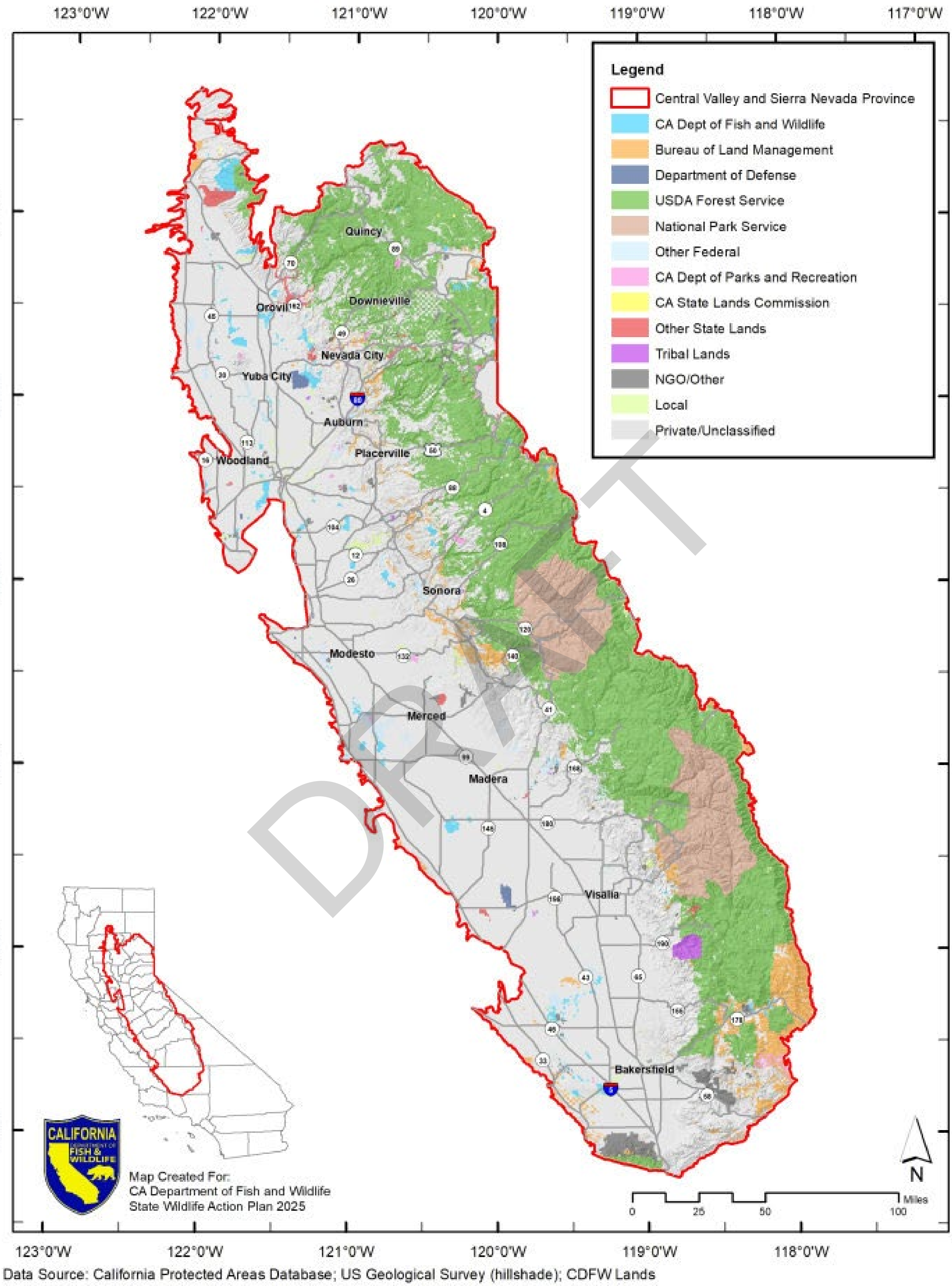


Figure 5.4 - 1 Land Ownership of the Central Valley and Sierra Nevada Province

The ecology of the Central Valley has been altered by the loss, degradation, and fragmentation of habitats, both terrestrial and aquatic, detailed in Section 5.4.5. Ecological systems have been impacted by the development of agriculture, construction of moderate and large dams and reservoirs, the channelization and diversion of rivers and streams, and urban development. Many of the streams have been dammed, blocking fish migration, or have been so severely degraded that they are no longer usable by many native fishes. Flood control structures, such as dikes, levees, and hardened embankments (riprap), have altered floodplain habitats like riparian forests, river processes (meanders and associated functions), and wetlands throughout the region. This loss of habitat has led to population reduction for waterfowl, wading birds, riparian brush rabbits, and Tricolored blackbirds, as well as other wetland dependent species. Some species that persist on the remaining habitat fragments are at risk of local extirpation or range wide extinction (e.g., Clear Lake hitch, winter-run Chinook salmon). A large percentage of the historic Central Valley riparian and aquatic habitat has been lost; with an estimated 98 percent reduction in the extent of riparian forests and a 75-95 percent reduction in aquatic salmon habitat (Reynolds 1993; CALFED Bay-Delta Program 2014; NMFS 2014).

The Central Valley is primarily in private ownership, and the role of private landowners in conservation is very important. More than 75 percent of the known California locations of 32 special-status animal species occur predominately on private lands. Examples of these species include Swainson's hawk, Burrowing owl, California tiger salamander, and Buena Vista Lake shrew.

Central Valley agricultural habitat is very important to species such as greater and lesser sandhill cranes, waterfowl, shorebirds, and other waterbirds as well as many other avian species including Tricolored blackbird and Swainson's hawk. Therefore, it is important to focus on maintenance of wildlife-friendly agriculture (e.g., discouraging habitat loss from urbanization and orchard and vineyard encroachment into important wintering areas and encouraging wildlife friendly crops and cropland management (Ivey et al. 2016). The Central Valley Joint Venture Implementation Plan (2020), provides recommendations for wildlife management and conservation on private lands in the Central Valley.

Managed wetlands in the Central Valley are broadly categorized as seasonal, semi-permanent, or permanent. Seasonal wetlands are typically flooded in the fall, with hydrologic drawdown occurring between March and May. Semi-permanent wetlands are usually flooded from early fall through early July, while permanent wetlands are flooded year-round. Since the majority of these non-seasonal wetland habitats are semi-permanent, for planning purposes, semi-permanent and permanent wetlands are combined. About two thirds of all managed wetlands in the Central Valley are privately owned, while nearly 90 percent of all wetlands are managed on a seasonal basis. Seventy-seven percent of all wetlands are in four basins: Butte, Colusa, Suisun, and San Joaquin (Central Valley Joint Venture 2020).

Sierra Nevada

Extending approximately 400 miles from north to south, the Sierra Nevada Mountain Range forms the spine of the California landscape. The predominantly granitic features of the Sierra Nevada extend from the Susan River and Fredonyer Pass in the north to Tehachapi Pass in the south. To the south, the Sierra Nevada range embraces the Mojave Desert to the east and curves south to link with the Tehachapi Mountains. The region includes the oak woodland foothills on the western slopes and, on the east, the Owens Valley and edges of the Great Basin.

On the west side, the slope of the Sierra Nevada rises gradually from near sea level at the floor of the Central Valley to ridges ranging from 6,000 feet in the north to over 14,000 feet in the south, then drops off sharply to the east. As the elevation increases from west to east, life zones transition from chaparral and oak woodlands to lower montane forests of ponderosa and sugar pine to upper montane forests of firs, Jeffrey and lodgepole pine and, above timberline, to alpine plant communities.

Ungulate Migration Corridor Mapping

California is home to several species of ungulates, including mule deer, elk, pronghorn, and bighorn sheep. Many of the ungulate herds in California are migratory and require large landscapes to persist, making them particularly vulnerable to habitat loss and fragmentation. Connectivity between seasonal ranges is therefore crucial to conserve these charismatic species and to facilitate their movement across the landscape. In addition to migration corridors, mapping and conserving high-use winter range habitat is also essential to maintain ungulate herd population viability.

In 2020, efforts began to analyze GPS collar datasets that provide accurate location information for ungulate individuals over time. Individuals from ungulate herds across the state are collared with GPS tracking devices to facilitate the mapping of high-use corridors that are used during migration between seasonal ranges. Mule deer living in the Sierra Mountains, such as the Pacific herd (Figure 5.4-2), migrate to higher elevations in spring via specific corridors to track vegetative growth and move to lower elevations in fall to escape harsh winter conditions. Using collar data from historical and ongoing projects across the state, ungulate population-level corridors, stopovers, and winter range habitats are mapped and prioritized for conservation.

This interactive story map explores some of CDFW's ungulate migration products, describing the data and analytical processes. A complete list of ungulate migration products available to the public can be viewed in the Ungulate Migration Corridor Viewer. Detailed results of these analyses, and comparable analyses from other western states, can also be found in a series of reports (Ungulate Migrations of the Western United States) published by the U.S. Geological Survey (USGS). Links to these reports can be found on CAU connectivity. More information about CDFW's connectivity mapping and modeling efforts can be found in Appendix I.

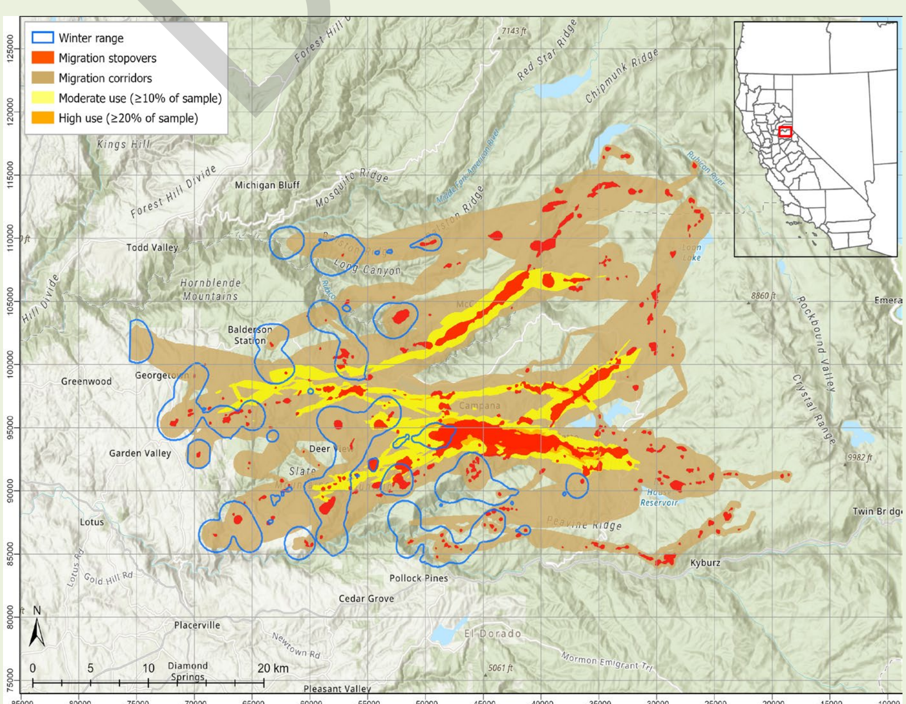


Figure 5.4-2 Pacific Mule Deer Migration Corridors

Federal agencies manage about 75 percent of the Sierra Nevada: 57 percent by the U.S. Forest Service (USFS), 13 percent by the National Park Service (NPS), and 5 percent by the Bureau of Land Management (BLM; Figure 5.4-1). About 2 million acres are wilderness areas, mostly in the southern Sierra, managed by USFS. Lands managed by the NPS include Sequoia, Kings Canyon, and Yosemite National Parks and Devils Postpile National Monument. State parks and wildlife areas account for 0.6 percent of the region, and the remaining approximately 24 percent of the Sierra Nevada is privately owned. Most of the higher elevations and the eastern Sierra are public lands, whereas most of the oak woodlands and lower mixed conifer forests and rangelands below 3,000 feet on the western slope are in private ownership. There is a checkerboard ownership pattern of private and public lands in areas of the northern half of the Sierra Nevada that lie near historical railway routes (Sierra Nevada Ecosystem Project SNEP Science Team and University of CA Centers for Water and Wildland Resources 1996; CA Resources Agency Legacy Project 2004).

Much of the state's surface-water runoff flows to the Central Valley from the Sierra Nevada and adjacent Cascades. These flows are critical to meet California's hydropower demands and agricultural and drinking water needs. Much of the water is stored in reservoirs and is conveyed by aqueducts to irrigate agriculture from Redding to Bakersfield and to provide drinking water for most of urbanized California, including the San Francisco Bay Area and Southern California (DWR 2023).

The hundreds of creeks and streams of the western slopes of the Sierra Nevada drain via a dozen major river basins to merge with the Sacramento River in the north and the San Joaquin River in the south, which eventually join at the San Francisco Bay Delta. The southern forks of the Kings River and streams farther south drain into the Tulare basin. The streams east of the Sierra crest flow into the Great Basin through the Lahontan, Mono, and Owens drainages. Maintaining and restoring the ecological health of these watersheds and aquatic systems is important to ensure clean water.

The variable topography, large elevation gradient, and varied climatic conditions of the Sierra Nevada support diverse plant communities. The Sierra Nevada supports at least 1,300 vascular plant species, along with numerous bryophytes and lichens, and more than 450 species of vertebrate animals (USFS 2004). The varied conditions and floristically and structurally diverse plant communities provide a large array of habitats important for maintaining California's wildlife diversity and abundance.

Several major pressures have altered aquatic ecosystems and transformed forest structure and habitats on both public and private lands. Dramatic human population growth and development in the western Sierra foothills, forest management practices, fire suppression, and livestock grazing have altered ecosystems and continue to affect wildlife habitats. Hydropower facilities and agricultural and municipal water diversions have disrupted natural river flow regimes. Eroding access roads in forested and other habitats and excessive livestock grazing have resulted in the conversion of wet meadows to drier lands and have degraded streams and aquatic habitat. The introduction of trout has caused declines in native species. In the central Sierra, historical mining severely altered watersheds and water courses, and those effects persist. Importantly, effects of climate change are already evident; the Sierra Nevada has experienced increased minimum temperatures, earlier snowpack melting, changes in stream hydrology, and increased frequency of large, severe wildfires (Safford et al. 2012). Fire suppression and inadequate forest management have led to uncharacteristic fires, which drastically change landscapes and habitat for decades and start self-perpetuating cycles of uncharacteristic fire.

The altered forest ecosystems of the Sierra Nevada largely lack the qualities of old-growth or late seral stage forests (forests that are in the later stages of development with large-diameter trees, snags, and logs) that are important for diverse and abundant wildlife (Franklin and Fites-Kaufmann 1996; USFS 2001). Species that depend on old-growth or late-seral stage forest habitat, like the Pacific fisher, have been negatively affected. The degradation of mountain meadows and loss of quaking aspen, willow, and other riparian woody plants have affected the endangered willow flycatcher and other species that have similar habitat requirements.

New conservation challenges and opportunities will affect the Sierra Nevada in the next few decades. How new development is managed, including renewable energy development, will determine the extent of wildlife habitat fragmentation. Changing global climate will alter depth and seasonality of snowpack, further modifying river flow regimes, fire behavior, and ecosystems. The relicensing of hydropower projects provides an opportunity to change hydropower operations to reduce their effects on fish and wildlife.

Concerned about the decline of old forests and associated wildlife species of the region, Congress funded, in 1993, the Sierra Nevada Ecosystem Project (SNEP), based at UC Davis, for the "scientific review of the remaining old growth in the national forests of the Sierra Nevada in California, and for the study of the entire Sierra Nevada ecosystem by an independent panel of scientists, with expertise in diverse areas related to this issue." The forests of the Sierra, Cascades, and the Modoc Plateau were evaluated by a multidisciplinary team of scientists from many organizations. SNEP completed its work and published a three-volume report in 1996 (Millar 1996). Based on the work of dozens of scientists, the report analyzed the status of conifer forests, rangelands, meadow and riparian plant communities, and aquatic ecosystems, and suggested alternatives to restore ecosystems.

Aquatic and riparian systems are believed to be two of the most altered and impaired habitats of the Sierra Nevada. Among other critical findings, SNEP found that key causes of the decline of mammals, birds, other vertebrates, and invertebrates in the Sierra, Cascades, and Modoc regions include the loss and degradation of riparian areas, foothill woodlands, and diverse old forest habitats (including large trees, snags, fallen logs, and layered vegetative structure).

A 1992 technical report by USFS Pacific Southwest Research Station highlighting at-risk California spotted owl populations triggered debate about habitat conservation and forest uses. That debate prompted USFS to initiate a multiyear planning process that resulted in the Sierra Nevada Framework for Conservation and Collaboration (Sierra Framework), which evolved into the Sierra Nevada Forest Plan Amendment (SNFPA) Final Environmental Impact Statement covering the national forests of the Sierra, Cascades, and Modoc regions. In January 2001, USFS announced the SNFPA Record of Decision, describing chosen management options. In January 2004, the SNFPA was amended, reducing livestock-grazing and timber-harvest restrictions and giving USFS greater management discretion. USFS Forest Plans are currently being updated to align with the new National Forest System planning rule adopted in 2012.

Numerous watershed groups, private landowners, local conservancies, resource conservation districts, and state and federal programs are engaged in habitat conservation and restoration work on public and private lands throughout the region. The legislatively created Sierra Nevada Conservancy, established in January 2004, is a key collaborator and a potential source of funding for conservation and restoration of habitats for species at risk in the Sierra Nevada.

5.4.2 Conservation Units and Targets

The conservation units associated with the Central Valley and Sierra Nevada Province are the Great Valley, Sierra Nevada Foothills, and Sierra Nevada ecoregions (Figure 5.4-3), and the Sacramento, Central Lahontan, San Joaquin, and Tulare-Buena Vista Lakes hydrologic units (Figure 5.4-4) are described below.

Ecoregion Summaries

Great Valley: Contains the alluvial plains of the Sacramento and San Joaquin Valleys. Summers are hot and dry, and winters are mild. Oceanic influence on climate is slight in the middle of the Great Valley, which receives some marine air through the Carquinez Strait, but becomes negligible at the north and south ends of the Valley. Predominant vegetation includes annual grassland, cheatgrass, valley oak, vernal pools and wetland communities, blue oak, allscale and saltgrass. Elevation range: 0 to 2,000.

Sierra Nevada Foothills: Includes the hot foothills of the Sierra Nevada, and the southwestern end of the Cascade Ranges, adjacent to the Great Valley. Predominant vegetation communities include blue oak, broom, cheatgrass, chamise, mixed chaparral, foothill pine, and valley oak. Elevation range: 200 to 5,000

Sierra Nevada: The temperate to very cold parts of the Sierra Nevada, which is a north-northwest aligned mountain range that is much steeper on the east than on the west side. Predominant vegetation communities include mixed conifer, ponderosa pine, Jeffrey pine, white fir, red fir, lodgepole pine, huckleberry oak, western juniper, aspen, big sagebrush, mixed subalpine forest, mountain hemlock, whitebark pine, and giant sequoia. Elevation range: 1,000 to 14,495.

Hydrologic Unit Summaries

Sacramento HUC 1802: Encompasses much of northern California. Includes the Sacramento River Basin, including Shasta Lake and the isolated Clear Lake drainage basin, in California and drainage into Goose Lake in Oregon. Covers an area of 27,600 square miles. Traverses the Coastal, Cascade, Warner, and Sierra Nevada mountain ranges, and Modoc Plateau.

Central Lahontan HUC 1605: Includes the Central Lahontan Basin, consisting of the Carson, Truckee, and Walker River Basins in California and Nevada. Covers an area of 12,500 square miles. This unit is characterized by a diverse topography and climate. It includes high points along the eastern slopes of the Sierra Nevada and adjacent valley bottoms. The unit experiences very high to very low levels of precipitation associated with heavy snowfall in the mountainous regions and rainshadow effects in the valleys to the east and a similarly wide variation in temperature extremes. Varied topography and climate provide for a correspondingly diverse array of habitats, including abundant high-quality waters and wetlands that support many distinct and unique plants and communities in this unit. Particularly notable are endemic fish species such as Paiute cutthroat trout and several species of desert pupfish. Numerous beneficial uses related to biological resources have been identified in this unit; as well as numerous CDFW-designated Significant Natural Areas. Elevation range: 4,200 to 11,400.

San Joaquin HUC 1804: Includes the entire San Joaquin River basin and its tributaries, including the Chowchilla, Merced, Stanislaus, Calaveras, Cosumnes, Mokelumne, Fresno, and Tuolumne rivers, Panoche Creek, and Mormon Slough. Also includes the San Luis reservoir and the San Joaquin Delta. Covers an area of 15,600 square miles. This unit, together with the Sacramento unit (1802), covers about one fourth of the total area of the state and furnishes roughly 51% of the State’s water supply. The upper portions of this unit are characterized by high gradient mountain streams entering low gradient meadows and grasslands/agricultural lands and in areas terminating into large warm water lakes with unique native fish assemblages. Surface water from this unit in combination with the Sacramento unit meet and form the Delta, which ultimately drains into the San Francisco Bay. Two major water projects, the CVP and SWP, deliver water from the Delta to Southern California, the San Joaquin Valley, Tulare Lake Basin, the San Francisco Bay area, as well as within the Delta boundaries. The Delta is a maze of river channels and diked islands. Historic and ongoing point and nonpoint source discharges impact surface waters in this unit.

Significant portions of major rivers and the Delta within HUC 1804 are impaired, to some degree, by discharges from agriculture, mines, urban areas, and industries. The wetlands of this unit form important waterfowl habitat for migratory waterfowl using the Pacific Flyway.

The alluvial fans within portions of HUC 1804 contain salts and selenium, which can be mobilized through irrigation practices and can pose potential threat to the condition of surface waters and wetlands supporting important wildlife. Elevation range: 0 to 12,800.

Tulare-Buena Vista Lakes HUC 1803: Includes drainage into the closed basins of Tulare and Buena Vista Lake in portions of Fresno, Kern, Kings, and Tulare counties of the southern San Joaquin Valley, California. Covers an area of 16,200 square miles. This unit is situated in the topographic horseshoe formed by the Diablo and Temblor Ranges on the west, by the San Emigdio and Tehachapi Mountains on the south, and by the Sierra Nevada Mountains on the east and southeast. It receives flood water from the major rivers during times of heavy runoff and surface water only drains from this unit north into the San Joaquin River in years of extreme rainfall. This unit once supported vast tule marshes, riparian corridors, abundant wetlands, and one of the most diverse, productive grasslands in temperate North America. However, the Tulare and Buena Vista lakes basin has been developed for farming due to its fertile soils, relatively cloudless summers, and high-quality runoff from the adjacent mountains; it is now one of the most important agricultural centers of the world. Surface water supplies are inadequate to support the present level of agricultural and other development; ground water resources supply additional demands.

The accumulation of salts is a primary concern in HUC 1803 due to importation and evaporative use of the water. Evaporation ponds are used for disposal of these saline waters; these ponds are known to detrimentally impact wildlife. Additionally, historically poor sanitation associated with recreational uses and erosion from construction, logging, grazing, and irrigated agriculture are threats to stream environments in this unit. Elevation range: 160 to 13,200.

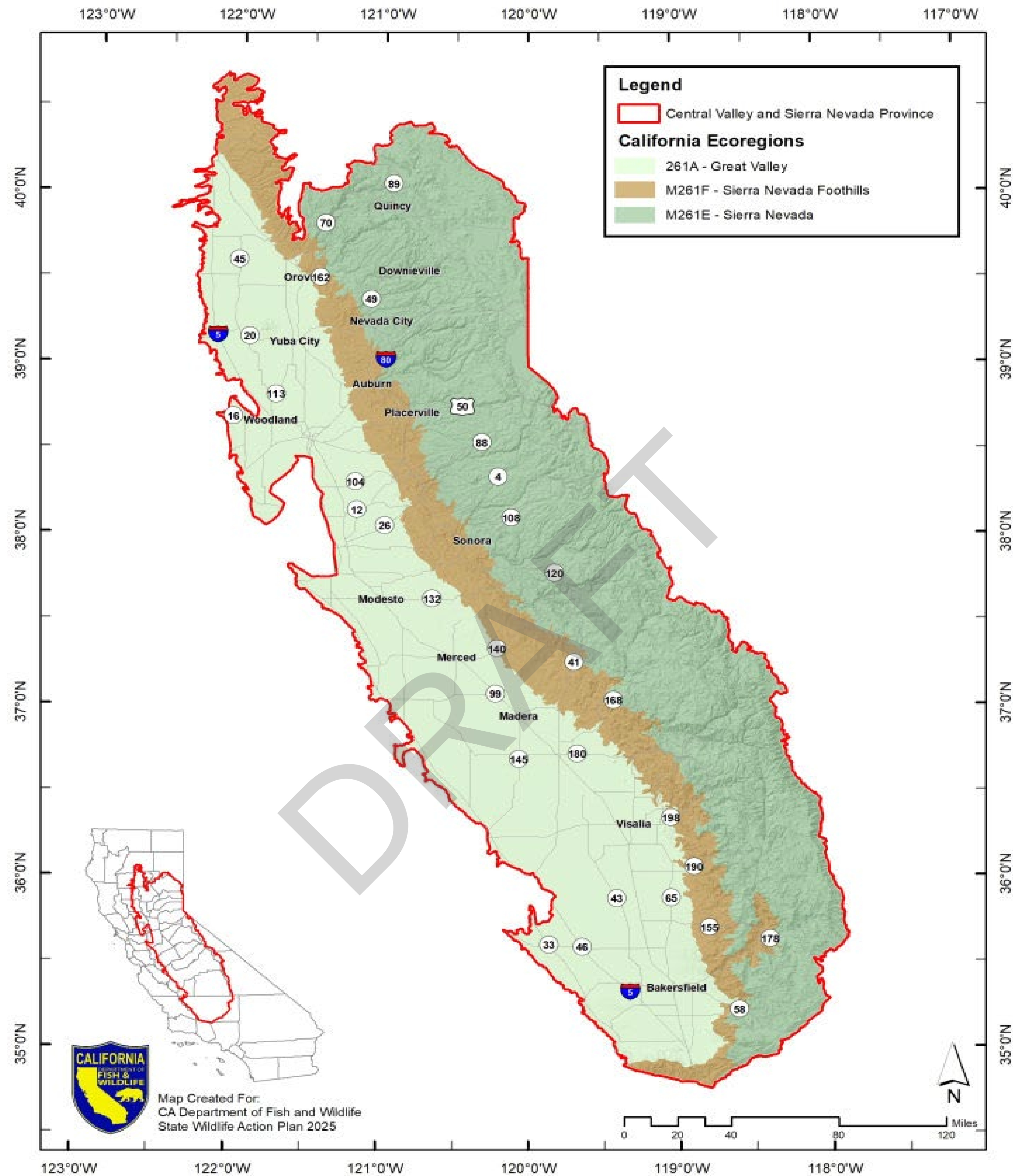
Conservation Targets

Conservation targets were selected in this province as priorities for conservation planning within the conservation units; targets are listed in a searchable, sortable table (Table 5.0). The conservation targets are summarized in Section 5.4.6 along with the strategies for each. The conservation targets include:

- Alpine Vegetation
- American Southwest Riparian Forest and Woodland
- California Foothill and Coastal Rock Outcrop Vegetation
- California Foothill and Valley Forests and Woodlands
- California Grassland
- Chaparral
- Desert Transition Chaparral
- Freshwater Marsh
- Montane Chaparral
- North Coastal Mixed Evergreen and Montane Conifer Forests
- Pacific Northwest Subalpine Forest
- Shadscale-Saltbush Scrub
- Wet Mountain Meadow
- Western Upland Grasslands
- Clear Lake Native Aquatic Assemblage
- Carson River Native Fish Assemblage
- Walker River Native Fish Assemblage
- San Joaquin Native Aquatic Species
- Upper Kern River Native Fish Species

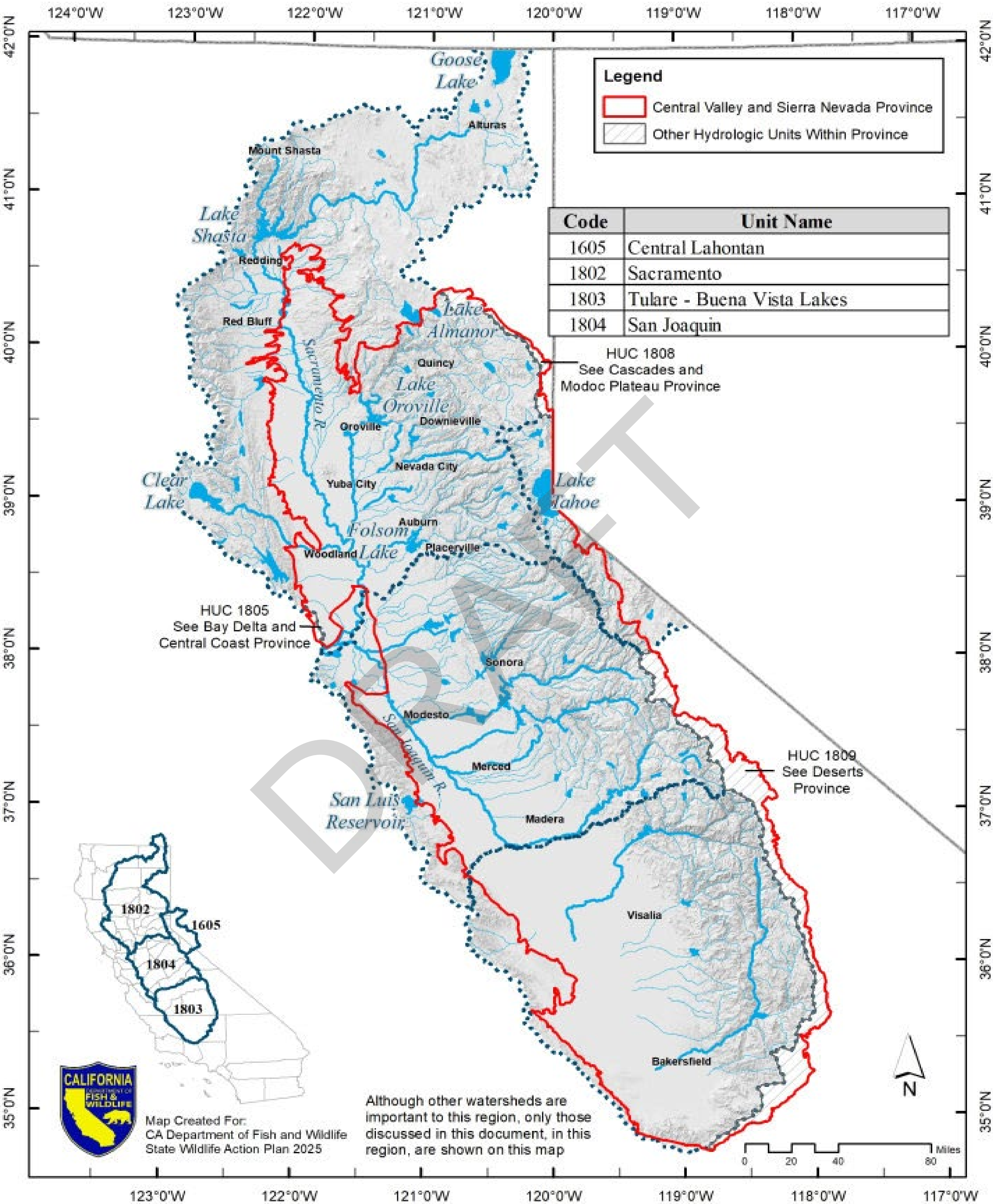
Although numerous potential conservation targets were identified within the province, conservation strategies were only developed for the targets that contain the greatest number of Species of Greatest Concern (SGCN) and that are under immediate threat. Additional key targets will be addressed through future conservation planning efforts.

Figure 5.4-5 shows the distribution of the plant communities (CWHR common names) within the province. Some of the plant communities identified as conservation targets do not appear on the figure because they exist in areas smaller than the mapping unit. Information about the methods used to prioritize conservation targets is presented in Chapter 1.5 and Appendix D.



Data Source: USDA Forest Service (ecoregions); US Geological Survey (hillshade)

Figure 5.4 – 3 Ecoregions of the Central Valley and Sierra Nevada Province



Data Source: Rivers/Lakes: National Hydrologic Dataset (NHD) and CDFW; Hillshade: US Geological Survey

Figure 5.4 - 4 Hydrologic Units of the Central Valley and Sierra Nevada Province

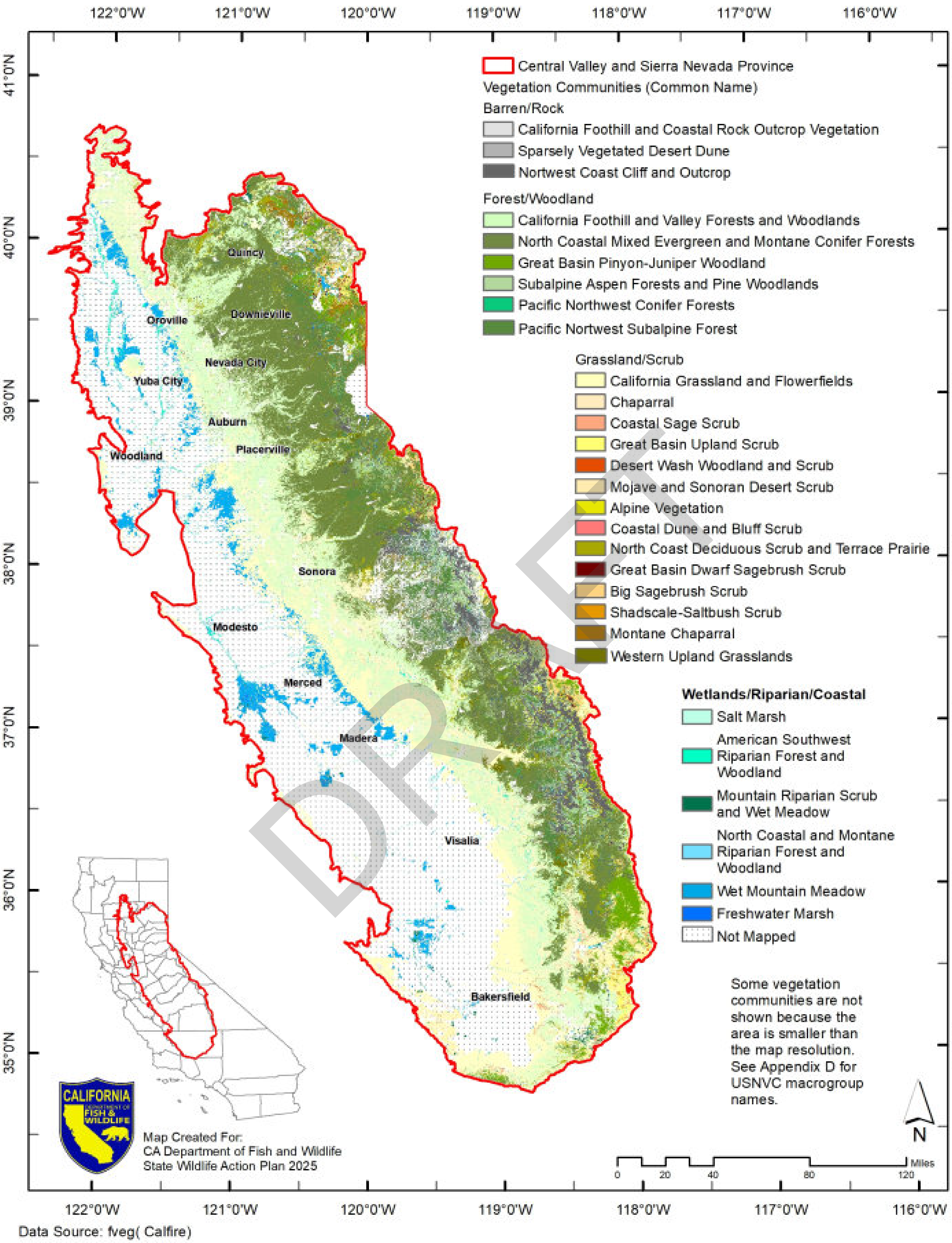


Figure 5.4 – 5 Vegetation Communities of the Central Valley and Sierra Nevada Province

Key Ecological Attributes

Key ecological attributes (KEAs) were identified for each conservation target (Table 5.0). These attributes are considered the most important for the viability of the targets and their associated species. The most commonly identified attributes for the Central Valley and Sierra Nevada Province are:

- area and extent of community
- fire regime
- connectivity among communities and ecosystems
- successional dynamics
- community structure and composition
- soil quality and sediment deposition regime

5.4.3 Species of Greatest Conservation Need in the Central Valley and Sierra Nevada Province

The SWAP identified the Species of Greatest Conservation Need (SGCN) for the entire state and identified ecoregion(s) and province(s) associated with each SGCN; data is summarized in Appendix C. The conservation strategies are aimed at benefitting the SGCN via the conservation targets.

For those SGCN that do not occur within the conservation targets identified for the province, conservation actions that target SWG funding should align with existing recovery plan documents where applicable, or demonstrate they address a critical conservation need for the species.

5.4.4 Pressures on Conservation Targets

Using the Open Standards of Conservation, a stress is an impaired aspect of a conservation target, equivalent to a degraded KEA (Conservation Measures Partnership 2020). Pressures are primarily human activities, or natural phenomena influenced by humans, that amplify environmental stress and further degrade conservation target(s). The pressures identified in the Central Valley and Sierra Nevada Province are the most significant pressures to the conservation targets, but do not constitute a complete list of pressures in the province. Some principal pressures in the province are discussed in more detail below. Dams and Water Management/Use

Central Valley

Water management pressures in the Central Valley include water diversions, dams, flood control structures (e.g., levees and bank protection), groundwater pumping, stream and river crossings (e.g., culverts, bridges), and dredging. Because of the important hydrologic connections, water management interrelationships, and other linkages between the Central Valley and the Bay Delta watersheds, the following includes some discussion of Central Valley water management influences on the Bay Delta.

Water diversions are found throughout the Central Valley's rivers and tributaries. Water is diverted for agriculture, municipal and industrial uses, and managed wetlands. Up to 70 percent of the freshwater flow that would naturally enter San Francisco Bay is now diverted (Steere and Schaefer 2001). Dams are located on all the major rivers in the Central Valley and on many of their tributaries.

Dams and diversions have dramatically affected the aquatic ecosystems of the Central Valley, altering historical flooding regimes, erosion, and deposition of sediments that maintain floodplains. They also decrease riparian habitats and coarse gravel supplies needed for salmon and other native fish reproduction. Dam operations create rapid changes in flow rates that have led to the stranding of fish and exposure of fish spawning areas (CDFG 2005).

Dams reduce the amount of water remaining in the river that is needed by fish at critical times, and they alter the flow regimes in ways that are detrimental to aquatic life. Less water in the rivers also means less water for managed wetlands. Reduced river flows downstream also allow saltwater intrusion into the Delta, increasing the salinity levels in the San Francisco estuary and bay beyond the tolerance levels of many species (Steere and Schaefer 2001).

Agricultural diversions usually get the highest quality water and then discharge salty water that is used in wildlife areas (Schwarzbach et al. 2006; CA Water Impact Network 2025; CDFW 2025). By the time water is discharged from some wildlife areas, its salinity triggers concerns about water quality by regulatory agencies, particularly in the San Joaquin Valley. Efforts to correct this problem are complicated, owing to a poor understanding of the historic elements of salinity and the naturally saline wetlands of the San Joaquin drainage (CDFG 2005).

Dams and diversions also block fish movement to upstream habitat, remove fish and wildlife habitat, alter water quality (i.e., temperature and flow), and kill fish through entrainment and entrapment. Dams have cut off salmon access to 95 percent of their historical range (NOAA Fisheries 2025). The diversion of water through powerful pumps from the Delta to the canals heading to Southern California reverses natural flows of the Old and Middle Rivers within the southern Delta and confuses migrating fish trying to find their way to the ocean. At times, the fish swim with the flowing waters toward the pumps rather than toward the open ocean.

Levee, bridge, and bank-protection structures are present along more than 2,600 miles of rivers in the Central Valley and in the Delta (DWR 2023). These structures prevent flood flows from entering historic floodplains and eliminate or alter the character of floodplain habitats, such as shaded riverine habitat, and floodplain ecosystem processes. Constrained flood-level flows increase scouring and incision of river channels and reduce or halt the formation of riparian habitat, channel meanders, and river oxbow channels.

These changes in water supply also stress many upland species. Most of the resident terrestrial animals need to find adequate water during California's long, dry summer months. As human demand for water increases, there is less water available for resident wildlife species, so they experience greater physiological stress. In some cases, water management has also led to sustained year-round flows in streams that historically dried up in the summer. Central Valley habitats rely on a large and complex drainage, involving snowmelt and land uses up to 300 miles away and water imports from and exports to other river basins.

Current water management practices exemplify interactions between pressures and resulting stresses. As urban development expands, it creates more impermeable surfaces like concrete, asphalt, and the roofs of buildings. Subsequent rainfall is then less able to soak into the ground and runs off quickly. Rapid runoff reduces the recharge of groundwater reservoirs and reduces later summer stream flows. Combined with water diversions, this reduction in groundwater causes streams to dry up more quickly, thus reducing the availability of water to wildlife during summer months. Increased urban runoff is also a major source of water pollution. Urban runoff washes various pollutants out of urban areas, depositing them into creeks, rivers, and other water bodies, adding to wildlife stress.

Central Valley Project Improvement Act

The Central Valley Project (CVP) is a federal water management project under the supervision of the U.S. Bureau of Reclamation (USBR). It was authorized in 1935 in order to provide irrigation and municipal water to much of the Central Valley—by regulating and storing water in reservoirs in the northern half of the state, and transporting it to the San Joaquin Valley and its surroundings by means of a series of canals, aqueducts and pump plants, some shared with the California State Water Project (SWP).

In addition to water storage and regulation, the system provides recreation and promotes flood control with its dams and reservoirs. Over time CVP operations have resulted in environmental impacts, such as salmon population decline in four major California rivers, and many natural river environments, such as riparian zones, meanders and sandbars no longer exist.

The Central Valley Project Improvement Act (CVPIA) was enacted in 1992 and mandated changes in management of the CVP, particularly for the protection, restoration, and enhancement of fish and wildlife. Its purposes are:

Protect, restore, and enhance fish, wildlife, and associated habitats in the Central Valley and Trinity River basins of California

Address impacts of the Central Valley Project on fish, wildlife and associated habitats, and improve the operational flexibility of the Central Valley Project

Increase water-related benefits provided by the Central Valley Project to the State of California through expanded use of voluntary water transfers and improved water conservation

Contribute to the State of California's interim and long-term efforts to protect the San Francisco Bay/Sacramento-San Joaquin Delta Estuary

Achieve a reasonable balance among competing demands for use of Central Valley Project water, including the requirements of fish and wildlife, agricultural, municipal and industrial and power contractors

Changes in management of the CVP under the CVPIA include: 800,000 acre-feet of water dedicated to fish and wildlife annually; tiered water pricing applicable to new and renewed contracts; water transfers provision, including sale of water to users outside the CVP service area; special efforts to restore anadromous fish population by 2002; restoration fund financed by water and power users for habitat restoration and enhancement and water and land acquisitions; no new water contracts until fish and wildlife goals achieve; no contract renewals until completion of a Programmatic Environmental Impact Statement; terms of contracts reduced from 40 to 25 years with renewal at the discretion of the

Sierra Nevada

Among the major rivers of the Sierra Nevada, all but a few have multiple dams or diversions. Flows are managed for hydropower generation, for water for irrigation and domestic uses, and for flood control (DWR 2023). A few small dams were developed and are still maintained for instream flow protection and management downstream, and/or for wet meadow habitat maintenance. Others were constructed by fisheries managers to provide barriers between sensitive native fish populations and introduced fish that have the capability to interbreed or prey upon the native species.

The unnatural, managed flows disrupt and degrade aquatic and riparian ecosystems. Below dams, river flows are ramped up and down and water temperatures are changed, often creating lethal conditions for aquatic species. Dams and diversions of the rivers that flow into the Sacramento and San Joaquin drainages have been particularly detrimental to anadromous Chinook salmon, steelhead trout, lampreys, sturgeon, and Delta smelt. Each of these species historically spawned in Sierra Mountain rivers and streams, their offspring swimming to the sea and returning a few years later as adult fish to spawn.

The construction of dams and water diversions blocked fish passage, contributing to dramatic declines in salmon and steelhead populations of the Sacramento and San Joaquin drainages. Fewer anadromous fish also means fewer eggs, young fish, and fish carcasses that provide nutrients for numerous other aquatic species. Historically, one to three million Chinook salmon spawned each year in the western Sierra. Today, dams block salmon access to upstream spawning habitat in all but a few creeks. Late fall, winter, and spring runs of salmon have collapsed. Steelhead and the spring-run Chinook salmon are federally threatened, and winter-run Chinook salmon are also listed by the state as endangered. Fall and late fall run salmon are taxa of special concern. Natural and hatchery produced fall run Chinook salmon continue to support ocean commercial and sport fisheries as well as river fishery. Many other aquatic species are also affected by the migration impediments imposed by dams and their associated reservoirs.

In the foothills, residential development continues to add “river wells” located directly at the location of stream aquifers. Increased water drafting has turned some year-round streams into seasonal creeks and dried up other streams (CDFG 2005). Native fish (such as hitch, hardhead, and native rainbow trout), amphibians, and native invertebrate populations are adversely affected where streams have receded. Similarly, the development of springs for domestic water supply on private and public lands has degraded riparian habitats for native amphibians and invertebrates.

Fire and Fire Suppression

Most of California's forest ecosystems have evolved with recurring fire, and each plant community of the Sierra Nevada and Central Valley provinces has adapted to changes in the frequency of wildfire. Prior to European colonization, fire events in these provinces were caused by Native American cultural burning practices and lightning. Lightning caused ignitions were most common in the mountainous areas and east of the crest of the Sierra Nevada mountains. Lightning caused ignitions were not common in the Central Valley due to the topography and weather patterns. While the frequency of fire and annual acreage burned in some vegetation communities remains lower than pre-colonization levels, the size and severity of wildfires has increased over the past three decades.

Accurate records of California's wildfire history began in 1932. Since that time, 18 of the 20 largest wildfires occurred in the last 20 years, and six of those occurred within the Central Valley and Sierra Nevada Province (CAL FIRE 2024). The most recent megafires to occur in the province are the Park Fire (2024) with 429,603 acres burned, the Dixie Fire (2022) with 963,309 acres burned, the Caldor Fire (2022) with 221,835 acres burned, and the Creek Fire (2020) with 379,895 acres burned.

The soil composition, topography, elevation, and climatic conditions influence the historical fire regime in the various plant communities in the Sierra Nevada (Hahm et al. 2014). A continuum of fire regimes exists in the various forest types of the Sierra Nevada. Lower elevation ponderosa pine-dominated mixed conifer forests have evolved with a fire regime of frequent low- to moderate-intensity fires and less frequent large high-severity fires. These frequent fire disturbances historically resulted in heterogeneous highly clustered groups of trees with sparsely treed or open gap conditions. With the exclusion of fire, these forests have been converted to denser, less resilient and more fire prone habitats (North et al. 2009).

In contrast, at higher elevations, lodgepole pine and whitebark pine communities evolved with less frequent but more severe fires (McKelvey et al. 1996). Wildfire is such an influential ecological element that the regeneration of some plant communities and the survival of many plant species requires fire (Kilgore 1973). Fire suppression, including the removal of cultural burning on the landscape, along with selective harvest of large trees, re-forestation with dense plantations of young conifers, invasive weeds, and intensive grazing has dramatically reshaped forest structure and altered ecosystems over the last 100 years.

With excessive fuel loads created by fire suppression and past forest management practices, other treatment types, such as mechanical and manual removal of vegetation, are typically necessary before prescribed burns can be implemented.

Historical fire regimes in the Central Valley are unknown due to the lack of long-lived trees to capture tree-ring records of fires (Keeley 2002; Anderson 2005). Historical accounts from the Spanish and then Europeans indicate the Native Americans burned within the Central Valley every 1 to 3 years (Frost 1998), and the plant communities in the Central Valley adapted throughout time as a result. But with the colonization of the Central Valley by Europeans came the invasion of non-native grasses and herbaceous plants while cultural use of fire was both suppressed and used to clear grazing lands. Fire suppression has continued within the Central Valley since, resulting in most wildfires being contained to less than 10 acres. This trend has continued with the decline of grasslands and shrublands in favor of developed lands (Van Wagtendonk et al. 2018)

Logging and Wood Harvesting

Forest management practices, including even-aged tree production, road building, and fire suppression, significantly affect forest ecosystems and wildlife in the Sierra Nevada.

Shaped by natural disturbances and variable ecological conditions, forests are characterized by a mosaic of different habitat types, including stands of trees of different ages, shrub-dominated habitats, and numerous open meadows containing grasses and forbs, and wet fens. In recently disturbed areas, saplings, shrubs, and herbaceous understory vegetation are abundant. Other forest areas are dominated by large trees several centuries old and support complex habitat features like large, standing dead trees and decaying, fallen trees.

Historical forest management practices resulted in significant impacts on the province's forest habitats and waterways. Regulations governing current logging practices and advances in technology have substantially improved timber-harvest practices. However, some ongoing management practices continue to adversely affect the vegetation communities and wildlife habitats of forest systems. Wildlife that depends on old, closed-canopy disturbances are sensitive to forest disturbances, including timber harvest and high-severity wildfires. These disturbances can happen rapidly, and recovery can take centuries (Linnell et al. 2023). Timber harvest may also make it difficult for a forest to recover to its historic state after a major disturbance, like a high-severity wildfire (Sterner et al. 2022).

Legacy impacts from past logging practices continue to reduce over-story shade and cool microclimates along stream channels provided by mature, near stream forests. Old-forest conditions (old-growth and late-seral forest) have been drastically reduced throughout the Sierra Nevada (USFS 2001). Fire suppression has allowed denser forests to develop with more shade tolerant trees in the understory causing heightened fire risk and risk of larger, catastrophic fires. This phenomenon also shades out oaks resulting in their death and prevents oak regeneration. Oaks are extremely important to wildlife as a food source and shelter/structure. While some of these pressures have been reduced in recent years, they all continue to affect the forests' ecosystems and wildlife.

In addition to treatments of forest stands, regeneration practices following timber harvests or fire are very important in shaping the future forest structure. While timber harvest strategies on public lands are beginning to incorporate wildlife and habitat needs, regeneration practices have generally not made similar changes. In some national forests, regeneration treatments clear shrubs and herbaceous vegetation to promote growth of tree species, even though shrubs and herbaceous vegetation are particularly important for wildlife. These kinds of post-harvest treatments are more common on private forest lands. The National Forest Management Act and federal regulations prescribe the method and speed of reestablishing the next generation of trees on federal lands (USFS 2001). State Forest Practice Rules have similar prescriptions for private forest lands. These regeneration prescriptions are generally designed to enhance timber production and do not generally support regeneration practices specifically to benefit wildlife and restore diverse native plant communities.

Road building is another potential ecological pressure in Sierra Nevada timberlands. Poorly constructed or maintained roads and ground disturbance resulting from timber harvest can also result in soil and surface-water runoff. High rainfall levels, steep topography, and erodible soils make many parts of the province particularly vulnerable to increased erosion and landslides. Erosion and sedimentation can have substantial consequences for aquatic systems, leading to turbidity and fine-sediment deposition that smothers spawning gravels as well as amphibian and invertebrate habitats (CDFG 2004).

Climate Change

The climatic changes presented below will likely affect all conservation targets identified in this province. Climate change has only been included as a pressure for a subset of targets that are considered more vulnerable to climate impacts, and/or in instances where it was determined that interactions between climate change and other pressures could be addressed in a meaningful way through a conservation strategy.

The climate projections that follow are presented as averages across the entire province, except where otherwise indicated. While these projections provide more insight into the expected magnitude and direction of change in important climate variables compared to the statewide estimates in Chapter 2, climate change will not in fact unfold uniformly across the province. For additional information on regional variability in climatic change and associated vulnerabilities within the Central Valley and Sierra Nevada regions, refer to the following resources (not an exhaustive list):

- Chapter 2: Climate Change Effects in the Sierra Nevada (In: Climate change vulnerability and adaptation for infrastructure and recreation in the Sierra Nevada: Halofsky et al. 2021)
- Integrated Vulnerability Assessment of Climate Change in the Lake Tahoe Basin (CA Tahoe Conservancy 2019)
- Sacramento Summary Report: California's Fourth Climate Change Assessment (Houlton and Lund 2018)
- Regional Report for the San Joaquin Valley Region on Impacts of Climate Change (Santiago et al. 2021)
- Sierra Nevada Summary Report: California's Fourth Climate Change Assessment (Dettinger et al. 2018)
- Observed and projected changes in snow accumulation and snowline in California's snowy mountains (Shulgina et al. 2023)
- Projected Changes in Water Year Types and Hydrological Drought in California's Central Valley in the 21st Century (He et al. 2021)

Temperature

Climatic changes in the Central Valley and Sierra Nevada Province are expected to include increased mean maximum temperatures of approximately 5.5°F by mid-century (2035–2064, centered on the year 2050) and 9.1°F by end-of-century (2070–2099, centered on the year 2085), compared to a historical baseline period (1961-1990); minimum temperatures are projected to increase across the province on average by 4.7°F by 2050 and 8.2°F by end-of-century (Pierce et al. 2018). Projections were generated based on a high-end greenhouse gas emissions scenario (RCP 8.5) and multiple climate models.

Precipitation and Snowpack

Within the Central Valley and Sierra Nevada Province, changes in annual precipitation will vary geographically, but average precipitation rates are projected to increase slightly throughout the century, compared to a historical baseline (Pierce et al. 2018).

April snow water equivalent, a common measure of snowpack in California, is expected to decline across the state. In the Sierra Nevada, snowpack is likely to disappear below about 6000 feet elevation and is projected to be reduced by more than 60% across nearly all of the range (Dettinger et al. 2018).

Warmer temperatures and more precipitation falling as rain rather than as snow are projected to cause snowmelt runoff to shift earlier. These shifts may cause more frequent flooding in the Central Valley as the snowline rises and increased rain drains to streams and rivers more quickly that snow. Declining snowpack, earlier runoff, and reduced spring and summer stream flows will likely affect surface water supplies and increase reliance on groundwater resources in the Central Valley.

Wildfire Risk

Wildlife risk and intensities are projected to increase in this province, resulting in more sever impacts to vegetation communities, longer recovery times, and changes to vegetation community composition (Hagmann et al. 2021; Williams et al. 2023; Brodie et al. 2024).

Wildfire risk is determined using several factors. Acres burned and re-burned, fire regime, and probability of ignition, are some of those factors. Over the last 20 years approximately 16%, or 5,035,000 of 31,300,000 acres have burned and reburned in the Central Valley and Sierra Nevada Province (2004–2023, CALFIRE FRAP fire perimeters). These fires have been concentrated in the Sierra Nevada and Sierra Nevada Foothills ecoregions, with some fires occurring in the Mono ecoregion and only very small fires occurring in the Great Valley ecoregion. In the last 21 years (including the 2024 fire season to-date), ten fires within this province have exceeded 100,000 acres, and six of these megafires have occurred in the last five years.

In addition to increasing fire size, climate change is increasing fire severity, driving larger patches of high-severity fire. Increases in fire severity are attributed to climatic changes creating drier conditions and increasing evapotranspiration, and fuels (Wasserman and Mueller 2023). Recent severe wildfires have killed an estimated 13–19% of mature sequoias across their native range(Stephenson et al. 2021; Shive et al. 2022). Unprecedented tree crown fires killed much of the local sequoia seed source (Soderberg et al. 2024).

A climate adaptation planning analysis conducted in 2012 projected the eastern portion of the Southern Central Valley to have an increase in wildfire risk of four to six times greater by 2085. The north and eastern portions of the North Central Valley were projected to also have an increase in wildfire risk, up to 4 times greater in certain areas. In the North Sierra climate impact region, wildfire risk was projected to increase by 1.1 to 10.5 times throughout the region, with the highest risks expected in the northern and southern parts of the region. Whereas in the South Sierra climate impact region, wildfire risk in Alpine County and the northern part of Mono County was projected to increase up to 19.1 times greater than 2012 conditions by 2085. The rest of Mono County and all of Inyo County were projected to have an increase in wildfire risk between 1.1 to 4.8 times greater than 2012 levels (Dettinger et al. 2018).

According to Projected Effects of Climate Change in California from 2011, the probability of large fires (>500 acres) in the Sierra Nevada overall was projected to increase by 2100, more so on the west slope and in the foothills; and, up to a 50% increase in area burned was projected in the eastern Sierra Nevada by 2070–2090. Over the longer term, however, these projected wildfire conditions may lead to vegetation shifts that support less severe wildfire regimes (Dettinger et al. 2018).

This projection has been updated using the more recent 2018 Cal-Adapt wildfire data from California's Fourth Climate Assessment. Annual area burned across the footprint of this province is expected to increase by approximately 57% by mid-century and 51% by the end of the century under a high-end emissions scenario, compared to a 1961–1990 baseline (Westerling 2018). The Fourth Climate Assessment regional report on the Sacramento Valley, San Joaquin Valley, and Sierra Nevada indicate a 31% increase in annual area burned is projected in the Sierra Nevada Mountains S Sierra Region from 2025 to the mid-century average (2035–2064) and a 52% increase is projected from 2025 to the end-century average (2070–2099); however, the average annual wildfire probability is not expected to increase by 2100.

In the Assessment's Sierra Nevada Mountains N Sierra Region, a 36% increase in annual area burned is projected from 2025 to the mid-century average and a 70% increase is projected by the end-century average; additionally, a slight increase in average annual wildfire probability is projected, from 20 to 30% by 2100. In contrast, in the Assessment's San Joaquin Valley region, where a large portion of the area was excluded from wildfire simulations because they are outside of state and federal fire protection responsibility areas, only a 14% increase in annual area burned is projected from 2025 to the mid-century average and a 7% increase is projected by the end-century average. In summary, the annual area burned is expected to substantially increase in the Sierra Nevada mountains, particularly in the eastern Sierra Nevada ecoregion, but only slightly increase in the Central Valley. Based on these datasets, wildfire will continue to significantly affect fish and wildlife and their habitats in the Central Valley and Sierra Nevada province.

Central Valley

Although climate change is already affecting wildlife throughout the state (Parmesan and Galbraith 2004), and its effects will continue to increase, it has particular significance for this region's major river and estuarine systems.

In general, California winters will likely become warmer and wetter during the next century. Instead of deep winter snowpacks that nourish valley rivers through the long, dry summer, most of the precipitation will be winter rain that runs off quickly. For the Central Valley, this means more intense winter flooding, greater erosion of riparian habitats, and increased sedimentation in wetland habitats (Field et al. 1999; Hayhoe et al. 2004). This impacts riparian wildlife species, for example, riparian brush rabbits as there is little to no food-secure occupied habitat and other riparian species; during severe floods populations can decline by 80–90% (Tarcha 2020). Extensive flood control infrastructure traps floodwaters preventing drainage for months after catastrophic floods.

Hotter, drier summers, combined with lower river flows, will dramatically increase the water needs of both people and wildlife. This is likely to translate into less water for wildlife, especially fish and wetland species. Lower river flows will allow saltwater intrusion into the Bay and Delta, increasing salinity and disrupting the complex food web of the estuary. Water contaminants may accumulate during the summer as the natural flushing action decreases.

Sea level worldwide during the past 100 years has been rising from one to two millimeters per year, ten times faster than the rate over the past 3,000 years. Gauges along the California coast have already measured 4-inch to 6-inch increases in sea level since 1900 (NOAA 2005). By 2100, sea levels might rise as high as three feet above their present levels (IPCC 2001; Hassol 2004).

Sierra Nevada

While climate change will undoubtedly affect all regions of the state, the consequences for vegetation, wildlife, and water resources will likely be most dramatic in the Sierra Nevada. Depending on the model and assumptions, scientists project the average annual temperature in California to rise between 4 and 10.5°F above the current average temperature by the end of the century (Schneider and Kuntz-Duriseti 2002; Turman 2002; Hayhoe et al. 2004). Within 50 years, average wintertime temperatures are expected to rise between 2 and 2.5°F. A rise in this range would substantially reduce annual snowpack and increase fire frequency and intensity. By mid-century, the Sierra snowpack could be reduced by 25 percent to 40 percent and by as much as 70 percent at the end of the century (DuVair and CA Energy 2003). Snow season would be shortened, starting later and melting sooner, while fire season would be longer and hotter. The reduction of snowpack and more extreme fire conditions would have cascading effects on water resources, plant communities, and wildlife.

The average annual Sierra snowpack, which is roughly equal to half the storage capacity of all the state's reservoirs combined, holds water until the melt in late spring and early summer. Persistent winter snowpack is also important to insulate American pikas which remain active under the snow all winter and is thought to be a critical component of wolverine habitat (Johnston et al. 2019). Rising temperature has already begun to reduce the total snowpack and melt it earlier in the year, further shifting stream- and river-flow regimes throughout the Sierra (Stewart et al. 2004; Vanrheenen et al. 2004). As the runoff comes earlier, spring and summer stream flow is projected to decline by 10 percent to 25 percent by 2050 and decline by potentially as much as 40 percent to 55 percent by the end of the century (DuVair and CA Energy 2003). The changing flow regimes will alter riparian and aquatic ecosystems. Streams may be reshaped by different timing and intensity of flood conditions, while some perennial streams may dry up and transition to ephemeral streams no longer supportive of many aquatic species (Turman 2002). One strategy to alleviate these effects would rely on maintaining and restoring healthy mountain meadows, which act like sponges and would help to hold water later into the dry season.

Average annual temperature is a key element that determines plant communities found across the elevation gradient of the Sierra Nevada. As temperature rises, alpine and sub-alpine plant communities will shrink as mixed conifer forests expand higher in the range. Alpine and sub-alpine plant communities may decline by 40 percent to 50 percent by mid-century. Oak woodlands may move higher, replacing pine and fir forest. At the lower elevations, the longer, warmer dry season could lead to increased fire frequency, likely converting some shrub communities to grasslands (Turman 2002; DuVair and CA Energy 2003). The expected changes in fire regimes will likely alter the abundance and distribution of plant communities, affecting habitats for wildlife (Miller and Urban 1999; McKenzie et al. 2004).

As climate change shifts annual average temperatures along the elevation gradient, as fire reshapes plant communities, and as stream flow regimes change, habitats and wildlife populations will be substantially affected.

Housing and Urban Areas; Annual and Perennial Non-Timber Crops

Central Valley

The main underlying cause of habitat loss and degradation is the increasing human population and its high demand for a limited supply of land, water, and other natural resources.

Up until the last few decades, much of the terrestrial habitat loss in the region has been because of agricultural land conversion. Recent land-use trends show a more mixed set of pressures from both urban and agricultural land conversion, depending on the habitat, topography, and proximity to major highways. Some habitats, such as wetlands and floodplains, are receiving increased environmental protection and thus less development pressure than other habitats (Landis and Reilly). On the floor of the Central Valley, urbanization occurs mostly on previously cultivated lands, where much of the habitat has already been lost or highly degraded. In these areas, particularly in rural lands, the remaining fragments of habitat continue to be converted to intensive agriculture. Loss of native grassland is impacting many native bird populations. In the eastern uplands and foothills of the Central Valley, urban and rural residential development has had a greater impact on habitat because it occurs generally on grasslands and other naturally vegetated lands.

The rate of population growth in the Central Valley and Sierra Nevada is remarkable. Some of the fastest-growing counties in California are in the Central Valley; this pattern is likely to remain the same during the next 50 years.

Natural habitats of this region have been converted to a variety of different land uses, including weedy pastureland, dryland farming, irrigated cropland, relatively permanent orchards and vineyards, large dairies, rural residential, and high-density urban. Wildlife species have different tolerances for each of these conversions, with many of them unable to adapt to the more-developed land uses. Beyond direct habitat loss, converting land to more intensive human-related uses bring additional stresses, including invasive species, human disturbance, fire suppression, and insect control, which further degrade ecosystem health and wildlife viability.

In the Central Valley, 99.9 percent of the historic native grasslands, 99 percent of valley oak savanna, about 95 percent of wetlands, 89 percent of riparian woodland, 66 percent of vernal pools, and 67 percent of San Joaquin Valley shrublands are gone (TNC 1987, 1995, 1998; Hickey et al. 2003; Kelly et al. 2005; Central Valley Joint Venture 2020). Habitat conversion has continued since these analyses were conducted.

Growth and development fragment habitats into small patches that cannot support as many species as larger patches can. These smaller fragments often become dominated by species more tolerant of habitat disturbance, while less-tolerant species decline. Populations of less-mobile species often decline in smaller habitat patches because of reductions in habitat quality, extreme weather events, or normal population fluctuations. Natural recovery following such declines is difficult for mobility-limited species. Such fragmentation also disrupts or alters important ecosystem functions, such as predator-prey relationships, competitive interactions, seed dispersal, plant pollination, and nutrient cycling (Bennett 2003; Kennedy 2003).

Growth and development, along with associated linear structures like roads, canals, and power lines, impede or prevent movement of a variety of animals. This is generally less significant than habitat loss but makes it more difficult for those species that need to move large distances in search of food, shelter, and breeding or rearing habitat and to escape competitors and predators. Animals restricted to the ground, like mammals, reptiles, and amphibians, face such obstacles as roads, canals, and new gaps in habitats. Attempts to cross these obstacles can be deadly, depending on the species and the nature of the gap (e.g., four-lane highways with concrete median barriers compared to narrow, rural two-lane roads).

Fish and other water-bound aquatic species attempting to move either upstream or downstream are blocked by lack of water resulting from diversions, physical barriers like dams, and by entrainment in diverted water. Even the movement of highly mobile species like birds and bats can be impeded by such features as transmission lines and wind energy farms, particularly in focused flight corridors like Altamont Pass, and 50 new wind energy sites are currently proposed throughout the state on land managed by BLM (CDFG 2005). Such species either cannot see or do not avoid these structures, and many die as a result. The actual extent of bird fatalities because of power-line collision in California is unknown; however, the California Energy Commission (CEC) estimates that fatality rates because of Central Valley power-line collisions alone could reach as high as 300,000 birds per year (CEC 2002).

Sierra Nevada

The Sierra Nevada underwent population growth of 130 percent between 1970 and 1990, compared to the state's average of 49 percent growth over the same period, and growth in the region is expected to continue at a pace exceeding the state average, adding about 175,000 new residents every decade (Sierra Nevada Ecosystem Project SNEP Science Team and University of CA Centers for Water and Wildland Resources 1996; Duane 1999).

The greatest growth and development have occurred in the mostly privately owned western foothills, particularly in the watersheds of the Yuba, American, and San Joaquin rivers, in the Lake Tahoe Basin, and around Lake Almanor. Development pressure is strong in the foothills adjacent to the metropolitan centers of Sacramento, Stockton, Merced, Fresno, and Bakersfield, particularly along the foothill river corridors near these cities. On the Sierra Nevada's east side, growth pressure is greatest between Reno and Susanville and near Bishop.

Ranchette and residential communities are expanding from metropolitan areas of Reno and Redding along Highways 395, 299, and 44 along the eastern foothills and across the northern Sierra Nevada and Cascades (CDFG 2005). New development along these highway corridors is displacing wildlife habitat and creating barriers in important wildlife migration areas. For example, development along Highway 395 south of Susanville hinders the seasonal migration of deer across the Bass Hill Wildlife Area. Key wildlife corridors in the region are crossed by highways. Highway 299 descends the Cascades between Mount Lassen and Mount Shasta and winds northeast across the Modoc Plateau (Penrod et al. 2000). As development expands on the private lands adjacent to Highway 299, migrating mule deer, elk, and antelope will be less able to move between seasonal ranges. Without conservation planning, future development along these corridors will likely have a significant impact on the region's wildlife.

In the Sierra Nevada, development is also expanding into the forest. New golf courses scattered single-family homes, commercial properties, ski resorts, industrial sites, and new roads are replacing and fragmenting wildlife habitat. Where development occurs, fire is suppressed, preventing regeneration of fire-dependent vegetation and altering plant communities. Fuel reduction is required with development. With the new fire regime, the clearing requirements are going to increase significantly, expanding the footprint of human development and fragmentation effects. Development also requires new water diversions and creates new sources of pollution. Mountain meadows, oak woodlands, and riparian streams are places of high wildlife diversity, and they are also preferred sites for development.

As seasons change, the survival of many mammal, bird, and fish species depends on their ability to migrate between higher and lower elevations in the Sierra Nevada. But opportunities to migrate successfully have been compromised by dams, reservoirs, highways, altered stream flows, residential community development, and predation by free-roaming domestic pets.

For 150 years, the west-slope foothills have been the most seriously affected area of the Sierra Nevada, with cattle ranching having the greatest presence. Western foothill development has fragmented riparian corridors and other habitats (Kattelman 2000). Much of the development on the western slope of the Sierra Nevada has degraded oak woodlands, lower mixed conifer forests, and similar habitats that support more wildlife diversity than other plant communities of the region. More than 350 species of birds, mammals, reptiles, and amphibians inhabit the oak woodlands (CA Partners in Flight 2002). The Sierra Nevada Ecosystem Project documented that 85 terrestrial vertebrate species require west-slope foothill savanna, woodland, chaparral, or riparian habitats to retain population viability, and 14 of these species are at risk of extinction.

Many early homestead settlements in the high Sierra Nevada clustered in level areas close to water, areas that are also particularly important for wildlife habitats, including meadows and areas along rivers and streams. While most high-mountain habitats are public lands managed by federal agencies, these older settled areas remain largely in private ownership. Today, these private lands, surrounded by national forests, are prized for development.

Development in the Sierra Nevada over the last three decades has been primarily via incremental single-home and small commercial development, lacking the benefit of regional conservation planning. Low-density development has been the norm. Such development has resulted in greater fragmentation of the landscape and its corresponding negative consequences for wildlife. In many locations throughout the foothills, larger land holdings are being broken up into smaller parcels for single homes. In other areas, mountain meadows and pastures are being converted to golf courses and residential communities.

Development also exacerbates existing stresses on wildlife and habitats. Invasive plant species are often introduced along new roads and with new landscaping. Invasive species outcompete native species in development-disturbed lands. Additional domestic water use further reduces water available for aquatic ecosystems.

Growth has also increased the need to suppress fire, thereby expanding the conflict with efforts to restore more natural fire regimes in these fire-adapted ecosystems. Adding residents to the region will likely result in more citizen resistance to prescribed fire and more objections to the smoke it generates.

The severity of future development's effects on species at risk will depend on whether conservation planning is embraced and if growth allowed by counties is designed to account for fire, to protect ecosystems, and to minimize further fragmentation of habitats.

Invasive Plants/Animals

Invasive plant and animal species are an important pressure on wildlife in this province, just as they are in other regions throughout the state (Lewis et al. 1993; Jurek 1994; CA Invasive Plant Council 1999; SF Bay Area Goals Project 1999; CA Bay-Delta Authority 2000; Hickey et al. 2003; Riparian Habitat Joint Venture 2004; CDFG 2005). Many of the conservation actions described below address prevention, early detection, and rapid response to new invasive plants to prevent them from becoming widespread. Distribution maps and summary reports for invasive plants, as well as regional strategic plans for prioritized invasive plant species can be found on CalWeedMapper. Some of the invasive species affecting the province are discussed below. Invasive species are discussed in more detail in Appendix E.

Central Valley

Invasive plants can be found in many different habitats in this region. In grasslands, some of the more challenging plant invaders include eucalyptus, fountain grass, gorse, medusahead, tree of heaven, and yellow starthistle. In riparian and wetland areas, invading plants include edible fig, giant reed or arundo, Himalayan blackberry, pampas grass, Russian olive, tamarisk (or saltcedar), pennyroyal, pepperweed, tree of heaven, Scotch broom, and French broom. Oak woodlands are invaded by plants such as Scotch broom, French broom, pepperweed, medusahead, barbed goat grass, and yellow star thistle.

Introduced plants also invade aquatic habitats. These aquatic invaders include Brazilian waterweed, egeria, Eurasian watermilfoil, hydrilla, water hyacinth, water pennywort, scarlet wisteria, and parrot feather.

Introduced animals have invaded both terrestrial and aquatic environments. Rats (*Rattus rattus* and *R. norvegicus*) heavily impact the Central Valley. They compete with and kill endangered riparian woodrats and riparian brush rabbits along with countless other vertebrates and invertebrates.

Not all non-native species are considered invasive, which typically refers to species whose introduction causes or is likely to cause economic or environmental harm to human health. The species of most concern in the region parasitize songbird nests, dominate limited nesting habitat, prey on native species, or otherwise damage wildlife habitats.

Fifty-one new fish species have become established in California (Moyle et al. 2002), becoming prominent species in most of the rivers and streams in this region. These include species such as striped bass, white catfish, channel catfish, American shad, black crappie, largemouth bass, and bluegill. Many fish were historically introduced (via stocking) by federal and state resource agencies to provide sport fishing or forage fish to feed sport fish. Many introduced non-native fish and amphibians may out-compete native fish for food or space, prey on native fish (especially in early life stages), change the structure of aquatic habitats (increasing turbidity, for example, by their behaviors), and may spread diseases (Moyle et al. 2002). For example, several introduced predatory fish may have increased predation levels on Chinook salmon and other native fishes (CA Bay-Delta Authority 2000).

In addition to introduced fish, native aquatic species are stressed by introduced bullfrogs, red-eared sliders (a turtle), and invertebrates. Introduced invertebrates, such as New Zealand mud snail, quagga mussels, Asian clam, zebra mussel, Chinese mitten crab, and mysid shrimp are causing significant problems for native species in rivers, streams, and sloughs. While not all of the introduced aquatic species are invasive or have significant consequences for native species, biologists are concerned about the sheer abundance of these new species and their current and potential effects on the structure and function of the estuarine ecosystem.

In 2017, a reproducing population of nutria was discovered in the San Joaquin Valley. Since then, nutria have been found in the Delta and Suisun Marsh area, and up the San Joaquin River to Friant Dame and above Millerton Lake. Nutria have devastating impacts on wetland habitats, agriculture, and water conveyance/flood protection infrastructure through their extensive herbivory and burrowing habits. They cause extensive damage to native plant communities and soil structure, which results in severe erosion of soils. Nutria burrow into banks and levees, creating complex dens that span as far as six meters deep and fifty meters into the bank and often cause severe streambank erosion, increased sedimentation, levee failures, and roadbed collapses. CDFW is collaborating with other agencies as part of the interagency Nutria Response Team to develop and implement strategies to eradicate nutria in California. CDFW's Nutria webpage provides information to the public on nutria biology and control.

Sierra Nevada

Invasive plants have transformed plant communities and contributed to the decline of native species in ecosystems of the Sierra Nevada. Foothill oak woodlands and riparian plant communities, which are key for maintaining wildlife diversity, have been particularly affected by invasions of non-native grasses and shrubs. High desert shrublands on the east side of the Sierra have also been altered by invasive grasses. Sub-alpine and alpine plant communities, however, are relatively intact, with few invasive plants (Schwartz 1969).

The understory of foothill woodlands of blue oak, interior live oak, valley oak, and gray pine are now dominated by wild oats, fescue, cheatgrass, and other invasive non-native grasses. Scotch broom and yellow starthistle have also degraded the Sierra Nevada foothills (Bossard et al. 2000; DiTomaso and Gerlack Jr. 2000). Both weed species displace native species and are toxic to foraging wildlife. Saltcedar, Russian olive, giant reed, eucalyptus, and English ivy are among the invasive plants that have invaded low- and mid-elevation riparian habitats. On the east side of the Sierra, the combined effects of invasive cheatgrass, which outcompetes native perennial and annual grasses, and livestock grazing have contributed to changes in fire regimes and transformed desert scrub and grassland communities.

Generally, invasive plants that replace native plants degrade habitat quality for native species. Some wildlife species are dependent on specific native plants. Other animal species become stressed when the invasive plants offer inferior nutrition or nesting or prey habitat. In some areas, invasive annual grasses make for greater fuel loads compared to native vegetation, which increases the intensity of fires and causes further ecological changes.

The introduction of non-native fish to lakes and streams has substantially affected the aquatic life of the province (Knapp and Matthews 2000a; Knapp and Matthews 2000b; Schindler et al. 2001; Herbst et al. 2003; Finlay and Vredenburg 2007; Knapp and Sarnelle 2008). In the past, a century of stocking fish for recreational fishing contributed to the decline of native fish and frog species in the province (Bradford et al. 1993; Moyle et al. 1996). Stocking trout into historically fishless high mountain lakes has contributed to the extirpation of native amphibians in some basins, with particularly severe consequences for once-common mountain yellow-legged frogs (*Rana muscosa* and *R. sierrae*; Knapp and Matthews 2000b); (Pister 2001; Vredenburg et al. 2005; Vredenburg et al. 2007). By consuming native amphibians and aquatic insects, predatory trout also negatively affects gartersnakes, birds, and other species that prey on native insects and frogs (Matthews et al. 2002; Vredenburg et al. 2005; Epanchin et al. 2010). In foothill streams of the western Sierra Nevada, introductions of non-native black bass, sunfish, and other non-native species such as Common Carp have had a variety of impacts on native minnow and amphibian populations. Underlying mechanisms for displacement or localized extirpation of native aquatic species include predation, competition, and habitat modification such as that caused by the rooting behavior of the carp. Displacement of Sacramento Perch in the lowermost sections of Sierra Nevada foothill streams is associated with dominance by introduced sunfishes, Native minnows, such as Sacramento Hitch and Clear Lake Hitch, and amphibians, such as Foothill Yellow-Legged Frog, are now Species of Special Concern or listed as threatened as a result of these impacts.

In response to the unintended consequences to native species caused by non-native fish introductions (Knapp et al. 2001), researchers and government agencies have been undertaking management actions over the past 30 years to help restore high elevation aquatic habitats (Knapp and Matthews 1998; Vredenburg 2004; Knapp et al. 2007). These activities, which have largely included habitat restoration (via non-native fish removal) and species recovery endeavors in the form of frog translocations, captive-rearing (where early life stage frogs are collected from stable, persisting populations, raised at a zoo facility, and then released back into the wild), and captive breeding (in the case of southern California populations of *R. muscosa*), have shown proven benefit to native species in high elevation aquatic ecosystems (MYLF ITT 2018). Recent studies suggest these management efforts are showing promise for large-scale recovery of threatened and endangered California amphibians (Knapp et al. 2016; Knapp et al. 2024).

Historic widespread stocking of hatchery-raised Rainbow Trout and non-native Brook and Brown Trout throughout California where native and often endemic trout species occur has resulted in major declines in native trout populations. In some cases, complete localized displacement or extirpation of native trout has occurred. The mechanisms behind these declines include competition, predation, and interbreeding between closely related species. The Brook Trout outcompetes native Lahontan Cutthroat Trout and the Brown Trout is an effective predator on many native fishes. Rainbow Trout introduced to various areas of the Sierra Nevada where it did not occur historically have interbred with and compromised the genetic integrity of Lahontan Cutthroat Trout, Paiute Cutthroat Trout, McCloud River Redband Trout, and three subspecies of Golden Trout in various portions of their historical ranges.

Current methods for eradicating populations of non-native trout and their hybrids with natives often include temporary dewatering of aquatic habitats and intensive sampling to facilitate selective fish removals. Genetic methods are often integrated with field methods to enhance the efficacy of these efforts. For example, detection of non-native trout DNA in water provides information on non-native trout distribution within an area of interest for focusing eradication efforts. Once non-native trout are eradicated, reintroduction of the appropriate genetic stock of native trout occurs with translocation of fish from a natural source population or from a captive broodstock population maintained at a trout hatchery. Increasingly, trout stocking for sport fishery management utilizes native species in waters within their native range.

CDFW conducted a Sierra-wide field study of amphibians, trout, and other fauna in the high mountain lakes. The multiyear project, begun in 1998, has completed initial surveys of the Sierra Nevada's 10,000 high-mountain lakes that are not located in National Parks. The results of the study are serving to inform Aquatic Biodiversity Management Plans that are being prepared for the high mountain watersheds of the Sierra. Also, as a result of this study and others, less than 10 percent of the high mountain lakes stocked prior to 1998 are currently stocked. The goal of these plans is to protect and restore native amphibians and other fauna while maintaining thriving recreational fisheries where appropriate. The results of the field studies have yielded information needed to design management plans that will achieve both of these goals. Lakes isolated by fish barriers and where non-native trout reproduction is absent have been identified for restoring native fauna. Other lakes and streams have been designated for non-native trout eradication efforts. Lakes identified as popular with anglers, or where conflicts with native fauna restoration are absent, are managed to maintain or improve their fisheries. Implementation of the completed aquatic biodiversity management plans and the completion of additional plans are contingent upon future funding and staffing.

Livestock, Farming, and Ranching

The effects of grazing on wildlife vary from beneficial to detrimental, depending upon how grazing is managed, including the seasonality and duration of grazing and the type and number of livestock. These effects also depend on the relative sensitivities of individual wildlife species, because not all species respond the same way to grazing. Well-managed livestock grazing can benefit sensitive plant and animal species, particularly by controlling annual grasses and invasive plants where these have become established, and by removing understory growth to create a fire-resilient landscape. These working lands are an essential part of the solution to conserving the state's wildlife.

While recognizing the values of compatible grazing practices, this plan focuses on the negative impacts of pressures affecting wildlife species at risk. Thus, the following discussion describes those situations where excessive grazing practices result in stresses to species. Excessive grazing, as used here, refers to livestock grazing at a frequency or intensity that causes degradation of native plant communities, reduces habitat values for native wildlife species, degrades aquatic or other ecosystems, or impairs ecosystem functions. The term "overgrazing" has a different meaning; it usually refers to the productivity of the forage crop and range condition.

Over the past 150 years, grazing on forests, shrublands, and grasslands of the Sierra Nevada has been characterized as excessive and unsustainable, destroying native vegetation and degrading meadows and streams (Menke et al. 1996). At one time, millions of sheep and cattle grazed throughout the Sierra forests, on private and public lands of oak woodlands of the western foothills to high mountain meadows and the east-side high-desert slopes. Sheep and cattle grazing were unregulated on public lands until after the establishment of USFS in 1905, and livestock numbers continued to exceed sustainable levels and reduce forage quality as late as the 1960s. On the western foothills and on higher forest lands, shrubs were often cleared with fire or herbicides to expand rangelands or to respond to brush encroachment on overgrazed lands (Burcham 1957; Menke et al. 1996).

Today, livestock numbers have been lowered to levels that are more sustainable for livestock forage and production (Kondolf et al. 1996; Menke et al. 1996). However, grazing continues to have negative consequences for forage, cover, and nest sites for dozens of wildlife species throughout much of the Sierra Nevada. Plant communities and ecosystems that are particularly important for sustaining wildlife diversity, including riparian, aspen, meadow, aquatic, and oak woodland habitats, continue to be subject to livestock grazing.

The 1996 SNEP found that "over-grazing in mountain meadows is a threat to many rare species that are restricted to these habitats." Sierra high mountain meadows and plant communities evolved without the kind of grazing pressure caused by livestock. Yet, as described by USFS, "the riparian and meadow systems are the key livestock forage areas within allotments above 4,000-foot elevations. Studies have shown that 50 percent to 80 percent of the herbage used comes from these meadow systems, which constitute a small percentage (generally less than 5 percent) of the allotment area. In the Sierra Nevada forests, the meadow systems cover an estimated 2 percent of the allotment areas" (USFS 2001).

The SNEP and the SNFPA also found that aquatic and riparian habitats are particularly affected by livestock grazing. Cattle are attracted to the lush forage, water, and shade of riparian habitat. In late summer and fall, especially when upland habitats have dried out, cattle can decimate riparian plant communities, grazing and trampling meadows, converting meandering meadow streams into eroded channels, and stripping forage and cover needed by wildlife. The erosion increases sediment runoff, degrading aquatic ecosystems.

Revised riparian grazing standards and guidelines were implemented by USFS in the late 1990s and early 2000s and those standards and guidelines have made significant changes on the management of grazing lands in the Sierra Nevada. The standards and guidelines establish limits of the percentage of meadow forage production that can be used, sets a minimum residual height for vegetation following grazing, and limits the percentage of new vegetation growth that can be browsed. In addition, between 2000 and 2013 livestock animal unit months (AUMs) on National Forests in California have declined by 28 percent (Tate et al. 2015).

Livestock grazing is affecting the composition of plant communities that are important for wildlife diversity. Where livestock grazing is excessive, forage often becomes scarce, and both livestock and deer consume young aspen shoots, hindering the regeneration of aspen stands. Excessive grazing is a factor in reducing the regeneration of blue oak and many other plant species throughout the predominantly privately owned foothill region (McCreary et al. 2001; CDFG 2005). Livestock compact soils and remove leaf litter, making conditions less than optimal for germination of acorns and new growth. Livestock also consume acorns and young oak saplings.

Several aquatic, riparian, and meadow-dependent species are at risk in the Sierra region (USFS 2001). Half of the occupied willow flycatcher nest sites in meadow and riparian areas in the Sierra Nevada continue to be grazed by cattle or sheep. Knapp and Matthews (1996) concluded that grazing at current levels is degrading streams and riparian components to the detriment of California golden trout. Wet meadow and stream areas for the Yosemite toad, a state species of special concern and federally listed species, are also grazed (USFS 2004b). The SNEP project concluded that "livestock grazing has been implicated in plant compositional and structural changes in foothill community types, meadows, and riparian systems, and grazing is the primary negative factor affecting the viability of native Sierran land bird populations" (Sierra Nevada Ecosystem Project SNEP Science Team and University of CA Centers for Water and Wildland Resources 1996).

Livestock and other non-native species can also carry and transmit pathogens with serious implications for native species' population viability. There is significant professional and peer-reviewed consensus on the disease risk that domestic sheep and goats present to bighorn sheep (The Wildlife Society 2020), with contact of the groups being associated with pneumonia-related die-offs of bighorn (George et al. 2008; Wehausen et al. 2011).

After being reduced to a population of around 125 individuals, Sierra Nevada bighorn sheep (SNBS) have been state and federally endangered for almost 25 years. CDFW is the lead agency for recovery implementation and while there are multiple contributing factors affecting their survival, disease risk is of particular concern. Historical and current surveillance for exposure to a primary pneumonia pathogen show SNBS as naïve. Introduced exposure could result in the extinction of the subspecies (CDFG 2005); therefore, preventing or minimizing spatial and temporal overlap of domestic sheep and goats with SNBS is critical (George et al. 2008).

Recreational Activities

The mountains and wildlands of the Sierra Nevada are very popular recreation destinations. National parks, wilderness areas, and wildlife areas provide recreational opportunities while also providing greater protection for wildlife. The public develops a better understanding and appreciation for wildlife by visiting these natural areas.

Recreational activities are diverse, from traditional ones like fishing, hiking, and back-packing to those requiring more infrastructure and visitor services, such as fixed camps, ski resorts, golf courses, and off-highway vehicle (OHV) areas. Some types of recreation have grown significantly in the last few decades, such as mountain biking and OHV use; the numbers of OHV users have risen several-fold over the past 30 years.

Accordingly, the effects of recreation on wildlife and ecosystems are diverse and increasing in many areas. Ski-resort runs and infrastructure crisscross steep mountains, and golf courses have replaced some mountain meadows. Vegetation is removed and soils are eroded along creeks in popular camping areas, and more land is cleared for recreation infrastructure. Recreation technologies, such as all-terrain vehicles, snowmobiles, lighter, warmer, and waterproof camping gear and clothing, have allowed people to drive, mountain bike, ski, camp, and hunt in wild areas that years ago were natural refuges, too remote to be affected by recreation activities.

Recreation has consequences for soils, vegetation, wildlife, and aquatic resources. Soils become compacted or eroded, and habitat is cleared in areas that are heavily used by motorized vehicles, packhorses, and campers. A number of recreation activities inadvertently cause nest- or den-abandonment, displace wildlife from important foraging or watering sites, and interfere with migratory corridors (Leung and Marion 2000).

Providing more recreational opportunities while protecting wildlife habitats and aquatic ecosystems requires that sufficient resources be devoted to planning, management, and enforcement. Federal and state land agencies construct parking lots and restrooms, establish information kiosks, build and sign roads and trails, and manage garbage and sewage to accommodate recreational visitors. Additionally, there is an increased need for wildlife agencies to provide wildlife education to keep visitors safe and minimize their effects on species at risk.

Renewable Energy

Renewable energy projects, including wind energy, solar energy, and battery energy storage, have been constructed within the Central Valley and Sierra Nevada Province, with a large increase of solar energy either constructed, currently in development, or planned within the western portions of Kern, Kings, Fresno, Merced, and Stanislaus counties. Within these counties, the majority of the on utility-scale solar projects have been sited within mainly agricultural areas within the San Joaquin Valley, although several projects have been sited within more natural rangeland and grassland habitats, particularly within the western portion of Merced County.

There are concerns over the possible negative environmental effects associated with the construction and operations and maintenance of utility-scale solar projects and the associated electrical transmission lines and battery energy storage components. Construction of these large facilities, with some utility-scale solar projects encompassing more than 10,000 acres in size, not only have the potential for direct impacts to vulnerable plant and animal species but also have the potential for long-term direct and indirect impacts from ongoing operations and maintenance, including habitat loss and degradation, habitat fragmentation, increased predation, and a potential increase from the introduction and spread of invasive species. Additionally, construction and operation of electrical transmission lines, including both large transmission lines and networks of smaller collector lines, present collision and electrocution hazards to bird species.

While there are concerns related to impacts from utility-scale solar projects, particularly from a loss of native vegetation and habitat for wildlife, there is recent evidence that implementation of appropriate conservation measures, such as implementation of permeable fencing and vegetation management, may reduce impacts to permeability and connectivity and offer some benefit for wildlife use (Cypher et al. 2019; Cypher et al. 2021; Cypher et al. 2023). Additionally, several large-scale planning efforts in counties such as Kings and Fresno counties have been developed, or are in the process of being developed, to site future utility-scale solar developments within heavily disturbed agricultural areas. These siting efforts may have the potential to lessen direct and indirect impacts to vulnerable plants and animal species, although with the significant amount of solar development proposed within the Central Valley over the next several decades, loss of and degradation of wildlife habitat, species displacement, and direct mortality are still a concern.

5.4.5 Conservation Strategies

SWAP 2025 presents conservation strategies, including strategy objectives and targeted pressures, for the Bay Delta and Central Coast Province. Actions that were identified for specific conservation units are listed with the strategy. Table 5.0 summarizes conservation targets for the province.

Target: American Southwest Riparian Forest and Woodland

Diagnostic species include Fremont cottonwood, black and red willow, California sycamore, California wild grape, arroyo willow, narrow-leaf willow, button-bush, and spice bush. Most stands are found in permanently moist settings or riparian settings where sub-surface water is available year-round.

Conservation Strategy 1 (Land Acquisition/Easement/Lease): Acquire property and/or easements, including protection of land or water real property or rights through conservation easement

Objective(s):

- Increase the acreage of valley riparian habitat protected through fee title or conservation easement
- Protect high quality valley riparian habitat through fee title or conservation easement

Targeted pressure(s): Annual and perennial non-timber crops; housing and urban areas; invasive plants/animals; livestock, farming, and ranching

Conservation Strategy 2 (Land Acquisition/Easement/Lease): Acquire water rights focused on improving in-stream flow for fish and riparian habitat

Objective(s):

- Water rights are acquired by CDFW to improve in-stream flow for fish and riparian habitat

Targeted pressure(s): Dams and water management/use

Conservation action(s):

- Identify priorities for acquisition
- Coordinate with refuge water working groups
- Advocate for "water for wildlife"
- Review existing in-stream flow requirements

Conservation Strategy 3 (Data Collection and Analysis): Conduct research focused on informing the development of new or updating of existing best management practices (BMPs) for invasive species, grazing, and water flow

Objective(s):

- Collect and analyze adequate data to inform the development of new or updating existing invasive species BMPs
- Collect and analyze adequate data to inform the development of new or updating of existing grazing BMPs
- Collect and analyze adequate data to inform the development of new or updating of existing water flow BMPs

Targeted pressure(s): Livestock, farming, and ranching; invasive plants/animals; dams and water management/use

Conservation action(s):

- Identify study questions
- Develop study design
- Coordinate with experts
- Conduct literature review

Conservation Strategy 4 (Outreach and Education): Provide education and outreach for the conservation of natural resources

Objective(s):

- Private landowners have increased knowledge in the identification and management of invasive species
- Public awareness and knowledge of the values of riparian habitats is increased
- The public is participating in monitoring invasive species and rapid response
- The public has increased knowledge of grazing BMPs
- The public has increased knowledge of wildlife-friendly land use policy

Targeted pressure(s): Livestock, farming, and ranching; invasive plants/animals; annual and perennial non-timber crops

Conservation Strategy 5 (Law and Policy): Improve effective law enforcement and permitting compliance focused on: complying with water rights and Fish and Game Code (FGC) section 1600 et seq. Lake and Streambed Alteration agreements, eliminating illegal water diversions, and increasing Law Enforcement Division (LED) and Habitat Conservation (HabCon) Program staffing levels

Objective(s):

- Compliance with water rights
- Compliance with FGC section 1600 et seq. LSA agreements
- Illegal water diversions are eliminated
- LED and HabCon staffing levels are increased

Targeted pressure(s): Recreational activities; dams and water management/use

Conservation action(s):

- Include BMPs as enforceable condition of FGC section 1600 et seq. LSA Agreements
- Include BMPs as enforceable condition of water right permit/license.
- Coordinate with LED
- Advocate for opportunities to improve prosecutions of environmental laws and illegal diversions
- Identify partners to improve enforcement capabilities
- Evaluate and increase LED and HabCon staffing levels

Conservation Strategy 6 (Direct Management): Manage invasive species

Objective(s):

- Develop and implement BMPs to control or eradicate invasive species

Targeted pressure(s): Invasive plants/animals

Conservation action(s):

- Conduct assessment of the distribution and type of invasive species
- Coordinate with National Resources Conservation Service (NRCS) and other agencies
- Identify existing invasive species management plans and ongoing activities
- Support existing efforts or develop and implement invasive species control management plan
- Treat invasive species for removal

Conservation Strategy 7 (Direct Management): Manage water flows

Objective(s):

- Allow more flows to support riparian habitat
- Restore critical flow dynamics to benefit riparian ecosystem functions and incorporate climate considerations into water flow management practices

Targeted pressure(s): Dams and water management/use

Conservation action(s):

- Coordinate with State and Federal Water Projects, counties and local water districts
- Coordinate with Floodsafe and local flood agencies
- Identify and prioritize critical streams to restore flow dynamics
- Assess opportunities for dam removal on smaller streams
- Identify or create working groups focused on flow and ecological function
- Identify and review existing local groundwater policies to inform future policy recommendations
- Encourage setback levees to restore hydrological and geomorphic function

Conservation Strategy 8 (Management Planning): HabCon Program staff assist in the development and implementation of Habitat Conservation Plans (HCPs) (Central Valley Flood Protection Plan, South Sacramento HCP, San Joaquin County Multi-Species Habitat Conservation and Open Space Plan, Bay Delta Conservation Plan [BDCP], Yolo, Solano, Butte, and Yuba-Sutter HCPs)

Objective(s):

- Ensure riparian habitats are included and conservation measures proposed in the development of valley floor HCPs
- The FERC re-license process is streamlined to better incorporate riparian conservation actions
- Projects identified in the HCPs/NCCPs are compatible with ecosystem conservation requirements
- Climate change adaptation strategies are incorporated into the conservation planning documents and activities by local, state and federal agencies
- Invasive species are eradicated or controlled in riparian habitat areas
- Riparian habitat is addressed, and conservation measures are included in the Bay Delta Conservation Plan

Targeted pressure(s): Housing and urban areas; utility and service lines; roads and railroads; recreational activities

Conservation Strategy 9 (Management Planning): Provide input on local planning; Lead or participate in land use planning for rural, urban, or agricultural lands (e.g., provide input on local land use plans; develop county-wide zoning plans; participate in workgroup regarding low impact development siting)

Objective(s):

- Staff from local governments are informed and knowledgeable about important wildlife habitats (riparian)
- Local policies are in place that protect important wildlife (riparian) habitats

Targeted pressure(s): Housing and urban areas; utility and service lines; roads and railroads; recreational activities; annual and perennial non-timber crops; invasive plants/animals

Target: Freshwater Marsh

This vegetation type consists of freshwater emergent marshes and coastal/tidal marshes and meadows. It can be found surrounding streams, rivers, lakes and wet meadows. These habitats occur on virtually all exposures and slopes, provided a basin or depression is saturated or at least periodically flooded. Dominant species are generally perennial monocots including graminoids such as rushes, reeds, grasses and sedges. Dominant species include common reeds, hardstem bulrush, small-fruited bulrush, water parsley, slough sedge, soft rush, salt rush, and pacific silverweed

Conservation Strategy 1 (Outreach and Education): Provide outreach and education

Objective(s):

- Influence public awareness of proper land management for freshwater marshes by providing information to landowners regarding BMPs and proper wetland management

Targeted pressure(s): Other ecosystem modifications; livestock, farming, and ranching

Conservation action(s):

- Target Buckeye Conservancy and RCDs
- Design and produce brochures with wetland conservation message
- Employ web-based media for providing information to the public
- Coordinate with local landowners to determine what conservation efforts they are engaged with and determine how CDFW may assist in their efforts

Conservation Strategy 2 (Land Acquisition/Easement/Lease): Purchase land and conservation easements

Objective(s):

- Improve land management by removing invasive species and creating better grazing practices

Targeted pressure(s): Livestock, farming, and ranching; annual and perennial non-timber crops

Conservation action(s):

- Prioritize with Environmental Site Assessment

Conservation Strategy 3 (Law and Policy): Advocate for laws and policies

Objective(s):

- Strengthen regulatory authority over wetlands and integrate beaver ecology into wetland restoration activities

Targeted pressure(s): Livestock, farming, and ranching; annual and perennial non-timber crops

Conservation action(s):

- Evaluate and update Wetlands Policy
- Implement wetland and riparian technical memorandum
- Review and modify CDFW policy on beaver depredation
- Update wetlands implementation policy

Conservation Strategy 4 (Management Planning): Develop management plans

Objective(s):

- Develop BMPs for ecosystem management on CDFW lands
- BMPs would provide guidance on managing CDFW lands for multi-species use and benefit both recreation and conservation of native species

Targeted pressure(s): Invasive plants/animals; livestock, farming, and ranching; annual and perennial non-timber crops; climate change

Conservation action(s):

- Revise Land Management Plan (LMP) guidelines to include ecosystem management
- Update LMPs to be consistent with new guidelines for managing at an ecosystem level
- Develop policy on ecosystem management on public lands

Conservation Strategy 5 (Economic Incentives): Provide economic incentives for improved resource management

Objective(s):

- Provide economic incentives through restoration grants

Targeted pressure(s): Livestock, farming, and ranching; annual and perennial non-timber crops

Target: California Grassland, Vernal Pools, and Flowerfields

Includes all annual forb/grass vegetation native and non-native, as well as native perennial grasslands growing within the California Mediterranean climate. This does not include the cool-moist north coastal terrace prairies, the montane meadow/upland grasslands, and non-native perennial pasture grasses. Native perennial grasslands include needle grass species, melicgrass and giant wild rye. Annual native forb and wildflower fields including species of poppy, goldfields, popcorn flowers, fiddleneck, and others. Target also includes vernal pools within grasslands. Non-native annual grasslands such as wild oat, brome, annual fescue, star-thistle, mustards, fennel, and others are also present in grassland habitats and affect the habitat function of this target.

Conservation Strategy 1 (Land Acquisition/Easement/Lease): Acquire, conserve, restore, and manage habitat for SGCN that inhabit grassland habitats by finalizing draft conservation plans and implementing completed NCCPs, HCPs, and Conservation Strategies and other opportunities

Objective(s):

- Establish conservation and management plans for SGCN that inhabit grassland habitats

Targeted pressure(s): Housing and urban areas; Commercial and industrial areas

Conservation action(s):

- Develop, fund and implement conservation actions, land acquisition and management plans

Conservation Strategy 2 (Data Collection and Analysis): Identify and conduct research on high-priority study questions for grassland habitat/conservation areas; conduct research to inform coordination with Caltrans and county transportation agencies on wildlife-friendly transportation corridors; implement and fund monitoring and research components of completed and draft NCCPs, HCPs, and Conservation Strategies

Objective(s):

- Reflect the research and data analysis needs of the province
- Identify high priority research/study questions regarding grassland habitat/conservation areas
- Use research to inform coordination with Caltrans and County Transportation Agency on wildlife-friendly transportation corridors
- When Caltrans is currently implementing best management practices (BMPs), look for opportunities for alignment of BMPs through the implementation of SWAP strategies and existing processes such as those in place at Caltrans

Targeted pressure(s): Livestock, farming, and ranching; annual and perennial non-timber crops; roads and railroads

Conservation action(s):

- Obtain funding for research, surveys and monitoring for developing and existing conservation plans and recovery plans
- Gather and/or review existing information
- Utilize existing conservation plans and recovery plans to establish prioritization
- Identify inventory protocol
- Coordinate with landowners
- Utilize existing conservation plan partnerships and identify new partners
- Obtain funding for program implementation
- Analyze spatial distribution using Geographic Information Systems (GIS)
- Coordinate with Caltrans on siting of roads, and design and siting of wildlife crossings

Conservation Strategy 3 (Land Use Planning): Develop statewide strategies on renewable energy development location siting; identify renewable energy development zones and obtain their approval by the Renewable Energy Action Team (REAT)

Objective(s):

- Identify and approve renewable energy development zones by REAT

Targeted pressure(s): Renewable energy

Conservation Strategy 4 (Land Use Planning): Provide input on project planning and decision-making processes; ensure that city and county planning departments consider the conservation of grassland and vernal pool habitat

Objective(s):

- City and county planning departments take into account the conservation of grassland and vernal pool habitat

Targeted pressure(s): Renewable energy; Housing and urban areas

Conservation Strategy 5 (Direct Management): Manage invasive species, with focus on controlling or eradicating them in grassland habitats in the Central Valley Ecoregion

Objective(s):

- Eradicate or control invasive species in grassland habitats in the Central California

Targeted pressure(s): Invasive plants/animals

Conservation action(s):

- Fund and implement invasive species management actions in draft and final NCCPs, HCPs, conservation Strategies, and Recovery Plans
- Coordinate with the California Invasive Plant Council
- Identify sites for eradication of non-native tiger salamanders and bullfrogs
- Obtain funding for management actions

Conservation Strategy 6 (Partner Engagement): Coordinate with Caltrans and county transportation agencies to use information on high-priority wildlife corridors in the design of wildlife-friendly transportation corridors

Objective(s):

- Transportation agencies use information on high priority wildlife corridors to design wildlife-friendly transportation corridors

Targeted pressure(s): Roads and railroads; invasive plants/animals

Conservation Strategy 7 (Partner Engagement): Coordinate with fire agencies, local landowners, and tribal land managers, to develop and implement fire management BMPs in grassland habitats

Objective(s):

- Fire management BMPs to improve grassland habitat are co-developed with fire agencies and local landowners

Targeted pressure(s): Fire and fire suppression

Target: Shadscale-Saltbush Scrub

Shadscale-Saltbush Scrub communities are located in arid to semi-arid regions of central and southern California and typically found in desert valleys, basins, playas, foothills, and plains. These assemblages are typically characterized by flat to gently sloping terrain with predominantly fine-grained, alkaline and saline soil conditions dominated by primally Atriplex species and a mix of annual grasses and forbs.

Conservation Strategy 1 (Land Acquisition/Easement/Lease): Protect high-quality alkali desert scrub habitat through acquisition and easements

Objective(s):

- Increase the amount of acreage that is protected through purchase or conservation easement and identify high quality habitat for protection through purchase or easement

Targeted pressure(s): Roads and railroads; renewable energy; commercial and industrial areas; annual and perennial non-timber crops, utility and service lines

Conservation action(s):

- Identify and prioritize potential areas for acquisition/easement
- Identify areas already conserved
- Evaluate availability of suitable habitat
- Acquire land or conservation easements
- Develop habitat conservation plan
- Develop advance mitigation plan
- Establish criteria for minimum and maximum habitat size (conserved)
- Evaluate feasibility of acquisition/easement
- Create interdisciplinary team to facilitate land acquisition and conservation
- Develop database to track acquisition/tracking
- Develop standard protection criteria for conservation easement
- Obtain funding for acquisition/easements

Conservation Strategy 2 (Data Collection and Analysis): Gather and analyze data, particularly on the distribution of invasive species and their impacts on shadscale-saltbush scrub.

Objective(s):

- The distribution of invasive species and impacts to the target habitat are understood through research, and the distribution of invasive species within conserved lands is understood

Targeted pressure(s): Housing and urban areas; invasive plants/animals; annual and perennial non-timber crops; recreational activities

Conservation action(s):

- Identify basic tools needed for data and analysis
- Gather baseline information
- Develop scope of involvement
- Develop survey design and implementation plan
- Conduct economic impact analysis

- Evaluate ecosystem impacts
- Evaluate species impacts
- Identify and evaluate existing data
- Obtain funding to implement strategy
- Integrate climate change influence and modeling
- Conduct Geographic Information Systems (GIS) analysis
- Evaluate impacts to other ecoregions

Conservation Strategy 3 (Data Collection and Analysis): Gather data and conduct research to better understand alkali desert scrub ecology (e.g., population size, distribution, habitat relationships), pressures, and climate change effects; and collect and analyze baseline assessment information for alkali desert scrub

Objective(s):

- Alkali desert scrub ecological parameters are better understood, and baseline assessment information have been collected and analyzed

Targeted pressure(s): Roads and railroads; renewable energy; commercial and industrial areas; utility and service lines
Conservation action(s):
- Identify goals and objectives
- Coordinate with state and federal agencies and universities
- Design monitoring and implementation plan
- Prepare summary reports
- Obtain funding for strategy implementation
- Evaluate feasibility/efficacy of study design

Conservation Strategy 4 (Education and Outreach): Develop and implement an outreach program on the impacts of invasive species

Objective(s):
Land managers are more knowledgeable about the impacts of invasive species

Targeted pressure(s): Housing and urban areas; invasive plants/animals; annual and perennial non-timber crops; recreational activities

Conservation Strategy 5 (Education and Outreach): Provide outreach and education on resource conservation practices

Objective(s):

- Land managers and users are more knowledgeable, aware, concerned and participating in resource conservation practices

Targeted pressure(s): Roads and railroads; renewable energy; commercial and industrial areas; utility and service lines

Conservation Strategy 6 (Management Planning): Develop and implement management plans to guide maintaining or restoring connectivity for alkali desert scrub and SGCN

Objective(s):

- Develop and implement management plans to guide maintaining or restoring connectivity for alkali desert scrub and SCGN

Targeted pressure(s): Roads and railroads; renewable energy; commercial and industrial areas; utility and service lines; annual and perennial non-timber crops

Conservation Strategy 7 (Partner Engagement): Establish and develop co-management partnerships; use partnerships with desert land managers to manage invasive species on conserved lands; integrate climate change considerations into management plans for species and habitats

Objective(s):

- Establish joint partnerships with desert land managers to manage invasive species on conserved lands

Targeted pressure(s): Roads and railroads; renewable energy; commercial and industrial areas; utility and service lines, annual and perennial non-timber crops

Conservation Strategy 7 (Training and Technical Assistance): Provide training on invasive species control and management

Objective(s):

- Increase the knowledge of mangers about invasive species management and control techniques
- Conduct regular training (e.g., annually) for CDFW staff and make available to other organizations

Targeted pressure(s): Invasive plants/animals

Target: Chaparral; Desert Transition Chaparral; Montane Chaparral; California Foothill and Coastal Rock Outcrop Vegetation

Chaparral: Represented by a wide variety of floristic alliances, but in general can be grouped into coastal (maritime), xeric (dry, sunny slopes), mesic (cooler, shady slopes), and lower montane (somewhat frost sensitive) types. Each of these groupings have different characteristic species and fire regimes. The core diagnostic species are shrubs with evergreen thickened leaves including many species of manzanita, Ceanothus, scrub oaks, and other characteristic shrubs: toyon, chamise, flannel-bush, silk-tassel bush, and many others. Many shrubs tend to break down into their fire responses, including obligate-seeding and resprouting strategies.

Desert Transition Chaparral: These chaparral stands occur in the "rain shadow" of the mountains. Compared to the target "Chaparral," the stands are less dense, contain a mix of other non-chaparral shrubs with desert affinities, and tend to have less frequent and less intense fires. This target contains the desert margin scrub oaks Quercus john-tuckeri, Q. turbinella, and Q cornelius mulleri, also sugar-bush, red-shank, Silk-tassel bush, and cup-leaf ceanothus. Understory short shrubs include golden-bush, California buckwheat, and matchweed. Prickly-pear, cholla, jojoba, nolina, and other desert perennials and annuals are also common associates in many of the stands.

Montane Chaparral: These are cold-adapted and occupy successional relationships to various coniferous forests on productive sites, or persist in rocky or other poor soil sites. Contains the Ceanothus cordulatus, C. velutinus, Arctostaphylos patula, A. nevadensis, Chrysolepis sempervirens, and Q. vaccinifolia-dominated montane chaparrals. Does not include bittercherry, ocean spray or other taller winter deciduous shrub stands, which may occur near or adjacent to these evergreen stands.

California Foothill and Coastal Rock Outcrop Vegetation: Vegetative cover is generally < 2%. Cliffs and outcrops west of the deserts and inland from the immediate coast, south of central California. Rock surfaces or rapidly eroding unstable slopes are characteristic. Stands do not include alpine or subalpine sparse, rocky vegetation, and do not include the sparsely vegetated portions of the warm and cold deserts. Target is poorly understood floristically; includes coastal succulents (e.g., Dudleya and Coreopsis gigantea).

Conservation Strategy 1 (Land Acquisition/Easement/Lease): Protect land through acquisition, easement, or lease

Objective(s):

- Clear management and monitoring plans are developed
- Funds are allocated by agency leadership for management and monitoring
- Priority sites are put in easements
- Sufficient funds are obtained
- At each annual review, the easement or lease is in compliance

Targeted pressure(s): Housing and urban areas; renewable energy

Conservation action(s):

- Develop inter-regional and inter-agency team to develop priorities
- Develop protection criteria for conservation easements
- Develop restoration and management plans

Conservation Strategy 2 (Data Collection and Analysis): *Collect and analyze data regarding the target*

Objective(s):

- Appropriate audiences are accessing data
- Data are used to inform conservation actions
- Recommendations for conservation action have been developed
- Research provides answers to relevant questions
- The proposal includes management needs and outcomes that have been identified with input from relevant data users

Targeted pressure(s): Annual and perennial non-timber crops; housing and urban areas; fire and fire suppression; renewable energy; invasive plants/animals

Conservation action(s):

- Use data to inform state and federal land managers
- Develop conservation strategies to reduce any pressures to target habitat that may be cumulative to climate change (e.g., recreation, grazing)

Conservation Strategy 3 (Direct Management): Conduct direct resource management

Objective(s):

- Management actions are implemented, including the following:
- Implement measures to manage fire frequency (prescribed burns or fuel management as appropriate)
- Control invasive species to prevent the spread of fire and invasive species,
- Conduct managed thinning and grazing
- Remove non-native species
- Conduct resource assessments to inform management decisions

Targeted pressure(s): Fire and fire suppression; invasive plants/animals

Conservation action(s):

- Manage fire frequency to recur no more than every 20 years
- Minimize and control invasive species
- Maintain and improve community structure and composition, and soil nutrient concentrations
- Develop plans for fire management to avoid prescribed burns and to favor fire avoidance measures in areas near human centers are developed

Conservation Strategy 4 (Management Planning): Work with partners on the development of large landscape conservation planning. Translocate/breed in captivity a SGCN to establish new populations in suitable habitat. Restore SGCN to historically occupied habitats.

Objective(s):

- Management plans include appropriate strategies, actions, and monitoring plans for SGCN, habitats, and natural processes
- Plan recommendations are used to inform conservation actions
- Within the first year and ongoing thereafter, fire management actions favor fire avoidance measures in areas near human centers

Targeted pressure(s): Fire and fire suppression; invasive plants/animals

Conservation action(s):

- Prepare plan recommendations (management strategies, action and monitoring plans) to reach the right people in the right format
- Develop or update management plans to integrate the effects of climate change
- Development of management plans for species, habitats and natural processes
- Develop a management plan for SGCN or its habitat
- Reintroduction, relocation, or stocking of native animals or plants to an area where they can better adapt

Conservation Strategy 5 (Partner Engagement): Engage conservation partners, including state and federal agencies, tribal governments, non-governmental organizations (NGOs), and other partners to achieve shared objectives and broader coordination across overlapping areas. Establish partnership to co-monitoring species/habitats on federally managed lands. Establish decision-making processes with other public and private entities to determine or implement strategies. Convene an advisory committee to assist with implementation of strategies.

Objective(s):

- A joint, mutually agreed upon project is developed and implemented (e.g., invasive plant early detection program is implemented)

Targeted pressure(s): Annual and perennial non-timber crops; housing and urban areas; fire and fire suppression; renewable energy; invasive plants/animals

Target: California Foothill and Valley Forests and Woodlands

These forests may open woodlands to denser forests and may be dominated by broadleaf evergreen or deciduous hardwoods, co-dominated by hardwoods and conifers, or dominated entirely by conifers. Understories can be grassy, shrubby, or mixed with both. This target contains two groups, one dominated by broad leaf trees and the other dominated by conifers. Fire ecology varies depending on the spacing of trees and the herbaceous or woody understory characteristics.

Conservation Strategy 1 (Economic Incentives): Provide economic incentives to landowners for managing grazing to maintain appropriate levels of residual dry matter

Objective(s):

- Provide economic incentives to landowners for managing grazing to maintain appropriate levels of residual dry matter

Targeted pressure(s): Livestock farming and ranching; invasive plants/animals

Conservation action(s):

- Outreach to landowner regarding programs
- Fund priority projects
- Monitor effectiveness and compliance
- Review and update CDFW's Private Lands Management (PLM) program
- Coordinate with local landowners to determine what conservation efforts they are engaged with and determine how CDFW may assist in their efforts

Conservation Strategy 2 (Direct Management): Conduct ecologically sound prescribed burns on CDFW lands

Objective(s):

- Conduct ecologically sound prescribed burns on CDFW lands

Targeted pressure(s): Fire and fire suppression

Conservation action(s):

- Prioritize candidate locations
- Conduct pre-burn baseline inventories
- Coordinate with BLM and CAL FIRE
- Complete Environmental Assessment
- Prepare burn plan in coordination with CAL FIRE
- Evaluate and perform relevant BMPs
- Plan and conduct post-fire monitoring

Conservation Strategy 3 (Direct Management; Outreach and Education): Conduct demonstration management, including providing public demonstrations of successful BMPs and scientifically documenting environmental change from implementation of BMPs

Objective(s):

- Provide public demonstrations of successful BMPs

- Scientifically documenting environmental change from implementation of BMPs

Targeted pressure(s): Livestock, farming, and ranching; invasive plants/animals

Conservation action(s):

- Develop monitoring study design
- Identify existing demonstration programs
- Develop implementation plan for BMPs and budget

Conservation Strategy 4 (Land Acquisition/Easement/Lease): Purchase and provide long-term conservation of land including protecting land through conservation easements

Objective(s):

- Provide long-term conservation of land
- Protect land through conservation easements

Targeted pressure(s): Livestock, farming, and ranching; invasive plants/animals

Conservation action(s):

- Refer to, and coordinate with, the Wildlife Conservation Board (WCB)
- Evaluate consistency with regional priorities
- Develop management plan for purchased lands and acquired lands/easements

Conservation Strategy 5 (Outreach and Education): Provide education and outreach, introduce landowners and lessees to new or existing BMPs for grazing; inform public of incentive programs available to them; educate recreation focused landowners on wildlife-BMP's; and keep CDFW staff current on relevant science (e.g., on restoration techniques, science)

Objective(s):

- Work with landowners and lessees to implement BMPs for grazing
- Inform public of incentive programs available to them
- Educate recreation-focused landowners on wildlife-BMPs
- Keep CDFW staff current on relevant science (e.g., restoration techniques, etc.)
- Coordinate with local landowners to determine what conservation efforts they are engaged with and determine how CDFW may assist in their efforts

Targeted pressure(s): Livestock, farming, and ranching; invasive plants/animals

Conservation Strategy 6 (Partner Engagement): Establish partnerships with agencies, tribal governments, and organizations

Objective(s):

- Develop partnerships with agencies and organizations to enhance conservation opportunities (currently BLM, RCDs, UCD, Audubon, and BRBP)

Targeted pressure(s): Recreational activities; invasive plants/animals; livestock, farming, and ranching

Conservation action(s):

- Engage partnerships through attendance at BRBP meetings
- Participate in internal revamping of PLM program
- Encourage use of CDFW's Shared Habitat Alliance for Recreational Enhancement program

Target: North Coastal Mixed Evergreen and Montane Conifer Forests

These forests' average cooler and wetter conditions than California Foothill and Valley Forests and Woodlands. There is relatively broad overlap between the three groups composing this target. The moist coastal mixed evergreen historically had tanoak, madrone, giant chinquapin mixed frequently with Douglas fir but also mixes with bigleaf maple and red alder in upland settings. The more interior mixed evergreen forests have cooler winters and warmer summers than the moist coastal group above and contain Oregon oak and drier Douglas-fir with canyon oak mixes.

Conservation Strategy 1 (Land Acquisition/Easement/Lease): Protect land through acquisition and conservation easements, including increasing the amount of key conifer areas protected through purchase or conservation easement. Key conifer areas include old-growth forest, watercourse zones, and nest sites.

Objective(s):

- Increase the amount of key conifer areas protected through purchase or conservation easement; Key conifer areas include old-growth forest, watercourse zones, and nest sites

Targeted pressure(s): Logging and wood harvesting

Conservation action(s):

- Identify potential areas, identify what is already conserved
- Develop HCPs and advanced mitigation plans
- Develop interdisciplinary team to facilitate land acquisition and conservation
- Develop database to track acquisition/tracking

- Develop protection criteria (uniformity in wording) for conservation easement language: standardizing, complete, doable, executable, legally enforceable, protection criteria

Conservation Strategy 2 (Data Collection and Analysis): Conduct research regarding effective target management

Objective(s):

- Research efficacy of different techniques to manage forest and reduce uncharacteristic fire; document the response of wildlife post-fire
- Document response of wildlife to different types of logging
- Document baseline conditions and monitor trends of SGCN using occupancy as a metric
- Document baseline conditions and monitor trends of the conifer forests ecosystem

Targeted pressure(s): Fire and fire suppression; logging and wood harvesting

Conservation action(s):

- Develop study and monitoring design
- Work with federal agencies and add wildlife components to ongoing/funded research
- Conduct pilot research project
- Sustain ongoing relevant monitoring and resources assessment work

Conservation Strategy 3 (Outreach and Education): Provide education and outreach for the conservation of natural resources

Objective(s):

- Educate the public on the ecological effects of fire and on recent landscape changes
- Relate fire management to beneficial uses of wildlife

Targeted pressure(s): Fire and fire suppression

Conservation action(s):

- Coordination with federal agencies and private landowners
- Identify objectives/goals for outreach and education strategy
- Develop key messages, identify target audience
- Conduct field trips and workshops
- Develop brochures and web content

Conservation Strategy 4 (Law and Policy): Advocate for laws and policies; coordinate with agencies to allow fires to burn when possible

Objective(s):

- Coordinate with agencies to allow fires to burn when possible

Targeted pressure(s): Fire and fire suppression

Conservation action(s):

- Identify and work with agencies to review and modify their existing policies
- Prioritize areas that can be allowed to burn
- Link to education and outreach strategy
- Coordinate with local Air Quality Management Districts to consider ways to allow for more prescriptive burn days

Conservation Strategy 5 (Law and Policy; Partner Engagement): Engage in decision-making process to achieve shared objectives and broader coordination across overlapping area; cooperate with federal agencies and private landowners, including tribal land managers, on where prescribed burns and forest thinning would be most beneficial to wildlife

Objective(s):

- Cooperate with federal agencies and private landowners on where prescribed burns and forest thinning would be most beneficial to wildlife

Targeted pressure(s): Fire and fire suppression

Conservation action(s):

- Coordinate with federal agencies, private landowners, and Fire Science Centers
- Engage in forest treatment priorities and elevate wildlife
- Work with USFS to identify possible treatment areas
- Establish ways to identify and prioritize high value wildlife habitat

Conservation Strategy 6 (Management Planning; Partner Engagement): Develop management plans and improve existing fire management plans

Objective(s):

- Improve existing fire management plans; identify high value wildlife habitat

Targeted pressure(s): Fire and fire suppression

Conservation action(s):

- Coordinate with state and federal agencies

- Coordinate with partners to prevent intense wildfires to protect wildlife habitat, water quality, and recreation opportunities
- Engage USFWS about listed species and management indicator species
- Identify high value forested wildlife habitats

Target: Alpine Vegetation

This target is representative of the state's alpine zone in the Sierra Nevada, Cascades, White, Sweetwater, and Klamath Mountains. It either occurs above timberline or is found localized within subalpine areas in cold air drainages (e.g., North-facing slopes, often near long persisting snowbanks). The characteristic species are either herbaceous (many are cushion plants, some tufted or rhizomatous graminoids) or low prostrate or dwarf shrubs. Different groups segregate based on substrate type (e.g., scree, talus, felfield) and moisture regime (e.g., snowbank, felfield).

Conservation Strategy 1 (Data Collection and Analysis): Gather more information on alpine vegetation habitat, particularly on the physical and biological variables affected by climate change

Objective(s):

- Within 10 years of research initiation, answers to relevant questions are provided, appropriate audiences are accessing information, and data are used to inform conservation actions. In particular, information is obtained on: macrogroup (target) habitat requirements and impacts to climate change on the macrogroup (target) and KEAs in the province, soil moisture regime and area requirements of target as a whole, soil temperature regime and area and requirements of target as a whole, snow pack levels and snow cover period requirement for habitat maintenance, minimal seasonality and weather regimes required to maintain target habitat, changes in the KEAs and area and extent of target in relation to current weather changes from climate change

Targeted pressure(s): Climate change

Conservation action(s):

- Develop conservation strategies to reduce any threats to alpine vegetation habitat that may be cumulative to climate change (e.g., recreation, grazing)
- Use data to inform state and federal land managers

Conservation Strategy 2 (Outreach and Education): Engage urban citizens on climate change; expand conservation education programs (e.g., in grade schools) to include climate change

Objective(s):

- Target audience receives the message, has desired attitudes and values, and continues the desired behavior

Targeted pressure(s): Climate change; livestock, farming, and ranching; invasive plants/animals; recreation activities

Conservation Strategy 3 (Economic Incentives): Develop economic incentives to reduce the impacts of climate change within California

Objective(s):

- Economic incentives are developed and provided, are implemented in a manner that is consistent with design, and the desired pressure reduction is observed

Targeted pressure(s): Climate change

Conservation Strategy 4 (Direct Management): Restore subalpine and alpine meadows, including restoration/enhancement of degraded habitats, monitoring populations, and removing barriers to species movement

Objective(s):

- Management actions are implemented

Targeted pressure(s): Strategy acts directly on target

Conservation action(s):

- Prioritize restoration of subalpine and alpine meadows
- Remove non-native or invasive species
- Add fencing to restrict livestock and human access to sensitive areas
- Prioritize early detection of invasive species
- Add BMPs for assisting vegetation shift from impending climate change

Conservation Strategy 5 (Direct Management; Management Planning): Manage grazing and invasive species, remove trails, restrict grazing and pack animal use of subalpine and alpine meadows on public lands, remove trail and campground use away from subalpine and alpine meadows, and treat and remove invasive species

Objective(s):

- Management actions are implemented

Targeted pressure(s): Livestock, farming, and ranching; invasive plants/animals

Conservation Strategy 6 (Management Planning): Develop or update management plans to integrate the effects of climate change

Objective(s):

- More information is obtained on local climate change impacts; management plans include appropriate strategies, actions, and monitoring plans for SGCN, habitats, and natural processes
- Plan recommendations are used to inform conservation actions

Targeted pressure(s): Climate change; livestock, farming, and ranching; invasive plants/animals; recreational activities

Conservation Strategy 7 (Partner Engagement): Establish partnerships to co-monitor alpine vegetation habitat on state and federal lands

Objective(s):

- Mutually agreed upon partnership and monitoring strategy is developed
- Engaging with the partner, monitoring is implemented

Targeted pressure(s): Climate change; livestock, farming, and ranching; invasive plants/animals; recreational activities

Conservation action(s):

- Monitor extent of alpine vegetation habitat

Conservation Strategy 8 (Training and Technical Assistance): Provide training on science-based applications and tools for climate change and natural resources management

Objective(s):

- Target audience (land managers) that were trained have knowledge consistent with the training goals
- Target audience (land managers) has adopted or continued actions consistent with the training goals

Targeted pressure(s): Climate change; livestock, farming, and ranching; invasive plants/animals; recreational activities

Target: Pacific Northwest Subalpine Forest

Includes montane conifer forests and woodlands adapted to very high winter snowfall, from montane to subalpine elevations: Snow loads are the greatest anywhere in North America and persist well into the summer; Tree germination is also limited in some cases by the short period the ground is not covered by snow; Characteristic trees include red fir, mountain hemlock, and western white pine

Conservation Strategy 1 (Data Collection and Analysis): Collect data on climate-related impacts to species and habitats in the red fir/subalpine conifer zone, to better predict future distribution and viability and inform land acquisition and other strategies

Objective(s):

- Proposal includes clear management needs and outcomes that have been identified with input from relevant data users
- The research provides answers to relevant questions
- The appropriate audiences are accessing data
- Recommendations for conservation actions have been developed
- The data are used to inform conservation actions

Targeted pressure(s): Climate change; fire and fire suppression

Conservation Strategy 2 (Data Collection and Analysis): Collect data to evaluate effects of fuels treatments in the red fir zone, and whether treatments can partly offset climate-related increases in fire severity in the red fir zone

Objective(s):

- Proposal includes clear management needs and outcomes that have been identified with input from relevant data users
- The research provides answers to relevant questions, appropriate audiences are accessing data
- Recommendations for conservation actions (e.g., fuels treatments) have been developed
- The data are used to inform conservation actions (e.g., fuels treatments)

Targeted pressure(s): Climate change; fire and fire suppression

Conservation Strategy 3 (Economic Incentives): Develop economic incentives to reduce greenhouse gas emissions in California

Objective(s):

- Economic incentives are developed and provided
- The target population is using economic incentives

Targeted pressure(s): Climate change

Conservation Strategy 4 (Land Use Planning): Provide input on local land use plans to incorporate climate change; provide local assistance grant funds for participation in general plan updates favoring natural resource conservation and climate change

Objective(s):

- Local land use planners receive input on land use plans from CDFW

- Land use plans consistent with input provided by CDFW are approved
- Plans are implemented in a manner consistent with the input

Targeted pressure(s): Climate change; fire and fire suppression

Conservation Strategy 5 (Direct Management): Implement fuels treatments in red fir forest, if determined to be effective (see "Data Collection and Analysis")

Objective(s):

- Implement management actions

Targeted pressure(s): Fire and fire suppression

Conservation Strategy 6 (Management Planning): Develop or update management plans to integrate the effects of climate change

Objective(s):

- Management plan/project includes clear management needs and outcomes that have been identified with input from relevant data users (particularly information on local impacts from climate change and management actions that exacerbate climate change impacts to KEAs specifically in the Sierra Nevada).
- Management plans include appropriate strategies, actions, and monitoring plans for SGCN, habitats, and natural processes
- Appropriate audiences are accessing data

Targeted pressure(s): Climate change; fire and fire suppression

Conservation Strategy 7 (Partner Engagement): Establish partnerships, including with tribal governments, to co-monitor target habitat on state, federal, and tribal lands

Objective(s):

- Mutually agreed upon partnership and monitoring strategy is developed and implemented

Targeted pressure(s): Fire and fire suppression

Conservation Strategy 8 (Environmental Review): Review projects for potential increases in greenhouse gas emissions; require mitigation as needed

Objective(s):

- Provide input on environmental review document
- An environmental review document is approved that is consistent with the input provided
- The plan is implemented in a manner that is consistent with the input
- The behavior of local entity is consistent with input

Targeted pressure(s): Climate change

Conservation Strategy 9 (Training and Technical Assistance): Provide science-based applications and tools for climate change and natural resources management

Objective(s):

- Target audience (land managers) trained has knowledge consistent with the training
- Target audience (land managers) adopts or continues to act consistently with the training

Targeted pressure(s): Climate change; fire and fire suppression

Target: Wet Mountain Meadow; Western Upland Grasslands

Wet Mountain Meadow: Typical of low-lying sites in the mountains and in some lower elevation valleys and depressions. Widespread throughout the state wherever freshwater meadows and seeps occur. Saturated soil or standing water through the growing season are key characteristics. Wet mountain meadows are generally characterized by herbaceous plants with shrubs or trees absent or sparse (<20 percent cover), or along the edges. Most species are perennial, and canopy cover is generally dense (60-100 percent).

Western Upland Grasslands: Dominated by grasses, which are typically not restricted to moisture surrounding landscape (not seeps, riparian, or wet meadows). Dominant vegetation generally includes native grasslands of Idaho fescue, Great Basin wild rye, blue wild rye, one-sided bluegrass. It also includes the non-native grasslands that are from cool temperate settings in Eurasia such as creeping bentgrass, velvetgrass, Kentucky bluegrass, and Harding grass and cheat-grass.

Conservation Strategy 1 (Land Acquisition/Easement/Lease): Protect land through acquisition and conservation easements, with emphasis on restoring and protecting degraded wet meadow habitat and conserving high-quality wet meadow

Objective(s):

- Restore and protect degraded wet meadow habitat, with focus on riparian areas that have the greatest ecological potential such as larger impaired systems and those that support SGCN
- Conserve high-quality wet meadow habitat

Targeted pressure(s): Livestock, farming, and ranching

Conservation action(s):

- Coordinate with Regional Water Quality Control Board(s)
- Identify existing conserved areas to form linkages

- Identify and prioritize areas of conservation emphasis (ACE)
- Direct and use conservation banking to address impacts to wet meadow habitat

Conservation Strategy 2 (Data Collection and Analysis): Gather and analyze data on wet meadows and wildlife: establish baseline inventory of wet meadows and research ecosystem services of wet meadows (e.g., carbon sequestration)

Objective(s):

- Establish baseline inventory of wet meadows, and research ecosystem services of wet meadows (e.g., carbon sequestration)

Targeted pressure(s): Dams and water management/use

Conservation Strategy 3 (Outreach and Education): Provide education and outreach to broad resource users on multiple-use policy and educate the public on the beneficial use of fire

Objective(s):

- Provide specific outreach to leaseholders and private landowners on grazing practices that benefit wildlife,
- Provide outreach to broad resource users on multiple-use policy, and
- Educate the public on the beneficial use of fire

Targeted pressure(s): Parasites/pathogens/diseases; fire and fire suppression

Conservation action(s):

- Coordinate with various Sierra Prescribed Fire Councils

Conservation Strategy 4 (Direct Management): Enhance habitat: improve water quality and temperature, coordinate water storage and timing of release to improve meadow hydrology, improve surface water recharge, reduce erosion and bank cutting, restore meadow hydrology, and improve resiliency of meadows to flood events

Objective(s):

- Improve water quality and temperature, coordinate water storage and timing of release to improve meadow hydrology, improve surface water recharge, reduce erosion and bank cutting, restore meadow hydrology, and reduce effects of extreme events (improve resiliency of meadows to flood events)

Targeted pressure(s): Dams and water management/use

Conservation action(s):

- Coordinate with state, federal, and local agencies and private landowners
- Consult hydrologist and soil scientists
- Develop methodology for meadow restoration/enhancement

- Conduct temperature modeling to determine optimal flows

Conservation Strategy 5 (Direct Management): Restore meadows impacted by roads and railroads: reduce sediment from existing and abandoned roads from entering meadows, restore hydrology altered by legacy roads and railroads, develop BMPs for road maintenance, and reduce the overall presence of roads and railroads in meadows (new and existing)

Objective(s):

- Reduce sediment from existing and abandoned roads from entering meadows
- Restore hydrology altered by legacy roads and railroads
- Develop BMPs for road maintenance
- When Caltrans is currently implementing best management practices (BMPs), look for opportunities for alignment of BMPs through the implementation of SWAP strategies and existing processes such as those in place at Caltrans
- Reduce the overall presence of roads and railroads in meadows (new and existing)

Targeted pressure(s): Roads and railroads

Conservation action(s):

- Coordinate with high meadow landowners
- Conduct road inventory and evaluation
- Conduct post-treatment monitoring

Conservation Strategy 6 (Direct Management): Manage invasive species

Objective(s):

- Control invasive and problematic native vegetation (introduced from roads, pack animals, livestock feed)
- Control invasive fish and wildlife (livestock, pack animals, non-native fish)
- Prevent wet meadow habitat degradation

Targeted pressure(s): Invasive plants/animals

Conservation action(s):

- Conduct invasive and problematic native plant removal projects
- Construct exclusion fencing
- Monitor post project habitat conditions
- Link to education and outreach
- Advocate BMPs for grazing practices
- Minimize road access
- Identify specific locations impacted by non-native species

Conservation Strategy 7 (Management Planning): Implement grazing practices that benefit meadow ecosystems (conduct managed grazing)

Objective(s):

- Reduce grazing impacts to wet meadow function and structure (including impacts to vegetation and stream bank erosion and sedimentation)
- Implement practices to reduce cattle use of meadows

Targeted pressure(s): Mining and quarrying; livestock, farming, and ranching

Conservation action(s):

- Coordinate with USFS, NRCS, RCDs, and private landowners
- Consult with UC Extension
- Link to education and outreach strategy
- Identify and work with existing stakeholder groups, watershed groups, and others involved in meadow conservation
- Review and update grazing management practices that benefit wildlife
- Promote meadow restoration in standard practices

Conservation Strategy 8 (Management Planning): Provide input on grazing management plans

Objective(s):

- Reduce adverse impacts from allotment grazing practices
- Improve enforcement of grazing lease conditions
- Permanently retire problematic grazing allotments

Targeted pressure(s): Livestock, farming, and ranching

Conservation action(s):

- Coordinate with federal agencies to better link grazing leases, BMPs, standard practices, and Lake and Streambed Alteration Agreements
- Conduct review of proposed allotment leases
- Coordinate with development of total maximum daily load (TMDL)
- Work with federal agencies to amend/alter lease criteria that favor conservation
- Coordinate with NRCS to implement Standard Practices and provide incentives
- Incentivize rotational grazing, seasonal resting
- Advocate for improved capacity within federal agencies in range specialists
- Develop/support education and outreach in cooperation with NRCS and UC Cooperative Extension to leaseholders and private landowners on management practices that benefit wildlife
- Review existing science and support ongoing research on grazing practices in high elevation meadows

- Work with Cattlemen's Association and California Rangeland Conservation Coalition to explore efficacy of developing grass banks

Target: Clear Lake Native Fish Assemblage

Species of Greatest Conservation Need (SGCN) associated with this target include, but are not limited to: Clear Lake hitch, Sacramento perch, Clear Lake tule perch, western brook lamprey, prickly sculpin, Sacramento blackfish, Sacramento pikeminnow, California roach, Sacramento sucker, three-spine stickleback, rainbow trout, western pond turtle, California red-legged frog, and foothill yellow-legged frog.

Conservation Strategy 1 (Land Acquisition/Easement/Lease): Purchase land and/or acquire easements

Objective(s):

- Acquire riparian water rights by purchasing lands along the critical streams
- Protect riparian areas by acquiring land adjacent to critical streams
- Acquire appropriative water rights in the watershed
- Reduce water diversions from the critical streams during late spring to summer

Targeted pressure(s): Strategy acts directly on target

Conservation Strategy 2 (Outreach and Education): Provide outreach and education for the conservation of natural resources

Objective(s):

- Educate the public on the need for water management BMPs, impacts associated with their activities, and impacts of invasive species introductions on native species
- Keep the public informed on development/status of water management BMPs

Targeted pressure(s): Dams and water management/use; invasive plants/animals; recreational activities; annual and perennial non-timber crops

Conservation Strategy 3 (Economic Incentives): Provide economic incentives for improved resource management

Objective(s):

- Reduce economic burdens on original owners in upgrading water systems to meet BMP standards while enhancing parcel values
- Provide incentives for water users to leave water in streams during critical seasons (late spring and summer)

Targeted pressure(s): Dams, fish passage barriers, and water management/use; annual and perennial non-timber crops

Conservation Strategy 4 (Law and Policy): Increase LED and HabCon Program staffing levels and implement effective law enforcement and compliance related to: illegal water diversions, illegal fishing, and invasive species introductions; compliance with FGC section 1600 agreements; and compliance with water rights

Objective(s):

- Ensure compliance with water rights and FGC section 1600 et seq. LSA agreements
- Reduce illegal diversions
- Increase LED and HabCon staffing levels

Targeted pressure(s): Recreational activities; invasive plants/animals; dams and water management/use; annual and perennial non-timber crops; mining and quarrying

Conservation action(s):

- Include BMPs as enforceable condition of Lake and Streambed Alteration Agreements
- Include BMPs as enforceable condition of water right permit/license
- Advocate for opportunities to improve prosecutions of environmental laws
- Identify partners to improve enforcement capabilities
- Evaluate and increase LED and HabCon staffing levels

Conservation Strategy 5 (Direct Management): Manage invasive species

Objective(s):

- Manage invasive species to improve conditions for native fish
- Prevent additional future invasive species from becoming established in Clear Lake

Targeted pressure(s): Invasive plants/animals

Conservation action(s):

- Update data on extent and distribution of native and non-native species in Clear Lake
- Examine alternative strategies for removal of non-native fish species and aquatic weeds
- Coordinate with Lake County and private landowners
- Conduct post treatment monitoring
- Initiate long-term monitoring and management plan
- Implement mechanical and chemical treatment of invasive weeds

Conservation Strategy 6 (Direct Management): Control damage to creeks from OHV use

Objective(s):

- Limit sediment entering creeks from OHV crossings

- Limit access to creeks by OHVs

Targeted pressure(s): Recreational activities

Conservation action(s):

- Identify and close unauthorized roads
- Identify locations where creek crossings could be constructed
- Coordinate with federal and state partners
- Link to education and outreach strategy
- Coordinate with LED

Conservation Strategy 7 (Direct Management): Develop BMPs for increased spring/summer flows for improved lake and fish health, improved fish passage, and water diversions

Objective(s):

- Increase spring/summer flows for improved lake and fish health, improve fish passage (e.g., remove barriers created for diversions)
- Develop BMPs for water diversions

Targeted pressure(s): Dams and water management/use; annual and perennial non-*timber crops*

Conservation action(s):

- Develop agreements between partners to work together on BMPs
- Look for existing management plans and evaluate their scope and success
- Link to education and outreach plan to keep the public informed
- Develop options for optimal timing of diversions
- Develop options for maintaining fish passage around diversion barriers
- Identify water conservation actions

Conservation Strategy 8 (Partner Engagement): Establish collaborative partnerships

Objective(s):

- Understand stakeholders' diverse needs and how to meet those needs while meeting BMP standards
- Develop trust among agencies and other stakeholders

Targeted pressure(s): Dams and water management/use; recreational activities; annual and perennial non-timber crops

Target: Carson River Native Fish Assemblage

Includes ten species of native fish; SGCN associated with this target include, but are not limited to: Paiute cutthroat trout, Lahontan cutthroat trout, mountain sucker, and mountain whitefish. Other species in native fish assemblage are Paiute sculpin, Lahontan creek tui chub, Lahontan redside, Lahontan speckled dace, Tahoe sucker, and Sierra Nevada yellow-legged frog.

Conservation Strategy 1 (Land Acquisition/Easement/Lease): Purchase land and/or acquire easements: acquire water rights by purchasing lands along the critical Carson River tributaries, acquire conservation easements to protect riparian areas in the Carson River Basin, acquire large mountain meadow ranches for conservation, and acquire water storage rights in the Carson River Basin

Objective(s):

- Acquire (CDFW and partners) water rights by purchasing lands along the critical Carson River tributaries
- Acquire conservation easements to protect riparian areas in the Carson River Basin
- Acquire large (> 500 acres) mountain meadow ranches for conservation (e.g., Charity Valley, Pleasant Valley, Wolf Creek Meadows)
- Acquire water storage rights in the Carson River Basin

Targeted pressure(s): Dams and water management/use; housing and urban areas

Conservation action(s):

- Survey the interests from willing sellers
- Partner with land trusts or NGOs for acquisition and management
- Partner with Sierra Nevada Conservancy and TNC

Conservation Strategy 2 (Data Collection and Analysis): Conduct research on SGCN; study the distribution and abundance of mountain whitefish and mountain sucker in the Carson River Basin, and the susceptibility of the Carson River Basin to invasive species

Objective(s):

- Natural Resource Managers understands mountain whitefish, mountain sucker, and other SGCN distribution and abundance in the Carson River basin
- Natural Resource Managers understands the susceptibility of the Carson River basin to invasive species

Targeted pressure(s): Introduced genetic material; invasive plants/animals

Conservation Strategy 3 (Outreach and Education): Conduct outreach; inform public of issues related to introduced genetic material, risks of invasive species, and importance of aquatic biodiversity management plants

Objective(s):

- Introduced genetic material is reduced

- The public is knowledgeable about the importance of aquatic biodiversity management plans and the risks of invasive species

Targeted pressure(s): Invasive plants/animals; introduced genetic material.

Conservation Strategy 4 (Law and Policy): Implement effective law enforcement and compliance related to: illegal water diversions, illegal fishing, and introduction of invasive species in the Carson River Basin; compliance with FGC section 1600 et seq. LSA agreements; and compliance with water rights

Objective(s):

- Reduce illegal diversions in the Carson River basin
- Reduce illegal fishing in the Carson River basin
- Reduce invasive species in the Carson River basin
- Increase LED and HabCon Program staffing levels to enforce fishing regulations and FGC section 1600 et seq. regulations
- Achieve compliance with FGC section 1600 et seq. LSA agreements
- Achieve compliance with water rights

Targeted pressure(s): Invasive plants/animals

Conservation Strategy 5 (Direct Management): Restore native species; manage invasive species and restore/maintain native fish populations in target streams

Objective(s):

- Remove non-native trout species from select streams (tributaries of the Carson and East Carson Rivers)
- Implement BMPs to prevent future contamination by invasive species
- Restore native fish to target streams

Targeted pressure(s): Invasive plants/animals; introduced genetic material

Conservation action(s):

- Update data on extent and distribution of native and non-native species in the Carson Basin
- Non-native trout removal strategy from selected waters developed
- Coordinate with USFS, BLM, County and private landowners
- Conduct post-treatment monitoring
- Develop reintroduction and genetic management plan for native species
- Initiate long-term monitoring and implement management plan
- Link to education and outreach strategy

Conservation Strategy 6 (Direct Management): Enhance habitat, improve water quality and temperature consistent with the Basin Plan, and coordinate water storage and timing of release between CDFW and water agencies to benefit fish habitat and water users

Objective(s):

- Water quality and temperature are improved and consistent with the Basin Plan
- Water storage and timing of release is coordinated by water agencies and CDFW to benefit fish habitat and water users

Targeted pressure(s): Dams and water management/use

Conservation action(s):

- Conduct temperature modeling to determine optimal flows
- Coordinate with USFS, BLM, Alpine County, and private landowners
- Coordinate water releases from Red, Heenan, Lost, and Kinney Lakes

Conservation Strategy 7 (Direct Management): Manage dams and other barriers to fish passage

Objective(s):

- Fish barriers are removed on private lands and water agencies agree to increase bypass flows based on gains made through water conservation

Targeted pressure(s): Dams and water management/use

Conservation action(s):

- Coordinate with USFS, BLM, Alpine County and private landowners
- Inventory barriers and assess flow and water condition
- Obtain funding for CDFW management plan
- Implement water conservation flow

Conservation Strategy 8 (Direct Management): Reintroduce Lahontan cutthroat trout and Paiute cutthroat trout to their historic ranges

Objective(s):

- Reintroduce native fisheries of Lahontan cutthroat trout and Paiute cutthroat trout to their historic ranges

Targeted pressure(s): Strategy acts directly on target

Conservation action(s):

- Conduct feasibility analysis to identify target streams
- Identify source population or propagate
- Evaluate eradication methods for non-native species
- Develop reintroduction plan including post treatment monitoring

- Coordinate with agencies and NGOs

Conservation Strategy 9 (Management Planning): Develop basin management plans

Objective(s):

- Develop and implement a basin-wide fisheries management plan

Targeted pressure(s): Invasive plants/animals; introduced genetic material

Conservation action(s):

- Coordinate with USFS, BLM, Alpine County, and CDFW
- Facilitate regional sub-committee to develop plan
- Conduct stakeholder meetings
- Implement trout management plan

Conservation Strategy 10 (Training and Technical Assistance): Provide training to staff and managers on non-native genetic issues, invasive species management and control techniques, and fish identification

Objective(s):

- Introduction of non-native genetic material is in the Carson River Basin
- Staff has knowledge and skills on techniques for modeling, invasive species management/control techniques, and fish identification

Targeted pressure(s): Invasive plants/animals; introduced genetic material

Target: Walker River Native Fish Assemblage

SGCN associated with this target include, but are not limited to: Lahontan cutthroat trout, mountain sucker, mountain whitefish, freshwater mussels, and Sierra Nevada yellow-legged frog.

Conservation Strategy 1 (Data Collection and Analysis): Collect data on the impacts of diversions, water management, water use, and the distribution of introduced genetic material on the native fish community

Objective(s):

- Understand the impacts of diversions, water management and water use to the native fish community
- Understand the distribution of introduced genetic material and impacts to the native fish community within the hydrologic unit

Targeted pressure(s): Introduced genetic material; invasive plants/animals; dams and water management/use

Conservation Strategy 2 (Outreach and Education): Provide outreach and education on native aquatic resource conservation efforts

Objective(s):

- Ensure that the public is aware, concerned, and participating in native aquatic resource conservation efforts within the hydrologic unit

Targeted pressure(s): Invasive plants/animals

Conservation Strategy 3 (Law and Policy): Implement effective enforcement of laws

Objective(s):

- Increase Law Enforcement Division capacity to allow greater enforcement of water laws

Targeted pressure(s): Dams and water management/use

Conservation action(s):

- Identify laws and regulations governing riparian areas and work with governing agencies to apply effectively
- Design and implement instream flow studies to collect empirical evidence to support/defend enforcement actions to protect aquatic public trust resources
- Increase the number of Water Branch and regional scientific staff working on water rights and instream flow studies
- Make recommendations to enhance enforcement of existing laws and regulations
- Provide law enforcement with maps of critical problem areas
- Provide funding for CDFW permitting, compliance, and enforcement of laws protecting streams and flows
- Develop a LED Academy curriculum emphasizing water law
- Conduct Office of Training and Development (OTD) training for non-enforcement water policies

Conservation Strategy 4 (Direct Management): Manage water for beneficial uses by native aquatic species

Objective(s):

- State and federal agencies manage water for beneficial uses by native species (e.g., provide adequate water for species survival); Engage with the Walker Lake Acquisition/Transfer Program under desert terminal lakes program

Targeted pressure(s): Dams and water management/use; recreational activities; invasive plants/animals

Conservation action(s):

- Coordinate with water agencies
- Identify/coordinate with key stakeholders
- Collaborate with state and federal agencies for management plan development and review
- Identify and quantify water needs for native SGCN, non-SGCN, and introduced trout species
- Evaluate existing occupied habitats

Conservation Strategy 5 (Direct Management): Translocate or reintroduce native fish species

Objective(s):

- Establish self-sustaining and genetically viable native fish populations in the basin

Targeted pressure(s): Dams and water management/use; recreational activities; invasive plants/animals

Conservation actions:

- Identify source populations
- Remove invasive or problematic species from historic native fish habitat
- Create georeferenced map/database for native fish habitats
- Complete basin-wide native fish surveys, and develop basin plan for native fish management
- Obtain funding for strategy implementation
- Coordinate management actions with natural resource agencies, NGOs and private landowners
- Collect/analyze genetic data to define priorities

Conservation Strategy 6 (Direct Management): Remove introduced brook trout in the context of recovery of listed Lahontan cutthroat trout

Objective(s):

- The extent and distribution of invasive species are known, and a plan is developed by federal agencies and landowners to remove or control invasive species within the hydrologic unit

Targeted pressure(s): Invasive plants/animals

Conservation action(s):

- Update data on extent and distribution of native and non-native species
- Develop strategy for removal
- Coordinate with USFS and private landowners

- Secure permits and conduct environmental review
- Conduct post-treatment monitoring
- Initiate long-term monitoring and management plan
- Monitor for re-establishment of invasive species
- Develop a management and control plan for invasive species

Conservation Strategy 7 (Direct Management): Implement direct management activities to restore aquatic habitats and ensure that SGCN are maintained or enhanced

Objective(s):

- Direct management activities to restore aquatic habitats are implemented to ensure SCGN are maintained or enhanced within hydrologic unit

Targeted pressure(s): Introduced genetic material

Conservation Strategy 8 (Management Planning): Ensure that planning and decision-making processes support the conservation of stream habitats and flows as a result of CDFW input

Objective(s):

- Ensure that planning and decision-making processes support the conservation of stream habitats and flows as a result of CDFW input

Targeted pressure(s): Dams and water management/use

Conservation Strategy 9 (Management Planning): Develop or update and implement grazing BMPs

Objective(s):

- Land managers within the hydrologic unit implement BMPs for grazing practices that reduce impacts to aquatic habitats

Targeted pressure(s): Livestock, farming, and ranching

Conservation action(s):

- Identify partners and stakeholders
- Identify and review existing grazing management policies
- Develop MOU/MOA between partners
- Schedule regular working group meetings
- Develop BMPs including enforcement policy
- Provide input to land management agencies on grazing policies
- Link to education and outreach strategy

Conservation Strategy 10 (Management Planning): Reduce impacts to native fish as a result of roads and railroads and invasive species through development and use of BMPs

Objective(s):

- Land managers implement BMPs to reduce impacts to native fish community from roads and railroads
- BMPs for road and rail maintenance activities are established and used by land managers to reduce impacts to native fish community from invasive species
- When Caltrans is currently implementing best management practices (BMPs), look for opportunities for alignment of BMPs through the implementation of SWAP strategies and existing processes such as those in place at Caltrans

Targeted pressure(s): Invasive plants/animals; roads and railroads

Conservation action(s):

- Collaborate with partner in development of BMPs
- Collaborate with state and federal agencies and landowners
- Identify existing BMPs, develop BMPs database
- Establish working group to define BMPs

Conservation Strategy 11 (Partner Engagement): Establish and develop co-management partnership, including with tribal governments, to affect change in dams and/or water management and use following interagency agreement

Objective(s):

- Establish a joint partnership to affect changes in dams and/or water management and use following interagency agreement

Targeted pressure(s): Dams and water management/use

Target: San Joaquin Native Fish Assemblage

SGCN associated with this target include, but are not limited to: hardhead, California roach, Red Hills roach, Sacramento sucker, Sacramento pikeminnow, Sacramento blackfish, Sacramento spittail, hitch, western pearlshell mussel, California floater mussel, Paiute cutthroat trout, Lahontan cutthroat trout, rainbow trout, California red-legged frog, foothill yellow-legged frog, Sierra Nevada yellow-legged frog, western pond turtle, and Giant garter snake.

Conservation Strategy 1 (Data Collection and Analysis): Gather, synthesize, and analyze data (new and existing); establish baseline inventory of SGCN and habitat, and pressure distributions

Objective(s):

- Establish baseline inventory of SGCN and habitat, and threat distributions

Targeted pressure(s): Household sewage and urban wastewater; invasive plants/animals

Conservation Strategy 2 (Outreach and Education): Provide outreach and education for the conservation of natural resources

Objective(s):

- Raise public awareness and support for native fish restoration projects
- Educate the public on the risks of invasive species
- Educate the public on the importance of aquatic biodiversity management plans

Targeted pressure(s): Recreational activities; invasive plants/animals

Conservation action(s):

- Coordinate with federal and county resource agencies, agricultural organizations, and NGOs
- Install and maintain signs along sensitive areas that receive high recreational use

Conservation Strategy 3 (Law and Policy): Advocate for effective enforcement and compliance of laws related to protection of significant riparian areas

Objective(s):

- Fewer significant riparian areas are impacted by waste and disturbance

Targeted pressure(s): Household sewage and urban wastewater

Conservation action(s):

- Identify laws and regulations governing riparian areas and work with governing agencies to apply effectively
- Make recommendations to enhance compliance and enforcement of existing laws and regulations
- Provide law enforcement with maps of critical problem areas
- Create an ACE database viewable by all CDFW staff
- Develop baseline inventory

Conservation Strategy 4 (Direct Management): Protect and restore floodplain function; implement and maintain priority floodplain restoration projects

Objective(s):

- Align policies, regulations, planning, and agency coordination to support multi-benefit floodplain management
- Implement and maintain priority floodplain restoration projects

Targeted pressure(s): Dams and water management/use

Conservation Strategy 5 (Direct Management): Restore natural flows

Objective(s):

- Identify streams and stream reaches in greatest need of flow remediation and create a plan for restoration
- Restored stream reaches will be monitored for recolonization and translocation will be implemented, as necessary, to reestablish populations

Targeted pressure(s): Dams and water management/use

Conservation action(s):

- Conduct flow compliance monitoring
- Conduct fish population monitoring

Conservation Strategy 6 (Direct Management): Improve fish passage: assess, prioritize, and remove/modify fish passage barriers

Objective(s):

- Assess, prioritize, and remove/modify fish passage barriers

Targeted pressure(s): Dams and water management/use

Conservation action(s):

- Develop barrier assessment protocols
- Develop barrier removal guidelines, BMPs, and plan to monitor barrier removal effectiveness
- Coordinate with state, federal agencies, local government, and private landowners

Conservation Strategy 7 (Direct Management): Control invasive species: assess, map, and develop control plans for invasive aquatic species

Objective(s):

- Comprehensively assess and map aquatic invasive species distributions and develop an integrated control plan for each

Targeted pressure(s): Invasive plants/animals

Conservation action(s):

- Develop Invasive Species Coordination Group to streamline and coordinate current agencies, organizations, and activities
- Implement priority species control plans
- Prioritize species to focus on
- Implement top-priority control plans
- Monitor invasive species and continue removal efforts as needed to control populations
- Provide outreach and education specific to spread of invasive species

Conservation Strategy 8 (Management Planning): Provide input on local planning; engage in local planning to encourage the use of bio(soft) engineering for flood control, retention of functional floodplains, and deterrence and capture of waste and pollution

Objective(s):

- Channel incision is reduced, and riparian vegetation is increased in floodplain
- Fewer significant riparian areas are impacted by waste and disturbance
- No more than two horizontal interspersion and vertical biotic structure levels are missing for each alliance
- SGCN diversity improves to historic/normal levels
- There is a reduction to area that has non-native invasive plant infestations and/or invasive animal species
- Ephemeral and permanent surface water flows are restored to mimic historic patterns of flooding and low flow patterns (+/- 25 percent); An adequate low flow is maintained to sustain dependent aquatic life

Targeted pressure(s): Housing and urban areas

Conservation action(s):

- Encourage use of biofilters for urban runoff
- Maintain treated effluent flows into riparian
- Engage in development and implementation of IRWMPs
- Direct increased resources/staffing towards engagement in local planning
- Encourage appropriate site-specific native riparian plants for adjacent landscaping
- Communicate BMPs to local planners

Target: Upper Kern River Native Fish Assemblage

SGCN associated with this target include, but are not limited to: California golden trout, hardhead, Kern River rainbow trout, Little Kern golden trout, and Sacramento Sucker.

Other SGCN include the Southern mountain yellow-legged frog and foothill yellow-legged frog.

Conservation Strategy 1 (Data Collection and Analysis): Conduct research on SGCN; update genetic status for golden trout; refine distribution for hardhead and Kern River rainbow trout

Objective(s):

- Natural Resource Management staff understands mountain whitefish, mountain sucker, and other SGCN distribution and abundance
- The susceptibility to invasive species is understood

Targeted pressure(s): Introduced genetic material; invasive plants/animals

Conservation Strategy 2 (Outreach and Education): Conduct outreach; inform public of issues related to introduced genetic material, risks of invasive species, and importance of aquatic and riparian habitat restoration

Objective(s):

- Introduced genetic material is reduced
- The public is knowledgeable about the importance of aquatic biodiversity management plans (ABMP) and risks of invasive species

Targeted pressure(s): Invasive plants/animals; introduced genetic material

Conservation Strategy 3 (Land Acquisition/Easement/Lease): Purchase land and/or acquire easements

Objective(s):

- Acquire (by CDFW and partners) water rights by purchasing lands, acquiring conservation easements to protect riparian areas

Targeted pressure(s): Livestock, farming, and ranching; housing and urban areas

Conservation action(s):

- Survey the interests from willing sellers
- Partner with land trusts or NGOs for acquisition and management
- Partner with Sierra Nevada Conservancy and TNC

Conservation Strategy 4 (Direct Management): Restore native species; manage invasive species, and remove non-native trout from target streams

Objective(s):

- Remove non-native trout species from select streams (tributaries of the Upper Kern River)

- Implement BMPs to prevent future contamination by invasive species
- By 2025, restore native fish to target streams

Targeted pressure(s): Invasive plants/animals; introduced genetic material

Conservation action(s):

- Update data on extent and distribution of native and non-native species in the Upper Kern River
- Utilize existing golden trout Conservation Assessment and Strategy and genetics management plans to develop non-native trout removal strategies for selected waters
- Coordinate with USFS, NPS, County and private landowners
- Implement chemical treatments and/or mechanical treatments
- Conduct pre- and post-treatment monitoring
- Implement reintroductions using genetic management plans for native species
- Initiate long-term monitoring and implement Conservation Assessment Strategy and management plans
- Link to education and outreach strategy

Conservation Strategy 5 (Direct Management): Restore and enhance meadow habitat; improve water quality and temperature consistent with the Basin Plan

Objective(s):

- Water quality and temperature are improved and consistent with the Basin Plan
- Water storage and timing of release is coordinated by water agencies and CDFW to benefit fish habitat and water users

Targeted pressure(s): Livestock, farming, and ranching; dams and water management/use

Conservation action(s):

- Conduct temperature modeling to help prioritize habitat restoration
- Coordinate with USFS and engage in Forest Plan revision process and grazing management allotment planning process
- Support habitat restoration projects with USFS, NGOs and volunteers; support seeking grants for restoration

Conservation Strategy 6 (Direct Management): Reintroduce golden trout to its historic *range*

Objective(s):

- Restore native fisheries of golden trout to its historic range

Targeted pressure(s): Strategy acts directly on target

Conservation action(s):

- Conduct feasibility analysis and prioritize target streams
- Coordinate with agencies and NGOs
- Conduct environmental review and obtain permits
- Evaluate eradication methods for non-native species and hybrid golden trout and implement treatments
- Utilize guidance in genetics management plans to develop reintroduction plans
- Develop monitoring plan to evaluate reintroductions

Conservation Strategy 7 (Management Planning): Develop new or revised management plans for native fish and implement existing Conservation Assessment and Strategy for golden trout

Objective(s):

- Develop and implement a basin-wide fisheries management plan

Targeted pressure(s): Invasive plants/animals; introduced genetic material

Conservation action(s):

- Coordinate with USFS, NPS, Tulare County, and NGOs
- Engage stakeholders in planning process
- Collect and compile status and distribution data
- Review/revise and implement existing golden trout Conservation Strategy
- Develop/revise Kern River rainbow trout Conservation Strategy and revise Management/Recovery Plan for Little Kern golden trout

Conservation Strategy 8 (Training and Technical Assistance): Provide training to staff and managers on non-native genetic issues, invasive species management, and control techniques

Objective(s):

- Introduction of non-native genetic material is reduced in the Upper Kern River Basin
- Staff has knowledge and skills on techniques for modeling, invasive species management/control techniques, and fish identification

Targeted pressure(s): Invasive plants/animals; introduced genetic material

5.5 South Coast Province

5.5.1 Geophysical and Ecological Description of the Province

California's South Coast Province encompasses more than eight million acres, extending along the coast from the Santa Barbara County in the north to the Mexico border in the south (Figure 5.5-1). Inland, the region is bounded by the Peninsular Mountain Ranges and the transition to the Mojave and Colorado Deserts on the east and by the Transverse Mountain Ranges on the north. It is an area of strikingly varied landscapes, ranging from wetlands and beaches to hillsides, rugged mountains, arid deserts, and densely populated metropolitan areas.

The region's coastal habitats include coastal strand, lagoons, and river-mouth estuaries that transition from riparian wetlands to fresh and saltwater marshes. California least tern, western snowy plover, light-footed Ridgway's rail, California brown pelican, and other waterfowl and shorebirds depend on these habitats. Moving inland, the predominant hillside and bluff communities are coastal sage scrub and chaparral. Southern California's coastal sage scrub is composed of a mix of drought-resistant shrubs and forbs found no place else in the country, commonly including California sagebrush, bush monkeyflower, buckwheat species, and black, purple, or white sage. Coastal sage scrub is a globally endangered community whose worldwide distribution is a narrow coastal strip from Ventura County, CA to El Rosario in northern Baja California, Mexico.

Chaparral plant communities (also drought tolerant) are characterized by a greater component of woody species, including chamise, manzanita, California lilac, and scrub oak. Inhabitants of sage scrub and chaparral communities include the Blainville's horned lizard, California gnatcatcher, San Diego cactus wren, Pacific pocket mouse, and Quino checkerspot butterfly. Isolated grasslands and vernal pool habitats are interspersed in the coastal landscape and support unique and endemic species such as Stephens' kangaroo rat and fairy shrimp species. Low- to mid-elevation uplands often feature oak woodlands, including Engelmann oak. Higher-elevation mountainous areas are dominated by coniferous forests, including Jeffrey pine, Ponderosa pine, big-cone Douglas fir, and white fir, and support sensitive species such as long-eared and long-legged myotis bats. Along the Peninsular Mountain Range, coniferous forests transition to the western edge of the Colorado and Mojave Desert ecosystems.

The province's largest river drainages include the Tijuana, San Diego, San Luis Rey, Santa Margarita, Santa Ana, San Gabriel, Los Angeles, Santa Clara, Santa Ynez, and Ventura rivers. Coniferous forests occur along high-elevation stream reaches, and some mountain drainages host mountain yellow-legged frog, California red-legged frog, Santa Ana sucker, unarmored three spine stickleback, and Santa Ana speckled dace. Lower-elevation river reaches support riparian vegetation species, including cottonwood, willow, sycamore, and coast live oak, which provide habitat for such riparian bird species as the least Bell's vireo, southwestern willow flycatcher, Swainson's thrush, yellow-billed cuckoo, and yellow warbler, as well as the arroyo chub and arroyo toad. In urbanized coastal areas, many sections of the province's river corridors are channelized with concrete and support mostly non-native species.

Tricolored Blackbird Conservation

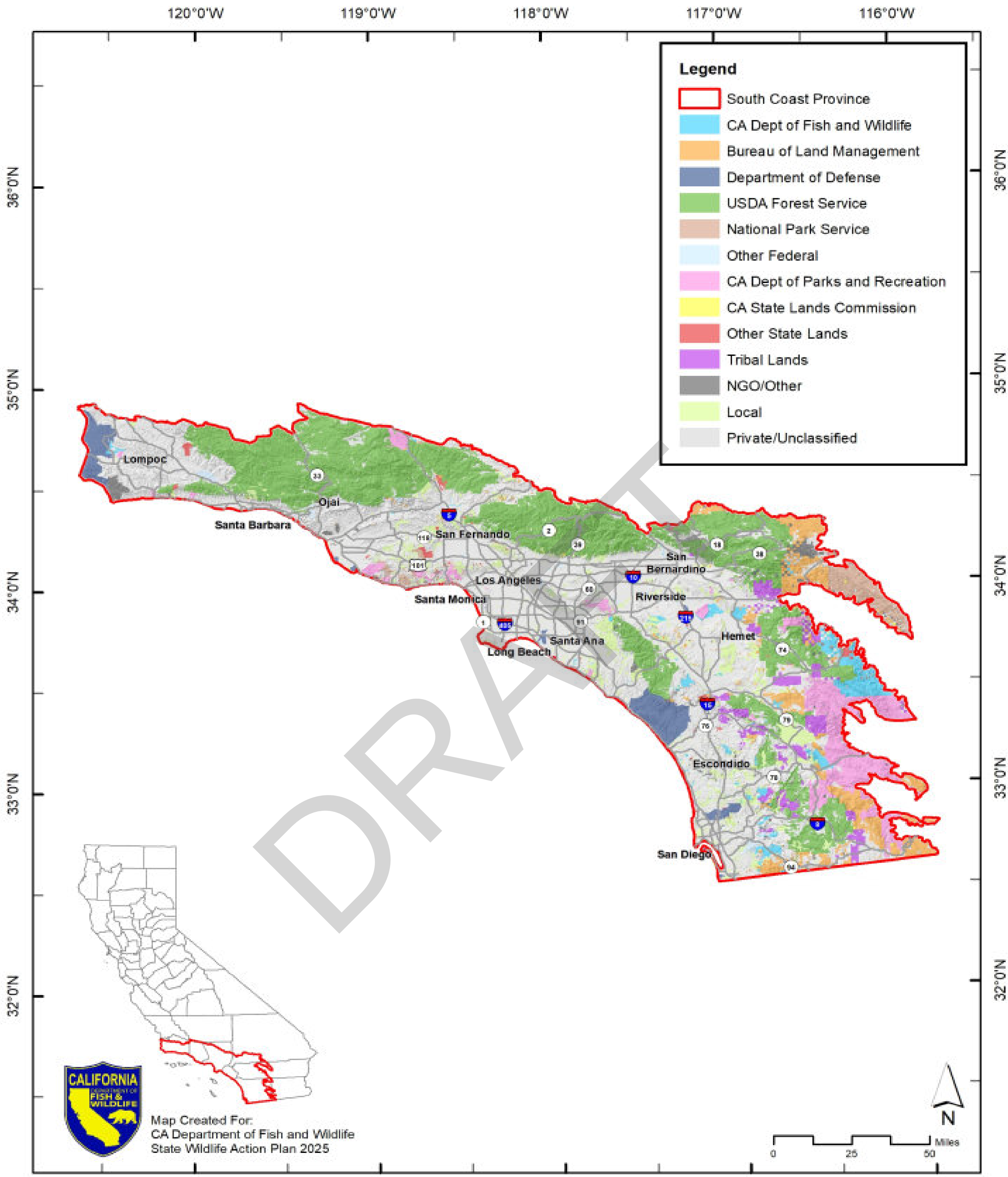
In the South Coast Province (SCP) the tricolored blackbird [TRBL (*Agelaius tricolor*)] was noted by J. G. Cooper (in Baird et al. 1860) as "the most abundant species near San Diego" (Baird et al. 1860). Since this time, in addition to populations severely declining throughout their distribution from Washington State to Baja California, Mexico, southern populations have shifted northward, contracting the species range (CDFW 2018). The remaining abundance of TRBL is largely concentrated in California's Central Valley (Cook 2010; CDFW 2018; Erickson et al. 2018; Erickson et al. 2021; Colibri Ecological Consulting LLC. 2022).

As a result of these declines and range contraction, CDFW listed TRBL as threatened under the California Endangered Species Act in 2018. The South Coast Province faces the challenge that additional future development could potentially threaten the largest remaining colonies (Cook 2010; CDFW 2018).

To address these concerns in the South Coast Province, CDFW has contracted the San Diego Natural History Museum to survey TRBL identified sampling gaps in southern California, particularly on non-conserved land, as well as colony-focused foraging studies at two CDFW San Diego properties: Rancho Jamul Ecological Reserve and San Jacinto Wildlife Area. This valuable research has implications for local management efforts that can additionally build a framework for critical research on prey availability and habitat selection at regional and range-wide scales.

Significantly more investment into TRBL in the southern California area is needed to avoid complete extirpation from the region. This SGCN not only inhabits the current Freshwater Marsh conservation target for the South Coast Province but also has habitat management requirements specific to this Province. Focusing conservation efforts on this species and its habitat will provide additional support for other SGCN, including California red-legged frogs (*Rana draytonii*), southern western pond turtles (*Actinemys marmorata*), and western red bats (*Lasiurus frantzii*).

TRBL as a model species demonstrate the importance of addressing specific issues at the regional scale in the SWAP to contribute to species conservation across their range. With severe declines in the southern portion of their range, it is also vital to have bi-national coordination to protect tricolored blackbirds to promote Full Annual Cycle (FAC) conservation (See Chapter 7).



Data Source: California Protected Areas Database; US Geological Survey (hillshade); CDFW Lands

Figure 5.5 - 1 Land Ownership of the South Coast Province

The province is recognized as one of the world's hotspots of biological diversity and is home to more than 470 vertebrate animal species, approximately 38 percent of all the vertebrate species found in California. It is also distinguished by the tremendous population growth and urbanization that have transformed the landscape since the 1940s. This intersection of biological resources and urbanization has made the South Coast Province the most-threatened biologically diverse area in the continental U.S. (USGS 2003) . More than 150 species of vertebrate animals and 200 species of plants are either listed as protected or considered sensitive by wildlife agencies and conservation groups (Hunter 1999).

Despite the province's rapid growth and subsequent loss of habitat, Southern California retains some large and valuable natural lands, including the national forests, which form an interconnected system of wildlands flanking the coast's metropolitan areas. Wide-ranging species, including mountain lion, coyote, and golden eagle, can still be found in these large habitats.

On the outskirts of Los Angeles, hiking trails traversing canyons in the Santa Monica Mountains pass through the range of the mountain lion and golden eagle. Only from the mountaintops, where the view reveals the Los Angeles metropolis spreading to the ocean, is it clear that these natural lands exist within one of the world's most urbanized regions. The San Diego metropolitan area is the second most populous area in the state but is also surrounded by natural areas with extraordinary biodiversity. This juxtaposition of urban landscapes with remaining significant natural areas is one of the defining characteristics of the South Coast. The ongoing pressures of growth and urbanization require substantial and timely efforts to preserve the province's remaining wildlife diversity.

South Coast Region Connectivity

The South Coast Region (SCR) has several connectivity datasets to help guide data-driven decision making for direct conservation efforts, such as acquisitions, to areas of highest need. Through a State Wildlife Grant, San Diego State University (SDSU) completed a Climate Resilient Connectivity project for the South Coast Ecoregion of California in 2019. They used a unique approach to create GIS layers based on combined species habitat niche modeling, landscape modeling, species population dynamics, with different climate scenarios. These GIS layers are then used in combination with other layers such as Areas of Conservation Emphasis (ACE) layers for informed acquisitions. The report is available on the SDSU website. Understanding how barriers affect wildlife is important to connectivity, especially in the SCR where over 17 million people reside. From 2020 to 2022, SCR CDFW staff determined critical wildlife barriers preventing wildlife movement from roadkill observations, collared animal movement, road crossing studies, and professional expertise. This data was used in a larger Statewide effort that outlined wildlife crossing needs and priorities. The report is available in the Restoring California's Wildlife Connectivity 2022. For example, a wildlife bridge crossing was installed on Highway 101 for mountain lion genetic connectivity which has been threatened by habitat fragmentation. For more information on statewide connectivity, see Appendix I.

Throughout the region, the Natural Community Conservation Planning programs have identified important areas for conservation that were incorporated into our statewide ACE connectivity layer. The report, including a list of regional datasets included in ACE, that are posted on the CDFW ACE website. Cross-border alliances have also been formed with Universidad Autonoma de Baja California, Terra Peninsular, and Centro de Investigación Científica y de Educación Superior in recognition to name a few of our shared vision for ecological connectivity across the border into Baja California, Mexico. Continued cross border partnerships is critical in the south coast ecoregion for protecting wildlife across borders. For more information on regional coordination, see Chapter 7.

5.5.2 Conservation Units and Targets

The conservation units associated with the South Coast Province are the Southern California Coast Ecoregion, the Southern California Mountains and Valleys Ecoregion (Figure 5.5-2), and the Southern California Coastal hydrologic unit (Figure 5.5-3), described below.

Ecoregion Summaries

Southern California Coast: This unit contains mountains, hills, valleys, and plains of the Transverse Ranges and of the Peninsular Ranges that are close enough to the Pacific Ocean for the climate to be modified greatly by marine influence. Elevation range: 0 to 3,000.

Southern California Mountains and Valleys: This unit includes mountains, hills, and valleys of the Transverse Ranges and the Peninsular Ranges that are near the Pacific Ocean but not bordering it. Much of the section is close enough to the Pacific Ocean for the climate to be modified moderately marine influence. Elevation range: 300 to 11,500.

Hydrologic Unit Summaries

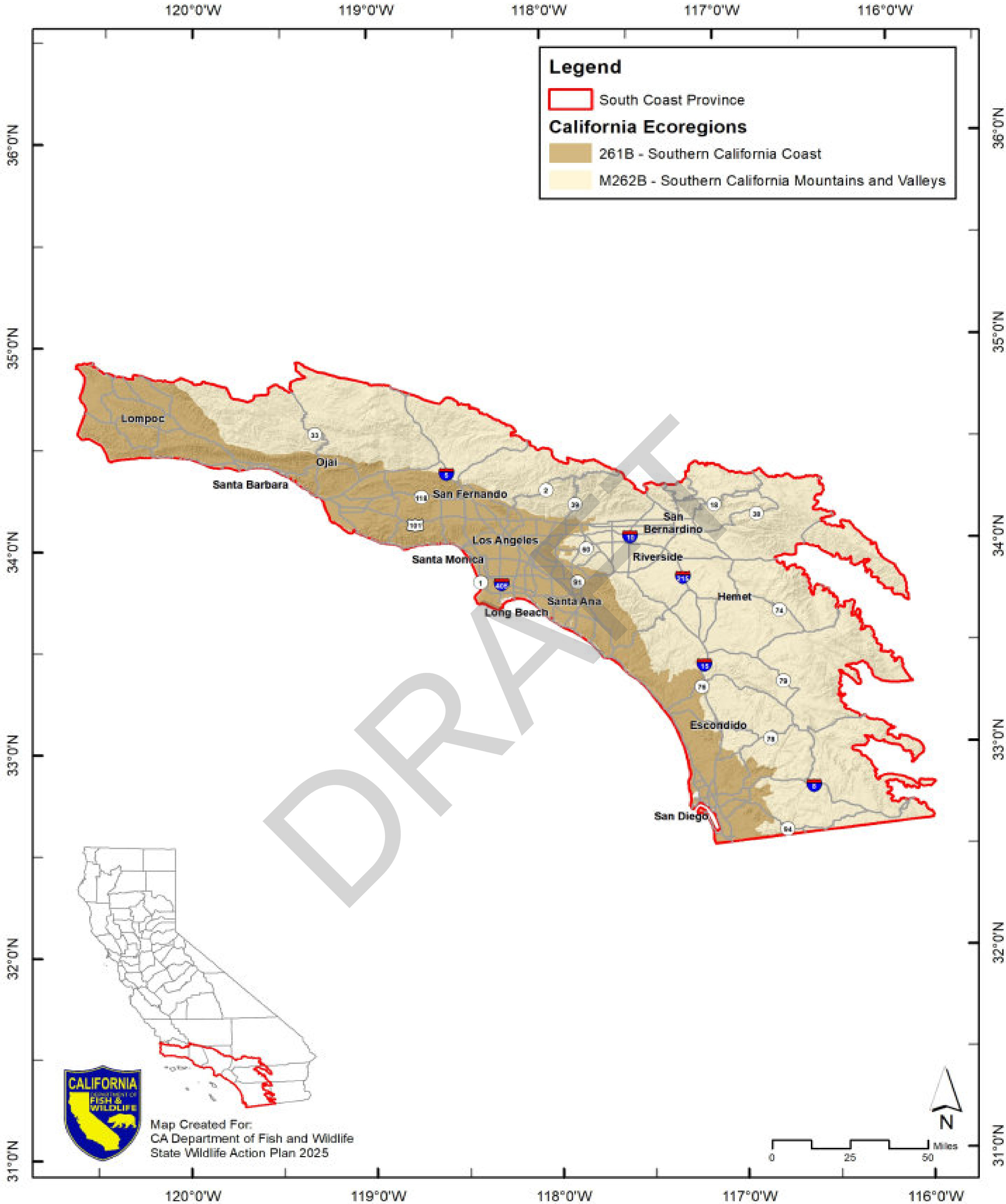
Southern California Coastal HUC 1807: Includes the drainage that discharges into the Pacific Ocean from the Rincon Creek Basin boundary south to the California-Baja California, Mexico border. Covers an area of 11,100 square miles. Elevation range: 0 to 9,700.

Conservation Targets

Conservation targets were selected in this province as priorities for conservation planning within the conservation units; targets are listed in a searchable, sortable table (Table 5.0). The conservation targets are summarized in Section 5.5.6 along with the strategies for each. The conservation targets include:

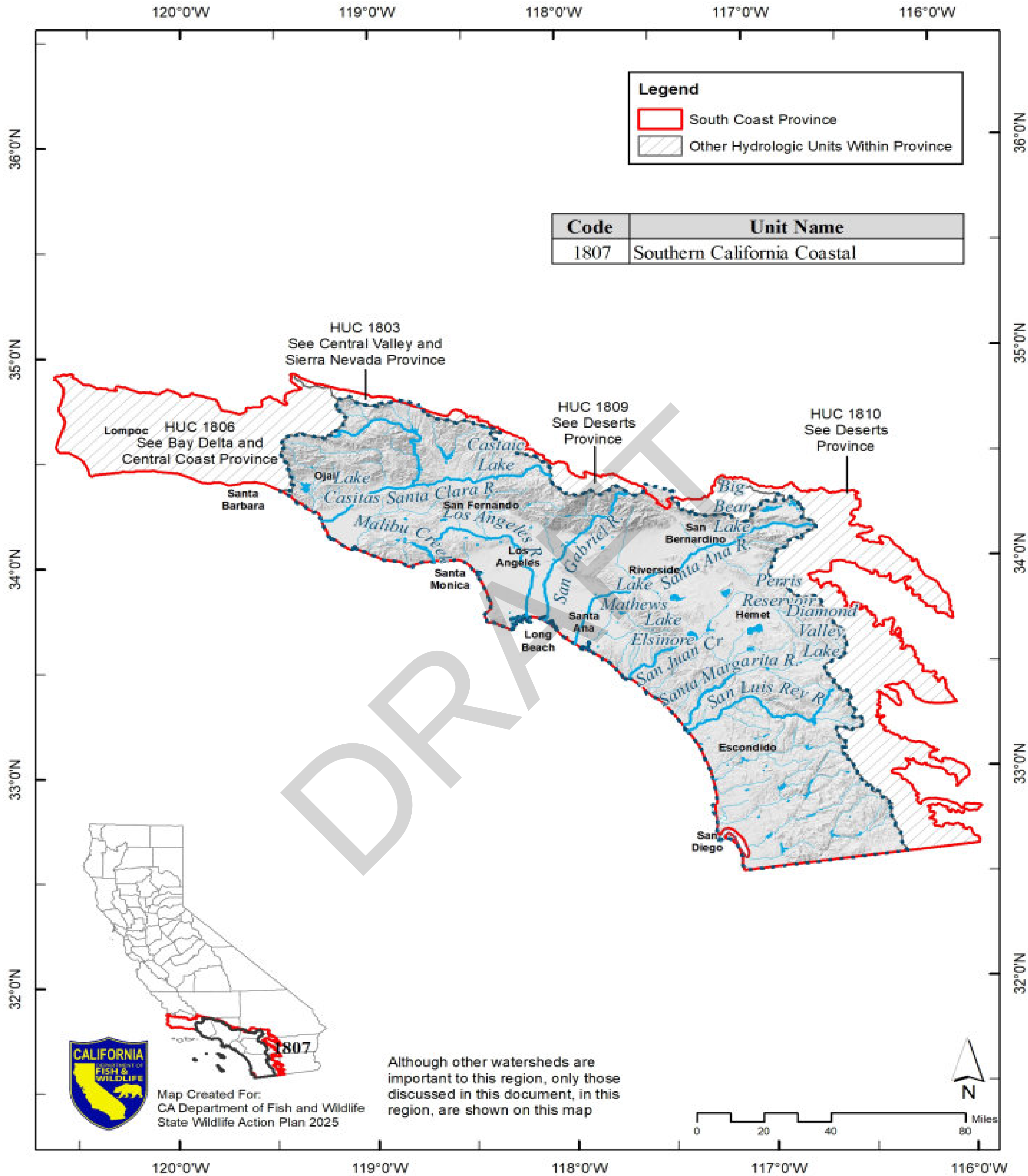
- American Southwest Riparian Forest and Woodland
- California Grassland and Flowerfields
- Coastal Dune and Bluff Scrub
- Coastal Lagoon
- Freshwater Marsh
- Western North America Vernal Pool
- Native Fish Assemblage
- Native Aquatic Herp Assemblage

Figure 5.5-4 shows the distribution of the plant communities (CWHR common names) within the province. Some of the plant communities identified as conservation targets do not appear on the figure because they exist in areas smaller than the mapping unit. Information about the methods used to prioritize conservation targets is presented in Chapter 1.5 and Appendix D.



Data Source: USDA Forest Service (ecoregions); US Geological Survey (hillshade)

Figure 5.5- 2 Ecoregions of the South Coast Province



Data Source: National Hydrologic Dataset (NHD); US Geological Survey (hillshade)

Figure 5.5 - 3 Hydrologic Units of the South Coast Province

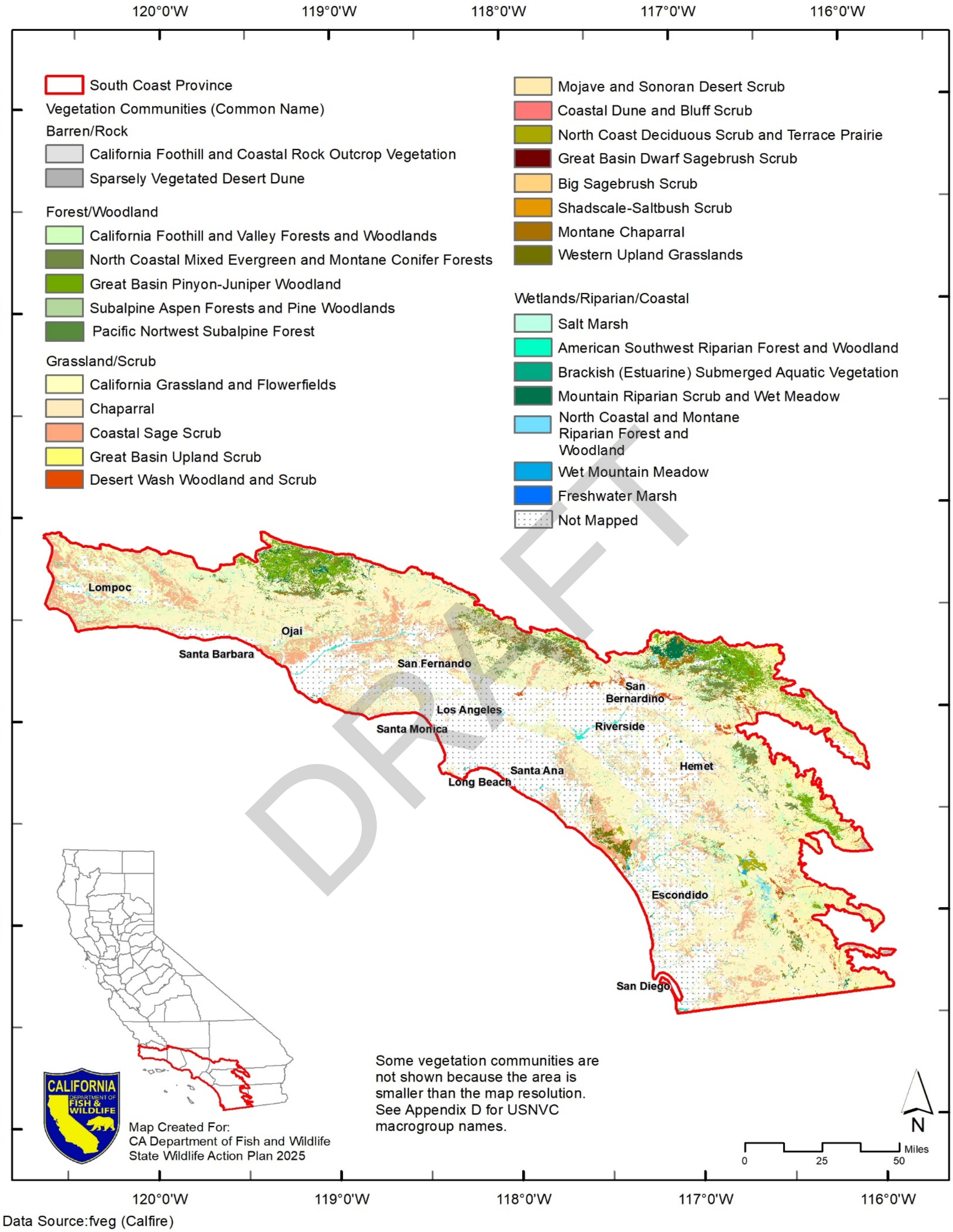


Figure 5.5 - 4 Plant Communities of the South Coast Province

5.5.3 Key Ecological Attributes

Key ecological attributes (KEAs) were identified for each conservation target (Table 5.0). These attributes are considered the most important for the viability of the targets and their associated species. The most commonly identified attributes for the South Coast Province are:

- Area and extent of community
- Connectivity among communities and ecosystems
- Community structure and composition
- Surface water flow regime

5.5.4 Species of Greatest Conservation Need in the South Coast Province

The SWAP identified the Species of Greatest Conservation Need (SGCN) for the entire state and identified ecoregion(s) and province(s) associated with each SGCN; data is summarized in Appendix C. The conservation strategies are aimed at benefiting the SGCN via the conservation targets.

For those SGCN that do not occur within the conservation targets identified for the province, conservation actions that target SWG funding should align with existing recovery plan documents where applicable, or demonstrate they address a critical conservation need for the species.

5.5.5 Pressures on Conservation Targets

Using the Open Standards of Conservation, a stress is an impaired aspect of a conservation target, equivalent to a degraded KEA (Conservation Measures Partnership 2020). Pressures are primarily human activities, or natural phenomena influenced by humans, that amplify environmental stress and further degrade conservation target(s). The pressures identified in the South Coast Province are the most significant pressures to the conservation targets but do not constitute a complete list of pressures in the province. Some principal pressures in the province are discussed in more detail below.

Housing and Urban Areas

Intensive population and development pressures in the South Coast have resulted in the greatest number of threatened and endangered species in California. By far, the most significant pressure on the South Coast's wildlife is urban, suburban, and rural development that results in habitat loss and fragmentation. With approximately 24 million residents, the area is the state's most populous region. The two largest cities on the west coast, Los Angeles and San Diego, are located in southern California (California Coastal Conservancy 2010). Despite comprising only eight percent of the land area of California, the South Coast contains 56 percent of the total population (Keeley 2010).

Following World War II, Southern California experienced an economic and population boom spurred by military and industrial growth. The region's development patterns followed agricultural land uses and the availability of easily developed land. Across inland valleys that had supported citrus orchards and grazing, small agricultural towns grew to meet the needs of growing industry. Along the coast, development spread across the relatively flat coastal plains and mesas. Between 2010 and 2020, Los Angeles County grew from 9.8 million residents to 10 million, San Diego County from 3.1 to 3.3 million, and Orange County from 3 to 3.2 million, however in the past few years all of these metropolitan areas have had modest decreases in population size (U.S. Census Bureau 2023).

Large portions of the province's natural areas have been converted to other uses; currently, nearly 40 percent the South Coast's land area is in urban and suburban use (CAL FIRE: FRAP 2018). Beyond the immediate footprint of development, urban, suburban, and rural growth patterns have fractured the landscape. Land-use planning and zoning laws have allowed sprawling development, including residential projects that are located far from existing urban centers, requiring new roads and infrastructure, along with communities designed with large lot sizes and little or no preserved open space. Presently, the region's remaining rural areas and natural lands are highly threatened by zoning for 4- to 8-acre lots for rural ranchette-style development.

As in other provinces, these development patterns not only reduce the amount of habitat available but also degrade the quality of adjacent habitat. With the expansion of the urban-wildland interface, remaining natural lands become more vulnerable to the incursion of invasive plants and animals, air and water pollution, and altered fire regimes. Developed areas, roads, and utility corridors fragment landscapes and sever connections between habitat areas.

Invasive Plants/Animals

As in other provinces across the state, invasive species problems on the South Coast are tied to regional land use and management issues. Many of the conservation actions described below address prevention, early detection, and rapid response to new invasive plants to prevent them from becoming widespread. Distribution maps and summary reports for invasive plants, as well as regional strategic plans for prioritized invasive plant species can be found on CalWeedMapper. Some of the invasive species affecting the province are discussed below. Invasive species are discussed in more detail in Appendix E.

In terrestrial ecosystems, many highly aggressive non-native plant species invade grasslands and scrub, including yellow starthistle, artichoke thistle, medusahead, Pampas grass, fennel, pepper weed, black mustard, vinca, fountain grass, ivy, iceplant, and castor bean. These species lower habitat quality for sensitive wildlife species such as the Quino checkerspot butterfly and the California gnatcatcher. Some of these species dry out earlier in the summer than native species and contribute to increased wildfire frequencies. Access roads and rights-of-way for infrastructure and powerline maintenance, as well as recreational use of natural areas, can facilitate the spread of these species. In addition to degrading habitat quality, invasive species change the community structure and composition within the target habitats, making habitats more vulnerable to altered fire regimes.

Among terrestrial animals, Argentine ants pose a significant regional threat. Favoring irrigated areas and edge habitats, such as irrigated golf courses and residential neighborhoods, Argentine ants tend to outcompete and displace native ants in the region's fragmented landscapes, disrupting larger community food-web relationships. For example, the coast horned lizard (a California Species of Special Concern), whose major prey is native harvester ants, cannot sustain itself on a diet of Argentine ants and so can be driven locally extinct in fragmented habitat patches.

Two pest species of boring beetles adversely affect trees and woodland habitats in portions of southern California. The goldspotted oak borer feeds beneath the bark of oak trees and damages the tissues of the main stem and larger branches, eventually causing tree damage and mortality. The invasive shot hole borer is a relatively new pest in southern California; it infects a variety of tree species with Fusarium fungus, sometimes resulting in tree damage or mortality.

Nest parasitism by brown-headed cowbirds also threatens many of the region's sensitive bird species, including least Bell's vireo, southwestern willow flycatcher, and California gnatcatcher. Although a native species, cowbirds thrive in many human-altered habitats, including suburban areas and agricultural and grazing lands, where they are attracted to livestock droppings and feed. With the expansion of these land uses over the last century, cowbirds have thrived, greatly expanding both their range and population across California.

Other problems are caused by introduced red fox, feral animals, and pets, which prey upon native wildlife, particularly ground-nesting birds. European starling, introduced from Europe and now widespread in the region and in most human-modified habitats across much the state, aggressively competes with native woodpeckers, bluebirds, and other native songbirds for cavity nest sites.

In aquatic systems, the most problematic invasive plant species is Arundo, or giant reed. Arundo is widespread along major coastal river basins, particularly the Ventura, Santa Clara, Santa Ana, Santa Margarita, San Luis Rey, and San Diego rivers. Tamarisk is less widespread but also invades regional riparian habitats. Tamarisk is distributed in coastal and desert drainages (Stephenson 1999) . Both species choke waterways, increase flash flood risks, crowd out native plants, and provide inferior habitat for riparian species. Tamarisk also consumes prodigious amounts of water, reducing available surface water, and Arundo provides limited shade, resulting in higher water temperatures and lower dissolved oxygen levels.

Invasive species pose a serious threat to aquatic habitat functions and ecosystem stability. Among non-native wildlife species, bullfrogs, African clawed frogs, crayfish, mosquito fish (which are sometimes introduced for mosquito control), and introduced sport and bait fish (including green sunfish, largemouth bass, bluegill, common carp, and fathead minnow) all pose predatory or competitive threats to native fish and amphibians, particularly in stream systems. Many of these species are well adapted to ponded areas above dams, and dam releases can introduce them to downstream habitats.

Most voracious and widespread are bullfrogs, which are documented predators of California red-legged frogs, California tiger salamanders, arroyo toads, western pond turtles, and two-striped garter snakes (Stephenson 1999). Bullfrogs are an example of an invasive species spreading disease to native species. Bullfrogs act as a host species of the fungal pathogen chytrid (Batrachochytrium dendrobatidis), which causes chytridiomycosis, a deadly disease that impacts sensitive SGCNs like the California red-legged frog, southern mountain yellow-legged frog, and western spadefoot.

A broad diet and an extended breeding season give bullfrogs a competitive advantage over native amphibians. Additionally, human-modified habitats favor bullfrogs. They can tolerate elevated water temperatures and, unlike native amphibians, make use of standing pools resulting from urban runoff to complete their two-year life cycle.

Additional invasive species include quagga and zebra mussels, which impact water infrastructure by attaching in large numbers to any hard substrate, greatly increase maintenance costs, and reduce the base of the aquatic food chain through filter feeding. New Zealand mudsnails are also present in several streams and reduce the abundance of aquatic macroinvertebrates.

Recreational Activities

With nearly 20 million people living within driving distance of the region's national forests and other public lands, outdoor recreational access and its effects are a major concern. Recreational off-highway vehicle (OHV) use and mountain biking, particularly illegal use within protected conservation areas, can have adverse effects on natural communities and sensitive species. On public lands, OHV trails can open relatively undisturbed areas to increased use. The vehicles and bikes can disturb or run over wildlife, crush and uproot plants, spread seeds of invasive plants, can spread other pathogens, disturb soils, contributing to erosion and sedimentation of aquatic habitats. OHV use also increases the risk of human-caused fires.

Concentrated recreational use of streams and riparian areas is of particular concern in some locations. Hikers, picnickers, and equestrians in large numbers can damage these systems by reducing vegetative cover and disturbing sensitive species. Some recreational users build rock dams on streams to create ponds for swimming. The San Gabriel River, for example, has been altered by extensive ponded areas, as well as other effects of heavy recreational use, such as the deposition of trash and human waste (CDFG 2005). Particularly vulnerable riparian species include the two-striped garter snake, southern mountain yellow-legged frog, arroyo toad, Santa Ana sucker, Santa Ana speckled dace, and arroyo chub (Stephenson 1999).

Intensive recreational activities not only reduce the amount of habitat available but can also degrade the quality of the habitat in some cases. Habitats become more vulnerable to the incursion of invasive plants and animals, air and water pollution, and altered fire regimes. Roads and trails fragment landscapes and sever connections between habitat areas. Roads and trails also serve as vectors for invasive plant introductions and subsequent spread.

Other types of recreation that are not concentrated or intensive have been documented to have detrimental effects on wildlife such as human presence causing golden eagle nest abandonment by rock climbers.

Although recreation activities adversely affect biological resources in many cases, the specific effects of recreational uses on wildlife depend on several factors, including the type, magnitude, frequency, and predictability of recreation activity; location and timing of activity (e.g., seasonal and time of day); habitat types exposed to the activities; and the sensitivity of a species based on its life history characteristics (Knight and Cole 1995).

Fire and Fire Suppression

Wildfire is a natural ecosystem process and an ecologically important disturbance in much of the South Coast Province. Prior to European colonization, fire events in this province were caused by lightning strikes augmented by the Santa Ana winds and Native American cultural burning practices which have greatly influenced the development of plant communities and fire regimes within the different subregions of the province (Keeley and Fotheringham 2001). Cultural burning practices were used extensively to promote forage crops and likely converted large swaths of chaparral to grasslands and forbs for human use. While today's frequency of fire and annual acreage burned in some vegetation communities remains lower than pre-colonization levels, the size and severity of wildfires has increased over the past three decades. Accurate records of California's wildfire history began in 1932. Since that time, 18 of the 20 largest wildfires occurred in the last 20 years, and five of those occurred within the South Coast Province (CAL FIRE 2024). The most recent megafire to occur in the province was the Thomas Fire (2017) with 281,893 acres burned. In 2025 the Palisades Fire and Eaton Fires in Los Angeles County burned 23,707 acres and 14,021 acres respectively, destroying more than 20,000 homes and causing over $95–$164 billion in economic loss.

It is difficult to find accurate and unbiased historical accounts of fire in the South Coast (Van Wagtendonk et al. 2018). What is known is that with the first Spanish settlement in California at San Diego de Alcala in 1769, the influx of European colonization dramatically altered the existing landscape through introduction of non-native vegetation (Gilpin 1990). Aided by the highly modified landscape created by Native American cultural burning for at least 5,000 years prior to European colonization (Davis 1992), huge swaths of chaparral habitat were converted to grassland by fire to facilitate grazing for imported cattle and sheep.

Specific plant communities and habitats in the South Coast province have evolved with a variety of geographically and consistent human-influenced fire regimes that have shaped the landscape and influenced the evolution of unique plant alliances. Higher elevation forests and native woody vegetation have evolved to be resilient to long fire-free intervals and are sensitive to shorter fire intervals of once a decade (Zedler et al. 1983; Keeley 1986). Whereas the lower elevation chaparral and grasslands evolved with frequent fire. Fire regimes under fire suppression efforts of the last century have seen fires extinguished as soon as possible, disrupting the historical fire regime in the lower elevations of frequent, small, and low intensity fires, and an increase in frequency and severity of fires when they occur in the higher elevations due to build up of surface fuels. Increased fire frequency parallels human population growth in the densely populated province as most fires are human caused (Keeley and Fotheringham 2003). Efforts to reestablish more historical fire regimes are challenging due to the air quality and safety concerns of applying prescribed fire to habitats in proximity to dense population centers, and due to the pace at which urban areas increase in size and density and continue to expand into the wildlife-urban interface.

Annual and Perennial Non-Timber Crops

Despite the large urban population, the South Coast is still a base for significant agricultural production. Los Angeles County was once the most important agricultural county in the United States, measured by the value of its agricultural production. The South Coast's moderate climate and usually frost-free growing seasons make it suitable for high-value crops. Nursery products, foliage and flowers, avocados, citrus, strawberries, and wine grapes are the main crops in the region (Johnston 2003).

In agricultural river valleys, substantial habitat alteration results from river diversions and water use. Many small-scale irrigation diversions deplete the flows of regional river systems, sometimes resulting in rivers completely drying up. Stream habitats are also adversely affected by sedimentation. Agricultural consequences for the region's wildlife and ecosystems include runoff of agricultural chemicals and sediment, consumption of oversubscribed water resources, and conversion and fragmentation of habitat.

Climate Change

The climatic changes presented below will likely affect all conservation targets identified in this province. Climate change has only been included as a pressure for a subset of targets that are considered more vulnerable to climate impacts, and/or in instances where it was determined that interactions between climate change and other pressures could be addressed in a meaningful way through a conservation strategy.

The climate projections that follow are presented as averages across the entire province, except where otherwise indicated. While these projections provide more insight into the expected magnitude and direction of change in important climate variables compared to the statewide estimates in Chapter 2, climate change will not in fact unfold uniformly across the province. For additional information on regional variability in climatic change and associated vulnerabilities within the South Coast region, refer to the following resources (not an exhaustive list):

- San Diego Summary Report: California's Fourth Climate Change Assessment (Kalansky et al. 2018)
- Los Angeles Summary Report: California's Fourth Climate Change Assessment (Hall et al. 2018)
- High-resolution wildfire simulations reveal complexity of climate change impacts on projected burn probability for Southern California (Dye et al. 2023)

Temperature and Precipitation

Climatic changes in the South Coast Province are expected to include increased mean maximum temperatures of approximately 5.5°F by mid-century (2035–2064, centered on the year 2050) and 8.6°F by end-of-century (2070–2099, centered on the year 2085), compared to a historical baseline period (1961–1990); minimum temperatures are projected to increase across the province on average by 4.9°F by 2050 and 8.2°F by end-of-century (Pierce et al. 2018) . Projections were generated based on a high-end greenhouse gas emissions scenario (RCP 8.5).

Within the South Coast Province, changes in annual precipitation will vary geographically, but annual precipitation rates are projected to decrease slightly throughout the century, compared to a historical baseline (Pierce et al. 2018).

Wildfire Risk

Wildfire risk is determined using several factors. Acres burned and re-burned, fire regime, and probability of ignition, are some of those factors. Over the last 20 years approximately 26%, or 2,861,000 of 10,400,00 acres have burned and reburned in the South Coast Province (2004–2023, CALFIRE FRAP fire perimeters). These fires have occurred throughout both ecoregions and in all the counties within the province; however, the largest fires have been concentrated in Santa Barbara, Ventura, Los Angeles, and San Diego counties. In the last 21 years (including the 2024 fire season to-date), six fires within this province have exceeded 100,000 acres.

The South Coast province is already frequently at risk for wildfire, and as such the degree to which climate change will affect existing wildfire risk is variable (Westerling and Bryant 2006). Wildfire frequency and severity will depend on ignition sources both human and lightning caused, longer-term shifts in vegetation (e.g., from conifer forest to chaparral), and changes in Santa Ana wind behavior (Miller and Schlegel 2006; Westerling et al. 2011). Based on a climate adaptation planning analysis conducted in 2012, increased temperature and decreased moisture, along with longer drought periods, are expected to slightly increase wildfire vulnerability in some coastal mountain areas, such as near Ojai, Castaic, Fallbrook, and Mission Viejo (CalEMA and CNRA 2012).

This projection has been updated using more recent 2018 Cal-Adapt wildfire data from California's Fourth Climate Assessment. Annual area burned across the footprint of this province is expected to increase by approximately 20% by mid-century and up to 13% by the end of the century under a high-end emissions scenario, compared to a 1961–1990 baseline (Westerling 2018). The Fourth Climate Assessment regional reports on the Central Coast, Los Angeles, and San Diego indicate the largest increases in annual area burned are projected to occur in the mountains of Santa Barbara and Los Angeles counties. For the Western Region Climate Center's (WRCC) South Coast Climate Region, a 39% increase in annual area burned is projected from 2025 to the mid-century average (2035–2064) and a 36% increase is projected from 2025 to the end-century average (2070–2099). For WRCC's Southern Interior Climate Region, a 23% increase in annual area burned is projected from 2025 to the mid-century average and a 20% increase is projected by the end-century average. The average annual wildfire probability is not expected to increase by 2100 for both the South Coast and Southern Interior climate regions. Based on these datasets, wildfire will continue to significantly affect fish and wildlife and their habitats in the South Coast province for the foreseeable future.

Sea Level Rise

Along the coast, mean sea level will continue to rise. In recent years, increasing higher king tide events have already negatively affected coastal lagoon habitat for light-footed Ridgway's rails by decreasing the stature of cord grass. California recently updated its sea level rise projections for the next century, resulting in five plausible scenarios that encompass a range of possible futures for the state. At a local scale, sea level rise projections were generated for a series of NOAA tide gauges along the coast. Below are projections for the tide gauges located within the South Coast Province (CA OPC 2024). These projections are relative to a 2000 baseline and incorporate local estimates of vertical land motion.

- Santa Barbara: 0.3–1.1ft (by 2050); 0.6–6.3ft (by 2100)
- Santa Monica: 0.4–1.2ft (by 2050); 0.8–6.4ft (by 2100)
- Los Angeles: 0.4–1.1ft (by 2050); 0.6–6.3ft (by 2100)
- La Jolla: 0.5–1.3ft (by 2050); 0.9–6.6ft (by 2100)
- San Diego: 0.5–1.3ft (by 2050); 1.0–6.7ft (by 2100)

5.5.6 Conservation Strategies

SWAP 2025 presents conservation strategies, including strategy objectives and targeted pressures, for the South Coast Province. Actions that were identified for specific conservation units are listed with the strategy. Table 5.0 summarizes conservation targets for the province.

Target: American Southwest Riparian Forest and Woodland

Riparian forests and thickets are included in this target. The range of the main indicator trees and shrubs are the SW US and N Mexico. Most stands of this target occur below 4,000 feet elevation and are replaced by the cool-temperate version of riparian (Montane and North Coast Riparian Forest and Scrub) in the mountains. Diagnostic species include Fremont cottonwood, Black and red willow, California sycamore, California wild grape, arroyo willow, narrow-leaf willow, button-bush, spice bush and California fan palm (native stands in the warm desert). Most stands are found in permanently moist settings or riparian settings where sub-surface water is available year-round.

Conservation Strategy 1 (Land Acquisition/Easement/Lease): Acquire and conserve high-functioning riparian areas that have the greatest ecological potential (e.g., Santa Clara, San Luis Rey, and Ventura River watersheds, followed by larger impaired systems and those that support SGCN), and functioning riparian habitat on private property

Objective(s):

- Increase riparian habitat function and protection on private property (e.g., through conservation easement on agricultural land, fencing of cattle, limiting water diversions, and erosion control)

Targeted pressure(s): Housing and urban areas; livestock, farming, and ranching

Conservation action(s):

- Purchase lands or secure easements from willing sellers through grants and other funding sources
- Integrate National Pollutant Discharge Elimination System (NPDES) permitting and NCCPs to allow water quality mitigation to complement habitat conservation planning
- Identify, prioritize, protect, and manage wildlife corridors necessary to complete regional protected area networks across the entire region to facilitate the movement of native species whose distributions are projected to shift with climate

change, and to provide "refuge" areas, which may allow species to persist as the climate changes

Conservation Strategy 2 (Data Collection and Analysis): Gather and analyze data to establish baseline inventory of SGCN distribution, habitats, and pressures

Objective(s):

- Establish baseline inventory of SGCN/habitat and threat distributions

Targeted pressure(s): Livestock, farming, and ranching; housing and urban areas; tourism and recreation areas; garbage and solid waste; household sewage and urban wastewater; catastrophic geological events; fire and fire suppression; dams and water management/use; invasive plants/animals

Conservation Strategy 3 (Outreach and Education): Provide outreach and education focused on improving vegetation structural diversity, reducing infestations of invasive species (for plants, specifically *Arundo* and tamarisk), and protecting functioning riparian habitat on private property

Objective(s):

- Improve vertical and horizontal structural diversity of riparian habitat
- Reduce the aerial extent of invasive infestations, specifically *Arundo* and tamarisk, and/or invasive animal species; For controlling riparian invasive plant species such as *Arundo* and tamarisk, this objective includes identifying upstream stream bank sources.
- Increase riparian habitat function on private property

Targeted pressure(s): Invasive plants/animals

Conservation Strategy 4 (Law and Policy): Advocate for effective enforcement laws to reduce impacts of waste and disturbance on significant riparian areas

Objective(s):

- Reduce the number of riparian areas that are impacted by waste and disturbance

Targeted pressure(s): Garbage and solid waste; household sewage and urban wastewater

Conservation Strategy 5 (Direct Management): Manage invasive species, with focus on reducing the extent of invasive species (particularly *Arundo* and tamarisk) and improving structural diversity of native vegetation

Objective(s):

- Improve vertical and horizontal structural diversity of riparian habitat

- Reduce the aerial extent of invasive infestations, specifically *Arundo* and tamarisk, and/or invasive animal species; For controlling riparian invasive plant species such as *Arundo* and tamarisk, this objective includes identifying upstream stream bank sources.
- Pursue funding for invasive species eradication and control

Targeted pressure(s): Invasive plants/animals

Conservation action(s):

- Identify areas with greatest restoration potential and upstream sources of invasive species
- Develop management plans
- Identify and develop restoration partnerships
- Identify appropriate and effective restoration techniques for each location
- Identify restoration success criteria
- Develop and implement monitoring plan
- Implement priority invasive removal
- Develop invasive plant tax
- Develop public outreach program
- Restore and enhance native plant species
- Streamline permitting for restoration projects

Conservation Strategy 6 (Direct Management): Manage barriers to water movement, with focus on improving stream water volume, groundwater levels, vegetation age-class heterogeneity, channel pattern, and seasonal flow variation

Objective(s):

- Restore ephemeral and perennial surface water flows to mimic historic patterns of flooding and low-flow patterns (+/- 25 percent)
- Maintain low flows to sustain aquatic species
- Increase age class heterogeneity and successional dynamics in impaired areas to maintain at least two age classes
- Reduce urban encroachment and channel incision and increase riparian vegetation in floodplains
- Restore seasonal flow variation (so that annual hydrographs track the natural hydrographs of drainages [+/- 10 percent], particularly in reaches with breeding amphibian SGCN)
- Increase and maintain ground water levels

Targeted pressure(s): Dams and water management/use

Conservation action(s):

- Inventory barriers and assess flow and water condition
- Coordinate with private landowners
- Prioritize watershed or reaches for barrier treatment
- Develop an eco-regional water management plan
- Obtain permits, conduct environmental review
- Implement water management plan
- Coordinate with the various dam operators to discuss opportunities and constraints
- Engage in State Water Resources Control Board (SWRCB) permitting process
- Streamline permitting for conservation projects

Conservation Strategy 7 (Management Planning): Engage in local planning to encourage the use of bio (soft)-engineering for flood control, retention of functional floodplains, and deterrence and capture of waste and pollution

Objective(s):

- Restore ephemeral and perennial surface water flows to mimic historic patterns of flooding and low-flow patterns (+/- 25 percent), maintain low flows to sustain aquatic species
- Improve vertical and horizontal structural diversity of riparian habitat
- Reduce the extent of invasive infestations, specifically *Arundo* and tamarisk, and/or invasive animal species; For controlling riparian invasive plant species such as *Arundo* and tamarisk, this objective includes identifying upstream stream bank sources.
- Increase SGCN diversity
- Reduce channel incision and increase riparian vegetation in floodplains
- Reduce the number of riparian areas that are impacted by waste and disturbance

Targeted pressure(s): Garbage and solid waste; household sewage and urban wastewater; dams and water management/use

Conservation action(s):

- Encourage use of bio filters for urban runoff
- Maintain treated effluent flows into riparian areas
- Engage in development and implementation of Integrated Regional Management Plans
- Direct increased resources/staffing towards engagement in local planning
- Encourage appropriate site-specific native riparian plants for adjacent landscaping
- Communicate BMPs to local planners
- Obtain funding for program implementation

- Identify key areas within watersheds where wetland banks to streamline NPDES permitting can be established to improve water quality and provide benefits to biological resources
- Integrate NPDES permitting and NCCPs to allow water quality mitigation to complement habitat conservation planning

Target: California Grassland and Flowerfields

Includes all annual forb/grass vegetation native and non-native, as well as native perennial grasslands growing within the California Mediterranean climate. This does not include the cool-moist north coastal terrace prairies, the montane meadow/upland grasslands, and non-native perennial pasture grasses. Native perennial grasslands include needle grass species (*Stipa*, *Achnatherum*, *Nassella*), melicgrass and giant wild rye. Annual native forb and wildflower fields include species of poppy, goldfields, popcorn flowers, *Phacelia*, fiddleneck, and other species. Non-native annual grasslands composed of Eurasian species such as wild oat, brome, annual fescue, starthistle, mustards, fennel, and others are also included in this target.

Conservation Strategy 1 (Land Acquisition/Easement/Lease): Acquire and conserve high-value grassland habitats

Objective(s):

- Identify, prioritize, and conserve high value grassland habitat

Targeted pressure(s): Housing and urban areas; annual and perennial non-timber crops; livestock, farming, and ranching

Conservation action(s):

- Coordinate with non-governmental organizations (NGOs), such as regional land trusts, to develop regional conservation strategies

Conservation Strategy 2 (Data Collection and Analysis): Gather and analyze data to establish baseline inventory of SGCN distribution

Objective(s):

- Establish a baseline inventory of SGCN distribution

Targeted pressure(s): Housing and urban areas; annual and perennial non-timber crops; livestock, farming, and ranching; invasive plants/animals; recreational activities; climate change; fire and fire suppression

Conservation Strategy 3 (Direct Management): Reduce extent and spread of invasive species, with emphasis on ecosystem function for SGCN; Improve grasslands through restoration efforts

Objective(s):

- Reduce the extent and spread of invasive species
- Improve grasslands habitat

Targeted pressure(s): Livestock, farming, and ranching; invasive plants/animals

Conservation action(s):

- Identify areas with high restoration potential
- Develop management plans
- Identify funding sources to implement management plans
- Identify appropriate and effective restoration techniques for each location
- Identify restoration success criteria
- Develop and implement monitoring plan
- Implement priority invasive plant removal
- Develop invasive plant tax
- Develop public outreach program
- Restore and enhance native plant species

Conservation Strategy 4 (Management Planning): Coordinate with U.S. Department of Fish and Wildlife (USFWS) and other agencies to assist local jurisdictions with conservation of grasslands (e.g., via the natural community's conservation plan/habitat conservation plan process) in light of increasing extent of vineyard development in grasslands

Objective(s):

- Influence local government decision making processes for local land use plans to fully incorporate the ecological values of grassland habitat

Targeted pressure(s): Annual and perennial non-timber crops; invasive plants/animals

Conservation action(s):

- Identify and prioritize areas of conservation emphasis (ACE)
- Identify existing conserved areas
- Pursue conservation easements and habitat acquisitions to protect grassland habitats
- Encourage/promote the use of NCCPs to identify and prioritize conservation areas
- Direct project mitigation to priority areas needing conservation
- Direct and use conservation banking
- Split parcels for conservation

- Incorporate conservation goals and best management practices (BMPs) into California Environmental Quality Act (CEQA) comment letters
- Provide input at local government public meetings on relevant land use decisions

Conservation Strategy 5 (Partner Engagement): Partner for joint advocacy for the conservation of natural resources

Objective(s):

- Establish partnerships with agencies, tribes, and landowners that benefit wildlife
- Implement habitat restoration projects jointly with agencies, tribes, and landowners that benefit wildlife

Targeted pressure(s): Livestock, farming, and ranching; fire and fire suppression; invasive plants/animals

Conservation action(s):

- Advocate for appropriate grazing practices
- Review existing ranching and grazing BMPs
- Partner and advocate for reducing rodenticide use
- Work with Natural Resources Conservation Service, California Cattleman's Association, California Farm Bureau Federation, and landowners to modify BMPs as needed
- Incorporate BMPs into CEQA comment letters
- Identify key private landowners to whom outreach is directed
- Coordinate with local landowners to determine what conservation efforts they are engaged with and determine how CDFW may assist in their efforts
- Advocate for prescribed burns where appropriate (e.g., where risk of conversion of native habitat types as a result of burning is low)
- Advocate for post-burn weed control in collaboration with Cal-IPC and CAL FIRE
- Work with local governments to incorporate structural fire treatments (e.g., building hardening, boxed eves, fire rated windows, etc.) to minimize impacts at the urban/wildland interface

Target: Coastal Dune and Bluff Scrub

Stands of coastal dune and bluff vegetation are limited to salty, rocky, or sandy settings immediately adjacent to the open coast. Traits include adaptation to salt spray, wind and shifting sands, result in several lifeforms including succulent or hairy leaves, long underground roots and stolons (adaptation to shifting sands), and good colonization of relatively unstable and sterile substrates.

Conservation Strategy 1 (Land Acquisition/Easement/Lease): Protect priority habitats through acquisition, permanent conservation easement, or other means; purchase land in a corridor connecting two protected areas to provide connectivity of habitat

Objective(s):

- Increase total acreage of conserved coastal dune and bluff scrub, prioritizing those areas that are resilient to sea level rise and/or increase available area for retreat of existing dune or bluff habitats
- Targeted pressure(s): Housing and urban areas; roads and railroads; climate change

Conservation action(s):

- Purchase lands or secure easements from willing sellers through grants and other funding sources

Conservation Strategy 2 (Direct Management): Conduct resource management

Objective(s):

- Restore coastal dune and bluff habitats through removal of non-native species, planting of native vegetation, and restoring of natural tidal flows
- Protect conserved habitat and sensitive coastal resources from human impacts due to recreation, habitat loss, and anthropogenic alteration of predator prey dynamics
- Enhance existing populations of sensitive and listed plant species and reestablish extirpated populations when appropriate based on genetic data
- *Targeted pressure(s):* Invasive plants/animals; recreational activities; garbage and solid waste; climate change

Conservation action(s):

- Treat/manage non-native vegetation using mechanical removal and herbicide treatments
- Plant/seed native vegetation
- Restore or improve tidal flows
- Install permanent or temporary fencing around sensitive resource locations to limit human encroachments and disturbance
- Implement predator management programs where needed for the protection of sensitive and listed species
- Collect, propagate, and plant sensitive native species to augment existing populations or to reestablish extirpated populations where genetic information exists, and suitable source populations can be identified

Conservation Strategy 3 (Data Collection and Analysis): Collect biological and ecological data to address key information gaps on SGCN, habitats, and pressures

Objective(s):

- Conduct genetic research on sensitive resources to understand genetic diversity, movement, and distribution patterns
- Collect data on SGCN, habitats, and pressures that are necessary to understand drivers of population trends, distribution, and abundance
- Analyze existing datasets to address information gaps for SGCN, habitats, and pressures

Targeted pressure(s): Climate change; housing and urban areas; invasive plants/animals; recreational activities

Conservation action(s):

- Conduct genetic research on sensitive plant and wildlife resources to understand genetic diversity, movement, and distribution patterns
- Analyze statewide monitoring data for California least tern to identify drivers of population distribution, abundance, and reproductive success
- Collect new data for SGCN, habitats, and pressures that address existing data gaps focusing on those research needs identified in recovery plans or stakeholder developed planning documents where recovery plans don't exist

Conservation Strategy 4 (Management Planning): Develop and implement management plans

Objective(s):

- Develop or revise long-term management plans for conserved coastal dune and bluff resources taking into account projected sea level rise and future changes in human use patterns

Targeted pressure(s): Climate change; housing and urban areas; invasive plants/animals; recreational activities

Conservation action(s):

- Develop long-term management plans in areas where they don't exist or revise those plans that are outdated or inadequate due to changes in resource condition, surrounding land use, or anticipated impacts due to climate change, incorporating local stakeholder input during the process

Target: Coastal Lagoons

Coastal lagoons are bodies of water that are permanently or seasonally separated from the ocean by sand bars and are also known as "bar-built estuaries." Lagoons are characterized by estuarine species when open to the ocean periodically and may be characterized by freshwater species when permanently separated from the ocean. Lagoons are surrounded by riparian vegetation providing habitat for amphibians, reptiles, birds, and mammals.

Conservation Strategy 1 (Land Acquisition/Easement/Lease): Protect riparian areas and coastal lagoons by acquiring land adjacent to lagoons and reduce water diversion from the critical lagoons and tributary streams during late spring to summer

Objective(s):

- Protect riparian areas by acquiring land adjacent to lagoons and reduce water diversion from the critical lagoons and tributary streams during late spring to summer

Targeted pressure(s): Agricultural and forestry effluents; climate change; commercial and industrial areas; dams and water management/use; household sewage and urban wastewater; housing and urban areas; industrial and military effluents; invasive plants/animals; livestock, farming, and ranching; tourism and recreation areas

Conservation action(s):

- Purchase lands or secure easements
- Obtain funding for implementation and staff
- Survey the interests from willing sellers
- Identify partners for funding and management
- Identify willing landowners

Conservation Strategy 2 (Data Collection and Analysis): Conduct baseline surveys for SCGN/habitat and pressures in at least 50 percent of coastal lagoons within the ecoregion

Objective(s):

- Conduct baseline surveys for SCGN/habitat and pressures in coastal lagoons within the ecoregion
- Assess what data are available within CDFW and from external sources to survey and manage the target
- Provide support for compilation and maintenance of data into databases that are readily available to, and easily useable by, managers, as well as the public

Targeted pressure(s): Agricultural and forestry effluents; annual and perennial non-timber crops; commercial and industrial areas; climate change; household sewage and urban wastewater; housing and urban areas; industrial and military effluents; invasive plants/animals; livestock, farming, and ranching; tourism and recreation areas

Conservation action(s):

- Collect new data for SGCN, habitats, and pressures that address existing data gaps focusing on those research needs identified in recovery plans or stakeholder developed planning documents where recovery plans don't exist

Conservation Strategy 3 (Law and Policy): Participate in the development of policies that promote conservation of lagoon habitat

Objective(s):

- Participate in the development of policies that promote conservation of lagoon habitat
- Ensure that riparian function and processes are maintained to provide desired conditions and manage riparian buffers

Targeted Pressures: Agricultural and forestry effluents; annual and perennial non-timber crops; climate change; commercial and industrial areas; household sewage and urban wastewater; housing and urban areas; industrial and military effluents; livestock, farming, and ranching; tourism and recreation areas

Conservation action(s):

- Develop CDFW policy for protecting riparian and watercourse zones tributary to lagoons
- Participate in interagency working group to advocate for lower order stream *protection*
- Advocate for compliance monitoring

Conservation Strategy 4 (Direct Management): Manage dams and other barriers to improve fish passage and stream ecosystem function

Objective(s):

- Using the Passage Assessment Database, Fish Passage Forum Barrier Optimization Model, and CDFW's internal prioritization team, establish a candidate list of small diversion dams that can be modified or removed to improve fish passage
- Quantify needed bypass flows to support biological requirements and geomorphology

Targeted pressure(s): Agricultural and forestry effluents; catastrophic geological events; climate change; dams and water management/use; household sewage and urban wastewater; industrial and military effluents; tourism and recreation areas; other ecosystem modifications

Conservation action(s):

- Coordinate with private landowners

- Inventory barriers and assess flow and water condition
- Develop plan for prioritization and construction or retrofits
- Identify funding sources-apply
- Permits, environmental review
- Perform conservation-oriented construction or retrofits
- Implement water conservation strategies
- Identify location of barriers

Conservation Strategy 5 (Direct Management): Develop an interagency direct management plan for coastal lagoons

Objective(s):

- Develop an interagency direct management plan for coastal lagoons

Targeted pressure(s): Agricultural and forestry effluents; annual and perennial non-timber crops; climate change; household sewage and urban wastewater; industrial and military effluents; invasive plants/animals; livestock, farming, and ranching; tourism and recreation areas

Conservation action(s):

- Coordinate with private and public landowners
- Inventory lagoons to assess flow and water condition and other important parameters for SGCN
- Identify groups/organizations to participate in interagency working group to establish priorities for restoration
- Develop plan for management prioritization, including restoration needs
- Identify funding sources
- Secure permits and complete environmental review
- Perform conservation-oriented management and restoration actions
- Implement strategies to enhance functions for SGCN critical life history needs
- Conduct or acquire existing assessments of parcels to determine restoration potential and biological value

Conservation Strategy 6 (Training and Technical Assistance): Provide training and technical assistance, including training interagency staff in SGCN identification and invasive species management/control techniques

Objective(s):

- Train interagency staff on fish identification (native and non-native) and invasive species management/control techniques
- Increase coordination between management and staff on training needs

Targeted pressure(s): Agricultural and forestry effluents; invasive plants/animals; annual and perennial non-timber crops; climate change; garbage and solid waste; household sewage and urban wastewater; invasive species; livestock, farming, and ranching

Conservation action(s):

- Identify target audience
- Conduct interagency coordination
- Develop training curriculum
- Obtain funding for strategy implementation

Target: Freshwater Marsh

This vegetation type consists of freshwater emergent marshes and coastal/tidal marshes and meadows. It can be found surrounding streams, rivers, lakes and wet meadows. These habitats occur on virtually all exposures and slopes, provided a basin or depression is saturated or at least periodically flooded. Dominant species are generally perennial monocots including graminoids such as rushes, reeds, grasses and sedges. Dominant species include common reeds, hardstem bulrush, small-fruited bulrush, water parsley, slough sedge, soft rush, salt rush, and pacific silverweed.

Conservation Strategy 1 (Outreach and Education): Provide outreach and education

Objective(s):

- Influence public awareness of proper land management for freshwater marshes by providing information to landowners regarding BMPs and proper wetland management
- Coordinate with local landowners to determine what conservation efforts they are engaged with and determine how CDFW may assist in their efforts

Targeted pressure(s): Livestock, farming, and ranching

Conservation action(s):

- Target conservation organizations and Resource Conservation Districts
- Design and produce brochures with wetland conservation message
- Employ web-based media to provide information to the public

Conservation Strategy 2 (Land Acquisition/Easement/Lease): Purchase land and conservation easements

Objective(s):

- Improve land management by removing invasive species and creating better grazing practices

Targeted pressure(s): Livestock, farming, and ranching; annual and perennial non-timber crops

Conservation action(s):

- Prioritize with best available species data, connectivity efforts and Environmental Site Assessments

Conservation Strategy 3 (Law and Policy): Advocate for laws and policies

Objective(s):

- Strengthen regulatory authority over wetlands and integrate beaver ecology into wetland restoration activities

Targeted pressure(s): Livestock, farming, and ranching; annual and perennial non-timber crops

Conservation action(s):

- Evaluate and update Wetlands Policy
- Implement wetland and riparian technical memorandum
- Review and modify CDFW policy on beaver depredation
- Update Wetlands Implementation Policy

Conservation Strategy 4 (Management Planning): Develop land management plans for CDW lands

Objective(s):

- Develop BMPs for freshwater marsh management on CDFW lands
- BMPs provide guidance on managing CDFW lands for multi-species use and benefit both recreation and the conservation of native species

Targeted pressure(s): Invasive plants/animals; livestock, farming, and ranching; annual and perennial non-timber crops; climate change

Conservation action(s):

- Update Land Management Plans for CDFW properties where needed to ensure they align with new guidelines in the CDFW Lands Program

Conservation Strategy 5 (Economic Incentives): Provide economic incentives for improved resource management

Objective(s):

- Provide economic incentives through restoration grants

Targeted pressure(s): Livestock, farming, and ranching; annual and perennial non-timber crops

Target: Western North America Vernal Pool

This macrogroup includes herbaceous communities with high diversity and high endemism that form distinct zones or concentric rings within shallow ephemeral pools on hardpan soils with an indurated clay or cemented layer or on shallow soils over unfractured bedrock. Plant species include *Callitriche, Downingia, Eryngium, Hemizonia, Lasthenia, Navarretia, Orcuttia, Plagiobothrys, Pogogyne, Psilocarphus, Sedella, Spergularia*, and *Trichostema*. Pools occur on shallow soils over volcanic bedrock, in scablands, on hardpan soils with an indurated clay or cemented layer that retains water throughout some portion of the spring, and that typically dry down completely into early summer months.

Conservation Strategy 1 (Land Acquisition/Easement/Lease): Protect priority habitats through acquisition, permanent conservation easement, or other means; purchase land in a corridor connecting two protected areas to provide connectivity of habitat

Objective(s):

- Increase total acreage of conserved vernal pool habitat through acquisition of fee title or conservation easements, prioritizing areas that are contiguous with conserved open space and have long-term management funding
- Targeted pressure(s): Climate change; housing and urban areas; recreational activities

Conservation action(s):

- Purchase lands or secure easements from willing sellers through grants and other funding sources

Conservation Strategy 2 (Direct Management): Conduct resource management

Objective(s):

- Restore vernal pool habitats through removal of non-native species, planting of native vegetation, and improving soil condition
- Protect vernal pool habitat from human impacts due to recreation

Targeted pressure(s): Climate change; invasive plants/animals; recreational activities

Conservation action(s):

- Treat/manage non-native vegetation using herbicide or other appropriate techniques that minimize soil disturbance
- Plant/seed native, vernal pool obligate vegetation
- Restore or improve water holding capacity and soil impermeability where altered by unnatural processes or climate change

- Install permanent or temporary fencing around vernal pool locations and/or redirect activities away from vernal pool resources to minimize impacts due to human recreation

Target: Native Fish Assemblage

SGCN associated with this target include but are not limited to unarmored three spine stickleback, tidewater goby, Santa Ana sucker, Santa Ana speckled dace, Southern California steelhead, and arroyo chub

Conservation Strategy 1 (Land Acquisition/Easement/Lease): Protect and restore unarmored threespine stickleback (UTS) habitat within the Santa Clara River mainstem, Soledad Canyon, and Bouquet Canyon

Objective(s):

- Protect and enhance UTS habitat within the Santa Clara River mainstem, Soledad Canyon, and Bouquet Canyon

Targeted pressure(s): Dams and water management/use; housing and urban areas

Conservation action(s):

- Develop and implement restoration and acquisition projects and funding sources
- Survey and map extent of UTS populations in all three streams
- Survey and map all potential UTS habitat in the three streams
- Provide education and outreach
- Obtain funding for plan implementation and staff

Conservation Strategy 2 (Data Collection and Analysis): Collect and analyze data to establish a baseline inventory of SCGN distribution

Objective(s):

- Establish baseline inventory of SGCN distribution
- Complete comprehensive UTS surveys in the Santa Clara watershed with a focus on Soledad and Bouquet Canyons

Targeted pressure(s): Dams and water management/use; housing and urban areas

Conservation action(s):

- Collect new data for SGCN, habitats, and pressures that addresses existing data gaps focusing on those research needs identified in recovery plans or stakeholder developed planning documents where recovery plans don't exist

Conservation Strategy 3 (Data Collection and Analysis): Identify areas that may act as climate refugia

Objective(s):

- Identify representative habitats to accommodate species movement and adaptation

Targeted pressure(s): Climate change

Conservation Strategy 4 (Outreach and Education): Implement outreach

Objective(s):

- Raise public awareness and support for native fish restoration projects
- Educate public on risks of invasive species and importance of aquatic biodiversity management plans

Targeted pressure(s): Invasive plants/animals

Conservation action(s):

- Identify target audience
- Develop outreach and education curriculum
- Obtain funding for strategy implementation

Conservation Strategy 5 (Direct Management): Translocate species to increase current distribution; specifically, translocate Santa Ana sucker, Santa Ana speckled dace, and UTS into suitable habitat in the Big Tujunga, San Gabriel, and Santa Clara watersheds

Objective(s):

- Increase the distribution of native fish

Targeted pressure(s): Dams and water management/use; invasive plants/animals

Conservation action(s):

- Develop a translocation plan
- Work with federal agencies and flood control agencies to identify constraints and obtain buy-in
- Monitor target fish populations
- Obtain funding for plan implementation and staff

Conservation Strategy 6 (Direct Management): Improve fish passage by working with federal, state, and local agencies to identify and remove key fish barriers to fish movement and sediment flow and keep priority areas barrier free

Objective(s):

- Assess, prioritize, and remove/modify fish passage barriers

Targeted pressure(s): Dams and water management/use

Conservation action(s):

- Develop barrier assessment protocols
- Develop barrier removal guidelines, BMPs, and plan to monitor barrier removal effectiveness
- Obtain funding for plan implementation and staff
- Coordinate with state, federal agencies, local government, and private landowners
- Identify partners

Conservation Strategy 7 (Direct Management): Protect and restore floodplain function

Objective(s):

- Align policies, regulations, planning, and agency coordination to support multi-benefit floodplain management; implement and maintain priority floodplain restoration projects

Targeted pressure(s): Annual and perennial non-timber crops; housing and urban areas; mining and quarrying

Conservation action(s):

- Conduct flow compliance monitoring
- Conduct fish population monitoring

Conservation Strategy 8 (Direct Management): Restore natural flows

Objective(s):

- Identify streams/reaches in greatest need of flow remediation and create plans for restoration
- Monitor restored stream reaches for recolonization and implement translocation, as necessary, to re-establish populations
- Work with relevant agencies and partners to develop a flow prescription for Bouquet Creek and the Santa Clara River

Targeted pressure(s): Dams and water management/use; invasive plants/animals

Conservation action(s):

- Monitor flow compliance
- Identify partners
- Coordinate with state and federal agencies, local governments, and private landowners
- Monitor fish populations
- Obtain funding for plan implementation and staff

Conservation Strategy 9 (Direct Management): Control invasive species

Objective(s):

- Assess, map, and develop control plans for invasive aquatic species

Targeted pressure(s): Invasive plants/animals

Conservation action(s):

- Compile maps of invasive species already completed for planning area
- Conduct additional mapping as necessary to fill gaps
- Develop control plans for priority species
- Develop Invasives Coordination Group to streamline and coordinate current agencies, organizations, activities
- Implement priority species control plans
- Map invasive species and develop control plans
- Implement top-priority controls plans
- Monitor invasive species and continue removal efforts as needed to control populations
- Implement outreach and education specific to spread of invasive species

Target: South Coast Native Aquatic Herp Assemblage

SGCN associated with this target include but are not limited to: California red-legged frog, California tiger salamander, mountain yellow-legged frog, arroyo toad, western pond turtle, coast range newt, and two-striped garter snake.

Conservation Strategy 1 (Land Acquisition/Easement/Lease): Protect land in fee or with conservation easements, with focus on riparian habitats that have the greatest ecological potential such as larger impaired systems and those that support SGCN

Objective(s):

- Increase riparian habitat function and protection on private property (e.g., through conservation easement on agricultural land, fencing of cattle, limiting water diversions, and erosion control)
- Conserve high functioning riparian areas, with focus on areas that have the greatest ecological potential such as larger impaired systems and those that support SGCN

Targeted pressure(s): Annual and perennial non-timber crops; housing and urban areas; invasive plants/animals; recreational activities

Conservation action(s):

- Purchase lands or secure conservation easements from willing sellers through grants and other funding sources
- Encourage/promote the use of NCCPs to identify and prioritize conservation areas

- Implement in lieu fee program
- Identify and prioritize ACE
- Obtain funding for program implementation, land acquisition and restoration
- Identify existing conserved areas
- Direct project mitigation to priority areas needing conservation
- Direct and use conservation banking
- Split parcels for conservation
- Identify which parcels to be acquired in fee or as conservation easement
- Conduct baseline inventory

Conservation Strategy 2 (Data Collection and Analysis): Conduct research to identify causal mechanism for Chytrid fungus and prevent its spread in amphibian populations

Objective(s):

- Identify causal mechanisms for Chytrid fungus and prevent its spread in amphibian populations

Targeted pressure(s): Parasites, pathogens, and diseases

Conservation action(s):

- Conduct literature review
- Gather existing information
- Develop study design
- Consult with experts
- Obtain funding

Conservation Strategy 3 (Outreach and Education): Provide outreach and education

Objective(s):

- Educate public on impacts associated with their activities and damage to native species from introduction of non-native species
- Keep public informed on development and status of BMPs

Targeted pressure(s): Recreational activities; annual and perennial non-timber crops; invasive plants/animals

Conservation action(s):

- Identify target audience
- Develop outreach and education curriculum
- Obtain funding for strategy implementation

Conservation Strategy 4 (Direct Management): Protect and restore habitat and create riparian buffers adjacent to streams

Objective(s):

- Create buffers of properly functioning riparian habitat adjacent to streams

Targeted pressure(s): Housing and urban areas; recreational activities; annual and perennial non-timber crops; invasive plants/animals; annual and perennial non-timber crops

Conservation Strategy 5 (Direct Management): Manage invasive species to improve conditions for native fish and aquatic herps

Objective(s):

- Prevent additional future invasive species from becoming established and manage invasive species levels to improve conditions for native fish and aquatic herps

Targeted pressure(s): Invasive plants/animals

Conservation action(s):

- Update data on extent and distribution of native and non-native species
- Develop strategy for removal of non-native fish species and aquatic weeds
- Coordinate with other agencies and private landowners
- Obtain permits and environmental review if needed
- Obtain funding for implementation and staff
- Conduct management activities (e.g., electroshock, seine, etc.)
- Conduct post treatment monitoring
- Initiate long-term monitoring and management plan
- Implement mechanical and chemical treatment of invasive weeds within riparian areas

Conservation Strategy 6 (Direct Management): Reintroduce native species

Objective(s):

- Re-establish native amphibians and reptiles in their historic range

Targeted pressure(s): Invasive plants/animals; housing and urban areas

Conservation action(s):

- Conduct feasibility analysis to identify target streams
- Identify source population or propagate
- Evaluate control methods for non-native species
- Develop reintroduction plan including post-treatment monitoring
- Coordinate with agencies and non-governmental organizations
- Conduct environmental review and obtain permits
- Obtain funding for implementation and staff

Conservation Strategy 7 (Direct Management): Manage flows, dams, and other barriers to best benefit aquatic herps and for fish passage

Objective(s):

- Allow more bypass flows through water conservation and allow fish passage

Targeted pressure(s): Dams and water management/use

Conservation action(s):

- Coordinate with state and federal agencies, counties, and private landowners
- Inventory barriers and assess flow and water condition
- Develop plan for prioritization and construction
- Obtain funding for implementation and staffing
- Obtain permits, conduct environmental review
- Remove or retrofit barriers
- Implement water conservation flow

5.6 Deserts Province

5.6.1 Geophysical and Ecological Description of the Province

The Deserts Province extends from the California-Mexico border on the south and Colorado River on the southeast, north to Topaz Lake on the California-Nevada border (Figure 5.6-1). The province's western border is formed by the Peninsula Mountain Ranges and Transverse Mountain Range in southern California, and the Sierra Nevada in central California. The province is the extension of desert regions located to the east and south of California in the states of Nevada and Arizona, and in Mexico. The Deserts Province has five different subregions: from north to south these are the Mono subregion, the Southeastern Great Basin, Mojave Desert, Sonoran Desert, and Colorado Desert. Each subregion has unique combinations of climate, topography, ecology, and land-use patterns.

The province is mostly in the rain shadow of mountain ranges that form the western border. The dry landscape created by this barrier is characterized by unique geologic features composed of cliffs, peaks, canyons, dry washes, sand dunes, and large dry lake playas. Elevations are generally low in the southern portion of the province and rise to the north. The elevation in the south (Sonoran and Colorado deserts subregion) is generally below 1,000 feet with the lowest point at 275 feet below sea level in the Salton Trough. The topography of the more northerly portion of the province (Mojave Desert subregion) is characterized by a moderately high plateau: elevations range from 282 feet below sea level in Death Valley to 11,000 feet above sea level in the Panamint Mountains. The northernmost portion of the province (the Mono subregion) is composed of isolated mountain ranges separated by alluvial fans and basins. Elevations range from 4,400 to more than 14,200 feet in the White Mountains. The

Southeastern Great Basin subregion is characterized by basin and range topography (i.e., widely separated short ranges in desert plains) and contains isolated mountains, plateaus, alluvial fans, basins, and dunes; elevations range from approximately 1,000 to 11,000 feet.

The climate of the province varies from cooler and wetter in the north to hotter and drier in the south. The climate of the southern portion of the province (Sonoran and Colorado deserts) experiences distinctly higher daytime temperatures than high desert regions to the north and has two rainy seasons per year: winter and late summer. The hydrology is characterized by groundwater springs and runoff from seasonal rains that form canyon-mouth alluvial fans, desert arroyos, desert fan palm oases, freshwater marshes, brine lakes, desert washes, and ephemeral and perennial streams. Perennial streams are found draining from Cottonwood Creek as well as Surprise Canyon in the Panamint Range. The Amargosa and Mojave Rivers also contain perennial reaches fed by groundwater. Major rivers and hydrologic features in the northern portion of the province include Owen’s River, Owens Lake, Crowley Lake (reservoir), Mono Lake, and the East and West forks of the Walker River. The most significant aquatic systems in the southern portion of the province are the Salton Sea and the Colorado River. These aquatic features provide vital wet habitats that support wildlife diversity in the province.

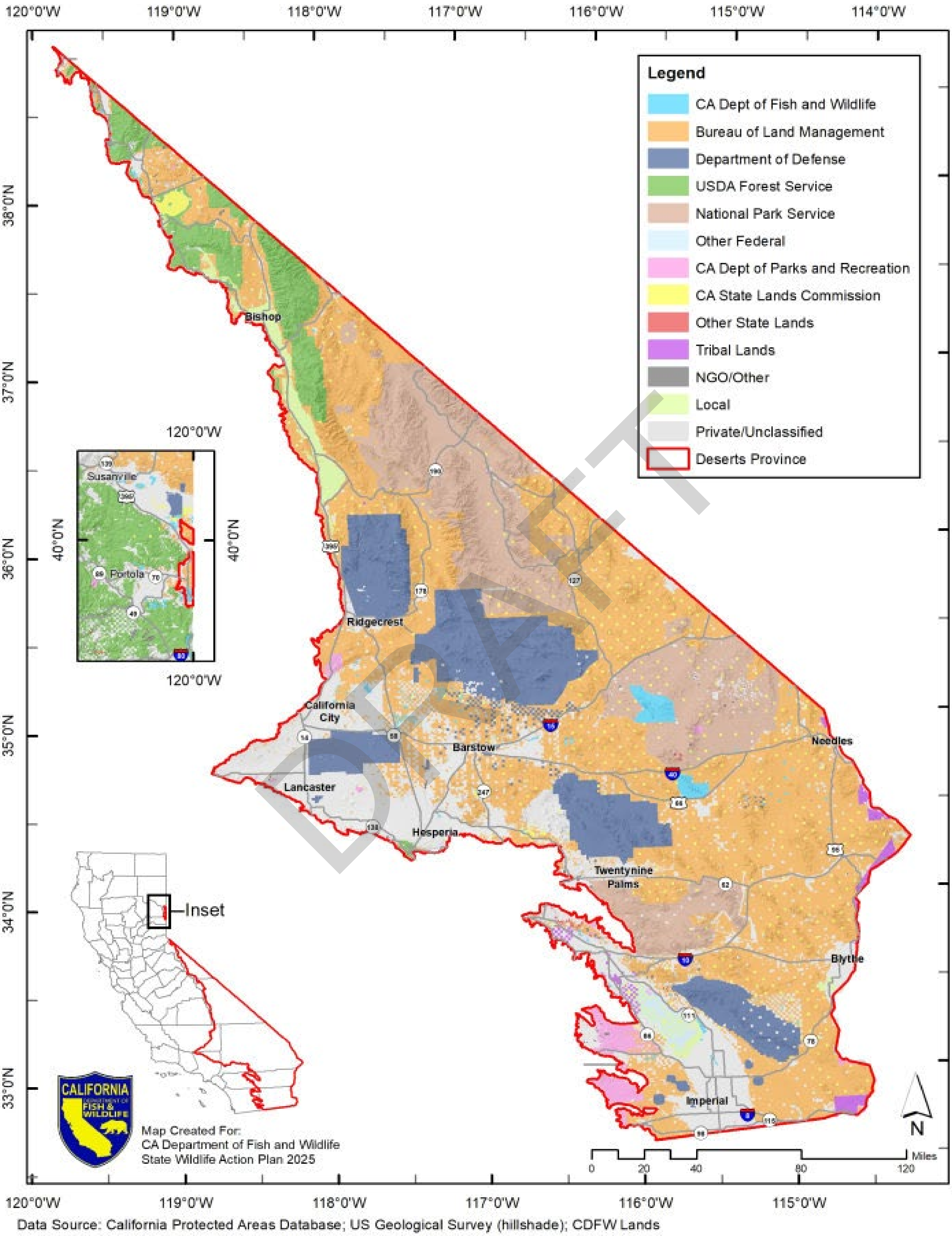


Figure 5.6- 1 Land Ownership of the Deserts Province

The variations in elevation, soil composition, and sun and wind exposure, along with desert springs, seeps, and riparian corridors provide isolated microclimates and ecosystems throughout the province.

Common habitats in the province are big sagebrush, creosote bush scrub, desert saltbush, Joshua tree scrub, desert wash, alkali scrub, mixed scrub (including yucca and cholla cactus), sandy soil grasslands and desert dunes, and juniper-pinyon woodlands in the Mojave Desert region. Aquatic and wetland habitats support cottonwood, willow, and non-native tamarisk. Desert fan palm oases are found only in the southern portion of the province where permanent water sources are available (e.g., springs). Higher elevation habitats include pinyon pine and California juniper, with areas of manzanita and Coulter pine.

The harsh and diverse environment found in this province has resulted in the evolution of numerous endemic species adapted to specialized desert habitats, many of which are now state and federally listed. Among these are the Joshua tree, barrel and prickly pear cactus, pinyon pine, California fan palm, Mohave ground squirrel, and Amargosa vole. The province provides habitat for burrowing owl, Gambel's quail, greater sage-grouse, rosy boa, western diamondback rattlesnake, Panamint rattlesnake, Mojave green rattlesnake, two distinct subspecies of sidewinder rattlesnake, Mojave fringe-toed lizard, desert horned lizard, collared and leopard lizard, desert kangaroo rat, cactus mouse, Mojave and Amargosa vole, black-tailed jackrabbit, bobcat, kit fox, American badger, mountain lion, mule deer, and desert bighorn sheep.

Additional state and federally listed species include Owens Tui Chub, Mojave Tui Chub, Owens Pupfish, Long Valley Speckled Dace, Lahontan Cutthroat Trout, Desert Pupfish, flat-tailed horned lizard, Coachella Valley fringe-toed lizard, prairie falcon, burrowing owl, desert tortoise, Andrew's dune scarab beetle, Peninsular bighorn sheep, Crotch's bumble bee, western Joshua tree and California leaf-nosed bat. Species reliant on aquatic and wetland habitats include arroyo toad, desert pupfish, Yuma Ridgeway's rail, and southwestern willow flycatcher, and many others. Fan palm oasis host species such as the blue-black giant palm-boring beetle, Ringtail and other species such as the western yellow bat, which is strongly associated with this habitat.

Sky Islands

Sky islands are isolated mountains surrounded by radically different lowland environments. This has significant implications for natural habitats. Endemism, altitudinal migration, and relict populations are some of the natural phenomena to be found on sky islands. One of the key elements of a sky island is separation by physical distance from the other mountain ranges, resulting in a habitat island, such as a forest surrounded by desert. Some sky islands serve as refugia for boreal species stranded by warming climates since the last ice age. Mountains in the Sonoran Desert subregion may be considered sky islands because they function as a habitat island for species associated with forested and montane communities.

The wildlife of the province is affected by ecosystem degradation from increases in temperature, frequency and duration of drought, and intensity of precipitation associated with climate change. Wildlife is impacted by urban growth, off-highway vehicle activity, large-scale renewable energy development, cattle and sheep grazing, surface water diversions, groundwater overdraft, illegal harvesting or commercialization of resources, increasingly large wildfires, and dominance of introduced invasive species. These activities and conditions have resulted in and continue to result in fragmentation of the landscape, degradation of habitat, and disruption of ecosystems.

In the Mojave Desert subregion of the province, 80 percent of the region is managed by federal agencies (U.S. Bureau of Land Management [BLM], National Park Service [NPS], and U.S. Department of Defense [DOD]); 18 percent of the region belongs to private landowners or municipalities. In the Colorado Desert and Sonoran Desert subregions of the province, the federal government manages approximately 50 percent of the region (BLM and DOD). Other public land management agencies within the region are California State Parks, CDFW, and U.S. Fish and Wildlife Service (USFWS). Joshua Tree National Park spans the transition zone from the Mojave to the Colorado Desert. Anza Borrego Desert State Park encompasses nearly nine percent of the Colorado and Sonoran Desert subregion. Together, Joshua Tree National Park, Anza Borrego Desert State Park, and the Santa Rosa Wildlife Area, along with other protected lands in the Mojave Desert, are part of the Mojave and Colorado Deserts Biosphere Reserve, designated by the United Nations as an important global site for preservation of the biological and cultural resources of these desert regions. In addition, a 25-million-acre expanse of land in the province is designated as the California Desert Conservation Area (CDCA) through the Federal Land Policy and Management Act.

Human activities have had substantial impacts on the province's habitats and wildlife. Some of the greatest human-caused effects on the region have resulted from the water diversions and flood control measures along the Colorado River and in the Mono and Mojave Desert Subregions. These measures have dramatically altered the region's hydrology by redistributing the province's water supply to large expanses of irrigated agriculture and metropolitan areas. Of the province's species at risk, many are dependent on habitats that have limited distribution such as desert pupfish. Pressures from population growth and development as well as invasive species are particularly acute for species that depend on restricted habitats, such as Peninsular bighorn sheep.

Salton Sea

The Salton Sea, located in southern Riverside and northern Imperial counties in Southern California, is California's largest lake. Although large seas have cyclically formed and dried over historic time in the basin due to natural flooding from the Colorado River, the current Salton Sea was formed when Colorado River floodwater breached an irrigation canal being constructed in the Imperial Valley in 1905 and flowed into the Salton Sink. The Sea has since been maintained by irrigation runoff in the Imperial and Coachella valleys and local rivers. Because the Sea is a terminal lake, increasingly concentrated salts have resulted in a salinity that is currently two times greater than that of the Pacific Ocean.

Although it has only existed for slightly over 100 years, the Salton Sea has become a critical resource for many species of resident and migratory birds, including several species of special concern. Due to the significant loss of wetlands in California and other areas, the Salton Sea ecosystem has become one of the most important wetlands for birds in North America and supports some of the highest levels of avian biodiversity in the southwestern United States. Recent studies have documented the great importance of the Salton Sea ecosystem in providing habitat for migrating and resident waterbirds, particularly Pacific Flyway waterbirds. More than 400 resident, migratory, and special-status bird species have been recorded in the Salton Sea area since its formation, with about 270 of those species using the Salton Sea on a regular basis. In addition to the diversity of birds, studies have indicated that the large number of individual birds using the Salton Sea is more ecologically relevant than the number of species.

Until recently, the Sea also supported a robust marine sport fishery that included orangemouth corvina (*Cynoscion xanthulus*), Gulf croaker (*Bairdiella icistia*), and sargo (*Anisotremus davidsoni*). Increasing salinity has eliminated the marine fishery and negatively impacted the Hybrid tilapia (*Oreochromis mossambicus* x *O. urolepis hornorum*) and Redbelly tilapia (*Tilapia zillii*), populations that are now likely restricted to agricultural drains, tributaries that flow into the Sea including the New River, Alamo River, and Whitewater River, and other areas of freshwater influence like Salt Creek and occasionally San Felipe Creek where an isolated population of tilapia persists. A number of birds species are sustained by feeding on tilapia, invertebrates like brine shrimp, and several smaller non-sport fish species, of which only the endangered desert pupfish (*Cyprinodon macularius*) is native.

Declining inflows in future years will result in collapse of the Salton Sea ecosystem due to increasing salinity and other water quality issues, such as temperature, eutrophication, and related anoxia and algal productivity. The deteriorating water quality appears to be affecting pile worms and barnacles, primary components of the Salton Sea food web.

Tilapia, which is presently the primary forage species for piscivorous (fish-eating) birds at the Salton Sea, seemed to have experienced a drastic population decline after salinity exceeded 60 parts per thousand (ppt). As of January 2024, total dissolved solids (TDS) in the southern portion of the Salton Sea have ranged from 71,000 mg/L to 82,000 mg/L (71–82 ppt). Tilapia may continue to persist in areas of lower salinity where the rivers, creeks, and agricultural drains enter the Salton Sea. piscivorous birds, such as pelicans, double-crested cormorants, and black skimmers reduced their use of the Salton Sea after the loss of fish populations by the early 2020s. In addition, the relative abundance of bird species that forage on invertebrates likely would change over time with increases in salinity and resultant changes in the invertebrate community.

The Quantification Settlement Agreement (QSA) is one of the factors contributing to declining inflows to the Salton Sea. California historically used more than its normal year apportionment of Colorado River water, obtaining the excess from water apportioned to Arizona and Nevada but not used by those states and by water designated as surplus by the Secretary of the Interior. The amount of unused apportionment previously available to California has diminished and is unlikely to be available in the future. After prolonged negotiations between the federal government and California water districts with entitlements to Colorado River water, a series of agreements, the QSA, were adopted in October 2003, between the federal government, State of California, Imperial Irrigation District (IID), Metropolitan Water District of Southern California, San Diego County Water Authority, and Coachella Valley Water District.

The QSA imposes water conservation measures that reduce the Salton Sea's chief source of water, by transferring agricultural runoff, within the IID service area. The IID was required to provide conserved water to the Sea to mitigate the effects of the transfer on salinity until 2017; after this the Sea's salinity was expected to exceed the tolerance limit for fish and, thus, mitigation for effects on salinity was ceased in December 2017.

The reduction in water to the Sea after 2017 has resulted in a drastic decline of the fishery, exposure of soils to wind erosion, and bird declines due to loss of food. Reduction of inflows to the Sea from other factors, such as water recycling in Mexico, has also contributed to increases in salinity and a declining sea elevation. IID is currently in the process of preparing a Natural Community Conservation Plan (NCCP) and Habitat Conservation Plan (HCP) in consultation with CDFW and U.S. Fish and Wildlife Service (USFWS).

In 2017, the State Water Resources Control Board (SWRCB) issued SWB Order WR 2017-0134 which required the State of California to implement 29,800 acres of projects on the playa exposed by the recession of the Salton Sea. Projects are to be completed by 2028, with half of the acreage to be aquatic habitat projects and half to be dust suppression projects, to offset the loss of wildlife habitat and increase in fugitive dust emissions as the shoreline recedes and the Sea increases in salinity.

In 2018, the Salton Sea Management Program (SSMP) was created to accomplish this goal. Led by the California Natural Resources Agency (CNRA) and including the California Department of Water Resources (DWR) and CDFW, the SSMP has developed the Salton Sea Management Program Phase I: 10-Year Plan to accomplish the goal of creating the required acreage of project and as of January 2024, 5,700 acres of projects have been constructed or are under construction and several hundred acres are in the permitting/planning stage.

Due to the ongoing drought, new Colorado River water conservation measures, including the System Conservation Implementation Agreement (SCIA) between Reclamation and the Imperial Irrigation District, are under development that will affect inflow into the Salton Sea. This agreement, administered through the Lower Colorado River Basin System Conservation and Efficiency Program and funded in part by the Inflation Reduction Act, supports voluntary system conservation to protect Colorado River reservoir storage volumes amid persistent drought conditions driven by climate change. Through this Agreement, the Imperial Irrigation District has proposed to conserve a volume up to a maximum of 300,000 acre-feet of Colorado River water each year from 2024 through 2026 which will remain in Lake Mead to benefit the Colorado River System and its users. Water conservation measures for after 2026 have not yet been developed but are anticipated.

5.6.2 Conservation Units and Targets

The conservation units associated with the Deserts Province are the Mono, Mojave Desert, Sonoran Desert, Colorado Desert, and Southeastern Great Basin ecoregions (Figure 5.6-2), as well as portions of the Central Lahontan (HUC 1605), Northern Mojave-Mono Lake (HUC 1809), and the Southern Mojave-Salton Sea (HUC 1810) hydrologic units (Figure 5.6-3). HUC 1503 (Lower Colorado Subregion), shown on Figure 5.6-3, is not specifically addressed in SWAP 2025, because the Lower Colorado River Multi-Species Conservation Plan is already in its implementation stage and addresses many conservation strategies important in HUC 1503. These ecoregions and hydrologic units are described below:

Ecoregion Summaries

Mono: This ecoregion is in the western part of the Great Basin, just east of the Sierra Nevada. Elevation range: 4,400 to 14,200 feet above sea level.

Mojave Desert: This section is the hot part of the Basin and ranges from the southern end of the Sierra Nevada and the north-northeastern side of the Transverse Ranges to Nevada and Arizona. Elevation range: –280 to 7,900 feet above sea level.

Sonoran Desert: This section is the hot part of the Basin and Range geomorphic province, from the eastern end of the Transverse Ranges and the Salton Trough east to Arizona. Elevation range: 250 to 4,400 feet above sea level.

Colorado Desert: This section is a very hot part of the Basin and Range geomorphic province that is sometimes called the Salton Trough. The surface of sediments in the middle of the trough is about 275 feet below sea-level. Elevation range: –230 to 2,200 feet above sea level.

Southeastern Great Basin: This section comprises the southern Great Basin in the Basin and Range geomorphic province. Characterized by basin and range topography (i.e., widely-separated short ranges in desert plains) and contains isolated mountains, plateaus, alluvial fans, basins, and dunes. Elevation range: 1,000 to 11,000 feet above sea level.

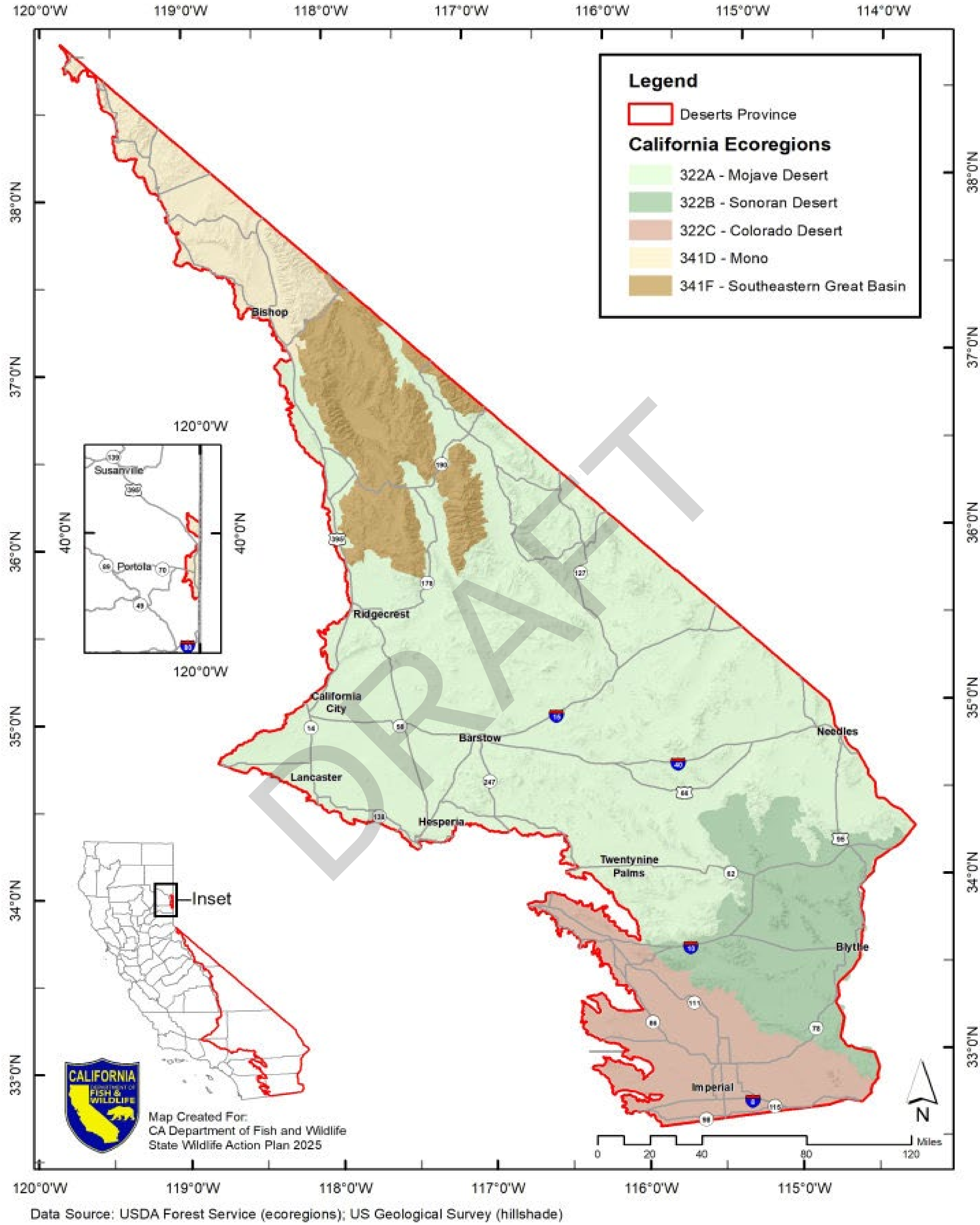


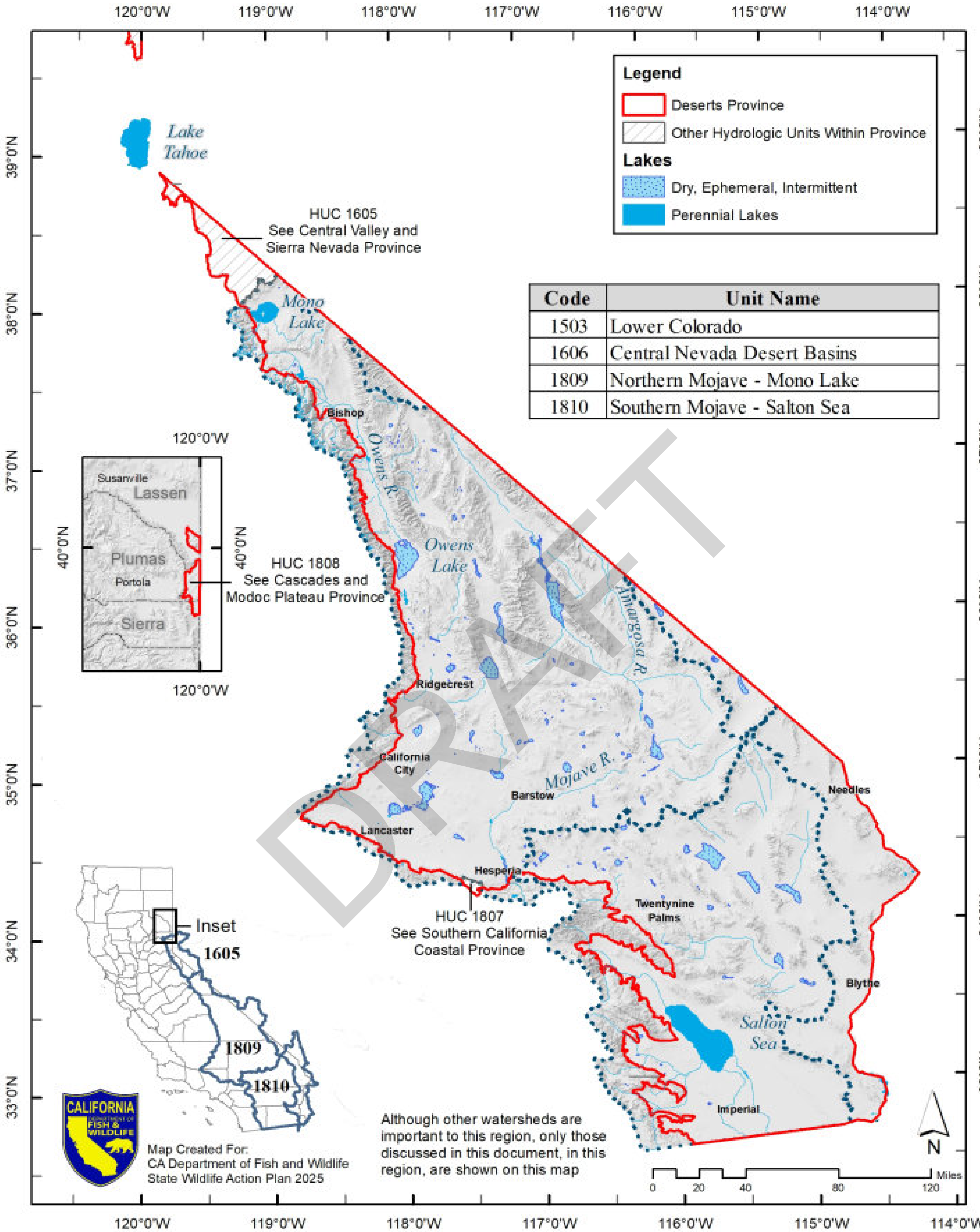
Figure 5.6 - 2 Ecoregions of the Deserts Province

Hydrologic Unit Summaries

Central Lahontan HUC 1605: Includes the Central Lahontan Basin, consisting of the Carson, Truckee, and Walker River Basins in California and Nevada. Covers an area of 12,500 square miles. Elevation range: 4,230 to 11,385.

Northern Mojave-Mono Lake HUC 1809: Includes the closed desert basins of eastern California that discharge into South Central California, including Mono Lake, Owens Lake, Death Valley, and the Upper Mojave Desert in California and Nevada. Covers an area of 28,000 square miles. Elevation range: –195 to 12,530.

Southern Mojave-Salton Sea HUC 1810: Includes the closed desert basins in southeastern California, including the lower Mojave Desert and the Salton Sea in California. Covers an area of 16,000 square miles. Elevation range: –230 to 10,040.



Data Source: National Hydrologic Dataset (NHD); US Geological Survey (hillshade)

Conservation Targets

Conservation targets were selected in this province as priorities for conservation planning within the conservation units; targets are listed in a searchable, sortable table (Table 5.0). The conservation targets are summarized in Section 5.6.6 along with the strategies for each. The conservation targets include:

Twelve conservation targets were selected in this province as priorities for conservation planning within the conservation units (Table 5.0). Summaries of these are provided in Section 5.6.6 along with the strategies for each. These conservation targets include:

- Big Sagebrush Scrub
- Great Basin Pinyon-Juniper Woodland
- Shadscale-Saltbush Scrub
- Desert Wash Woodland and Scrub
- Sparsely Vegetated Desert Dune
- American Southwest Riparian Forest and Woodland
- High Desert Wash and “Rangeland” Scrub, Great Basin Upland Scrub
- Mojave and Sonoran Desert Scrub
- Walker River Native Fish Assemblage
- Ciénegas
- Springs and Spring Brooks
- Anthropogenically-Created Aquatic Features

Figure 5.6-4 shows the distribution of the plant communities (CWHR common names) within the province. Some of the plant communities identified as conservation targets do not appear on the figure because they exist in areas smaller than the mapping unit. Information about the methods used to prioritize conservation targets is presented in Chapter 1.5 and Appendix D.

Key Aquatic Habitats in the Deserts Province

The following eight key habitats were identified as the aquatic conservation targets for SWAP 2025 and future SWAP updates, some of which are examined and reported more in detail under this document. Because of the extreme weather conditions and limited water availability, the aquatic ecosystems of the deserts significantly differ from the rest of the state and provide unique environments for native species. The Deserts Province team used the HUC system (see Chapter 1) as much as possible to select aquatic targets and developed strategies for SWAP 2025; however, the approach did not capture all the prominent features of the desert aquatic systems. A set of Species

Figure 5.6 - 3 Hydrologic Units of the Deserts Province

of Greatest Conservation Need (SGCN) found in the habitats are given at the end of each habitat description in parenthesis.

Rivers*: Large ocean-bound rivers form from sizeable montane watersheds and are usually groundwater-dependent and include the upper and lower Colorado River and Rio Grande, as well as their major tributaries like the Gila, San Juan, and Pecos rivers. [bonytail chub, Colorado pikeminnow, Colorado toad, razorback suckers]

Streams*: Fed by underground springs or runoff from rain and snow melt, streams such as the San Rafael (Upper Colorado), Rio Nutria (Lower Colorado), Black River (Pecos Basin), as well as isolated, often groundwater-driven relic drainage systems such as the Upper White River (Basin and Range) connect to these larger river systems. These include both perennial and intermittent (baseflow fed by groundwater) streams. Examples include the Owens River, Amargosa River, and Mojave River. [Amargosa (River) pupfish, Desert speckled dace, Long Valley Speckled dace, Mohave tui chub, Owens sucker, Owens tui chub, Salt Creek pupfish, Shoshone pupfish]

Springs and Spring Brooks*: Smaller spring-fed pool and run systems occur throughout the arid west and are included in the spring/spring brook habitats. [Cabin Bar tui chub, Cottonball Marsh pupfish, desert pupfish, Long Valley Speckled dace, Owens pupfish, Desert speckled dace, Owens tui chub, Saratoga Spring pupfish, Shoshone pupfish]

Ciénegas (and submersed wetlands)*: Ciénegas are water-saturated and poorly drained wetland areas associated with perennial spring and seep systems in isolated arid basins of the southwest. Cienega habitats are unique to the desert west and rapidly disappearing. [desert pupfish, Long Valley speckled dace, Desert speckled dace, Owens pupfish]

Ponds, Lakes, Reservoirs: Natural perennial stillwater (lentic) habitats plus man-made reservoirs. [Cabin Bar tui chub, desert pupfish, Desert speckled dace, Mohave tui chub, Owen sucker, Owen tui chub]

Aquatic Refuges: Natural, human-modified, or man-made watercourses/ waterbodies that are specifically managed or created for the recovery/restoration/conservation of at-risk native fishes. [Cabin Bar tui chub, desert pupfish, Long Valley speckled dace, Owen pupfish, Desert speckled dace, Owen tui chub, Shoshone pupfish]

Natural Ephemeral Aquatic Habitats: These include desert washes, dry arroyos, ephemeral (flowing in response to storm events, not groundwater) streams, playas, and vernal pools. [Couch's spadefoot]

Anthropogenically Created Aquatic Features: Various man-made features that function as perennial, intermittent, or ephemeral aquatic habitat, including agricultural drainage ditches, irrigation canals, roadside ditches, flood control

* The habitats definitions with (*) above are adapted from the Desert Fish Habitat Partnership, 2015, "Framework for Strategic Conservation of Desert Fishes" (Desert Fish Habitat Partnership 2015).

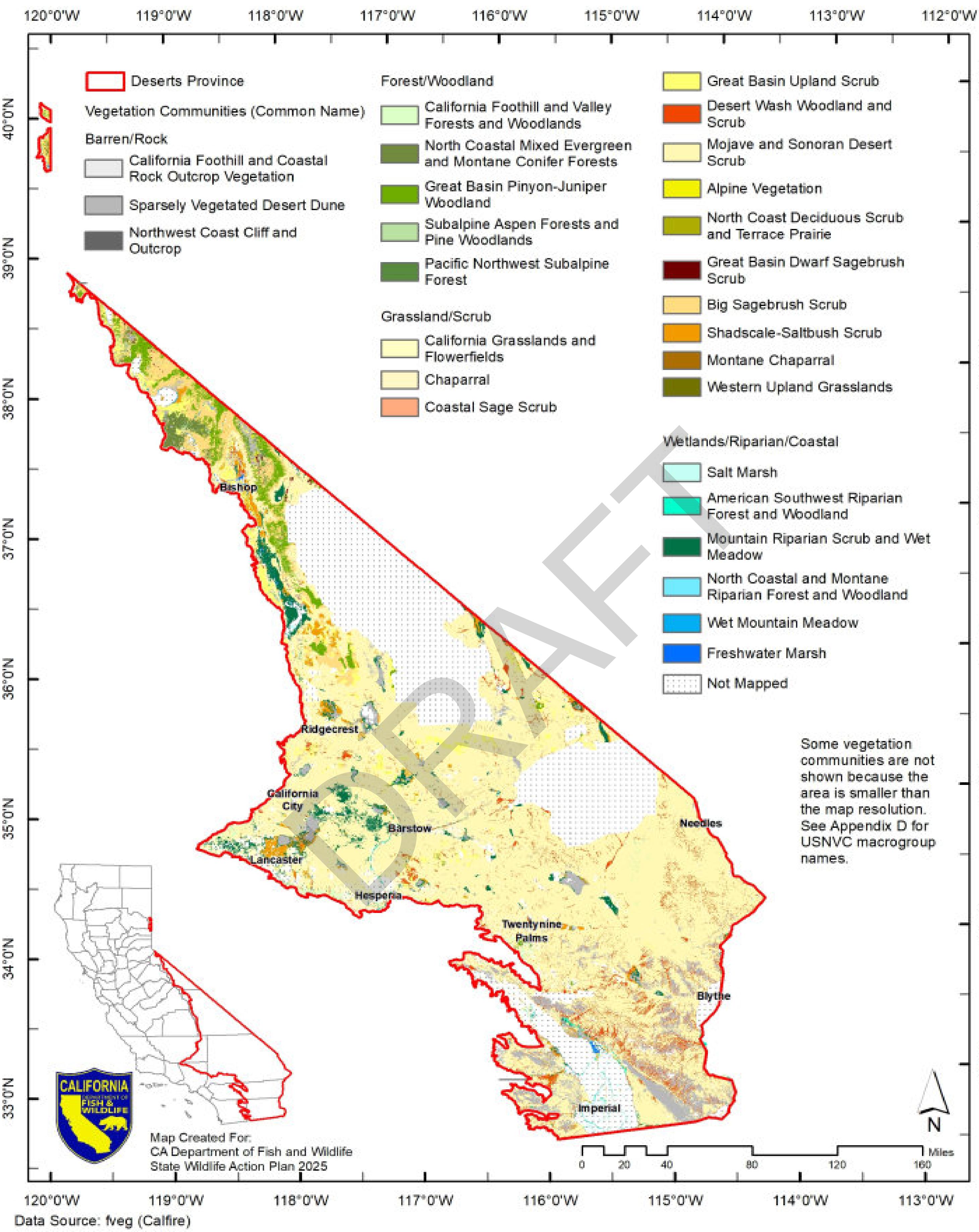


Figure 5.6 - 4 Plant Communities of the Deserts Province

5.6.3 Key Ecological Attributes

Key ecological attributes (KEAs) were identified for each conservation target (Table 5.0). These attributes are considered the most important for the viability of the targets and their associated species. The most commonly identified attributes for the Desert Province are:

- Community structure and composition
- Connectivity among communities and ecosystems
- Extent of community
- Hydrological regime
- Successional dynamics
- Soil quality and sediment deposition regime
- Surface water flow regime

5.6.4 Species of Greatest Conservation Need in the Deserts Province

The SWAP identified the Species of Greatest Conservation Need (SGCN) for the entire state and identified ecoregion(s) and province(s) associated with each SGCN; data is summarized in Appendix C. The conservation strategies are aimed at benefiting the SGCN via the conservation targets.

For those SGCN that do not occur within the conservation targets identified for the province, conservation actions that target SWG funding should align with existing recovery plan documents where applicable, or demonstrate they address a critical conservation need for the species.

5.6.5 Pressures on Conservation Targets

Using the Open Standards of Conservation, a stress is an impaired aspect of a conservation target, equivalent to a degraded KEA (Conservation Measures Partnership 2020). Pressures are primarily human activities, or natural phenomena influenced by humans, that amplify environmental stress and further degrade conservation target(s). The pressures identified in the Desert Province (Table 5.6-4) are the most significant pressures to the conservation targets but do not constitute a complete list of pressures in the province. Some principal pressures in the province are discussed in more detail below.

Dams and Water Management/Use

The primary pressures to aquatic habitats in the Deserts Province are the diversion of the Colorado River, decline of the Salton Sea, diversion of water from the Mono and Owens basins, and groundwater pumping and diversion for agricultural, industrial, municipal, and domestic uses.

Colorado River

The Colorado River is the region's largest perennial waterway, with aquatic species inhabiting the river's main stem and backwaters. Numerous bird species and other wildlife are dependent on the Colorado River riparian areas and the river delta at the Sea of Cortez.

The diversion of the Colorado River for agricultural and urban water uses substantially affects the region's wildlife and ecosystems. More than a dozen large dams control, store, divert, and allow for the consumptive use of nearly all the water in the Colorado River. These dams, as well as channelization, flood control structures, and flow regulation practices have drastically altered the river's flows and sediment transport processes. Flows are much reduced and have less variation. The delta wetlands at the Sea of Cortez have been reduced to about one-tenth of their original two million acres. Additionally, water is not available to recharge the groundwater table. In many locations, groundwater levels in riparian areas along the Colorado River have receded from historical levels of less than three feet to more than ten feet below the surface. Historically, sediment was deposited at the river delta or along the river's banks by flood events, creating deep floodplain soils. Over-bank flooding also flushed the soils of built-up salts, creating more favorable conditions for vegetation. Today, however, sediment transport is blocked by dams, and natural flooding is prevented along most of the river's length (CDFG 2005).

Salton Sea

The Salton Sea is the most recent in a series of inland lakes that have historically occupied the Salton Basin. Created by inadvertent flooding resulting from anthropogenic activities and partly sustained today by agricultural drainage water, the Salton Sea can be considered neither a natural nor an entirely artificial ecosystem. It is clear, however, that the sea provides critical resources for the region's wildlife, particularly for a great diversity of birdlife. More than 400 bird species have been recorded in the Salton Sea area, including approximately 100 locally breeding species.

The sea's importance stems from its status as the major remaining aquatic habitat of inland Southern California, from its location on the Pacific Flyway, and from the diverse array of habitat types it provides. The sea's proximity to the Imperial Valley's canals and fields creates a landscape mosaic uniquely able to fulfill multiple habitat requirements for nesting, foraging, and breeding.

The Salton Sea hosts the largest populations of several waterfowl and shorebird species in California south of the San Francisco Bay-Delta region. Several species protected as threatened or endangered (or other categories) maintain populations in and around the sea, including Yuma Ridgeway's rail and California black rail, and each of these uses a slightly different array of habitat types. The Salton Sea is a major staging area for waterbirds during migration in spring and late summer. A large percentage of the North American/global populations of eared grebe and ruddy duck overwinter on the open water of the sea and nearby impoundments. The sea is a primary wintering area in the interior U.S. for both American white and brown pelicans, western grebe, and western snowy plover, and is a major nesting area for the double-crested cormorant and Caspian tern. Each of these species is being monitored by Audubon Society due to population decline and sensitivity to climate change.

The Salton Sea is vital to migratory, wintering, and breeding waterbirds (Shuford et al. 2002). Birds may number in the millions during the winter. In some years, eared grebe numbers alone have been as high as 3.5 million. Several waterbirds of high conservation concern inhabit the sea, including brown pelican, American bittern, white-faced ibis, and ruddy duck. A significant portion of the North American populations of several sensitive species, including the eared grebe, American white pelican, and Ridgway's rail, are supported by the sea.

Threatened by a number of environmental problems, ranging from reduced freshwater inflows and increasing salinity to eutrophication, avian disease outbreaks, and the presence of toxic contaminants, the sea's health is declining, and birds that rely on the sea are at risk. Based on predicted trends, the brown pelican, white-faced ibis, California black rail, black tern, large-billed savannah sparrow, and most shorebirds (including long-billed curlew) are expected to struggle to maintain current population levels at the Salton Sea. The sea's decline prompted local agencies in 1993 to establish the Salton Sea Authority (composed of Imperial Irrigation District, Coachella Valley Water District, Imperial County, Riverside County, and the Torres Martinez Tribe) to address both biological and economic recovery. Most recently, the state of California established a Salton Sea Restoration Fund and took on responsibility for selecting a method for its restoration. At the federal level, the need to restore the sea was recognized with the enactment of the 1998 Salton Sea Reclamation Act, which charged the U.S. Department of the Interior (DOI) and U.S. Bureau of Reclamation (USBR) with the responsibility for restoring the sea.

The Salton Sea flooded several springs in the Salton Basin, which were inhabited by desert pupfish. Desert pupfish have not been encountered in the Sea during surveys for several years as the salinity has increased and the agricultural drains and inflows that feed it now act as habitat for desert pupfish. Due to this high salinity, pupfish are now likely restricted to agricultural drains, tributaries, shoreline pools, and possibly areas of freshwater influence near the Whitewater, Alamo, and New River deltas. The salinity of the Sea prevents its use as a conduit for connecting all remaining wild populations, including the spring-fed San Felipe Creek and Salt Creek.

Mono and Owens Basins

The Mono and Owens Basins receive precipitation in the form of snowfall and rainfall originating from the eastern Sierra Nevada. Winter snowfall in the Sierra Nevada is particularly important, as the snowpack melts during the spring and summer, providing a crucial source of water for both basins. Rainfall tends to be more sporadic and varies annually, with the majority of precipitation occurring during the winter months.

Mono Basin's hydrology is dominated by Mono Lake, a terminal lake. Streams originating from the Sierra Nevada, such as Rush Creek, Lee Vining Creek, and Mill Creek, carry snowmelt and rainfall into the basin, replenishing the lake. Due to its terminal nature, water in Mono Lake primarily leaves through evaporation, leading to high salinity and alkalinity levels and creating a unique aquatic environment that supports brine shrimp and alkali flies, which in turn attract numerous bird species.

Water exports began in the Mono Basin in 1941 when the Los Angeles Department of Water and Power (LADWP) started diverting water from the Mono Basin streams to the Los Angeles Aqueduct. Water is diverted from Lee Vining and Rush Creek into Grant Lake, which then exports the water into the Owens Basin via the Mono Craters Tunnel. This significantly reduced the inflow to Mono Lake, causing water levels to drop, salinity to increase, and the lake's ecosystem to be threatened. By the 1980s, the lake had lost over 25% of its surface area. Legal battles and conservation efforts led to a landmark decision in 1994 (D-1631) by the California State Water Resources Control Board to protect public trust resources by establishing minimum stream flows necessary to protect fishery resources and a management level for Mono Lake. The decision required LADWP to reduce water diversions and allow more water to flow into Mono Lake, aiming to restore and maintain the lake's ecological balance.

The Owens Basin's hydrology centers around the Owens River, which begins in the eastern Sierra Nevada and flows south through Long Valley and Owens Valley. As the river flows through the valley, it collects water from various tributary streams and artesian springs along the valley floor eventually reaching the Owens Lake. Historically, Owens Lake was a large, saline lake, but extensive water diversions by the Los Angeles Department of Water and Power (LADWP) have significantly reduced its water levels, causing it to become a dry lakebed.

The Owens hydrologic basin is a closed drainage system, meaning that water within the basin does not flow out to the ocean but instead evaporates or is diverted for human use. The basin's hydrology is heavily influenced by both natural processes and human interventions, such as water diversions for urban water supply and agricultural irrigation. The Owens River is a crucial water source for the region's ecosystem and agricultural activities. However, extensive water diversion projects in the early 20th century drastically altered the basin's hydrology.

In 1913, the completion of the Los Angeles Aqueduct allowed the LADWP to divert water from the Owens River to Los Angeles, significantly reducing the river's flow. This led to the desiccation of Owens Lake, which had previously been a large, saline lake. By the 1920s, Owens Lake had become a dry lakebed, causing environmental and air quality issues due to dust storms. The dust from the lakebed contained harmful particulates, making the area one of the largest sources of dust pollution in the United States.

In response to these environmental challenges, The Long-Term Water Agreement between the LADWP and Inyo County was established to manage groundwater resources in the Owens Valley and mitigate environmental impacts. The process began in 1972 when Inyo County sued LADWP under the California Environmental Quality Act (CEQA), necessitating an Environmental Impact Report (EIR) on groundwater pumping. In 1984, an interim agreement was executed, which called for cooperative studies and environmental enhancement projects. The draft of the long-term agreement was released to the public in 1989, and the final agreement was approved by both parties in 1991. This agreement aimed to manage water resources to avoid significant environmental impacts while ensuring a reliable water supply for both Los Angeles and Inyo County.

Both the Mono and Owens Basins exhibit unique hydrological characteristics shaped by natural processes and human interventions. The history of water diversions in these regions highlights the delicate balance between meeting urban water demands and preserving ecological health.

Groundwater Pumping

Groundwater pumping for agricultural, industrial, and domestic uses has lowered groundwater levels. Throughout the Mojave River basin, springs and riparian areas have dried up, causing water-stressed cottonwoods, willows, and mesquite to perish. In some areas, where groundwater levels dropped seven to ten feet, more than 50 percent of the cottonwood trees have perished. Where the water table has dropped by 20 feet beneath the Mojave River, 95 percent of the riparian forest has died. Many of the remaining areas of the riparian corridor are dominated by tamarisk (salt cedar), a non-native plant that invades areas where the native riparian habitat is stressed. Tamarisk roots can reach deeper for water, causing groundwater to recede farther (CDFG 2005) .

Development and the demand for water for domestic and industrial use continue to grow. Pressure to further overdraft groundwater, especially in the Mojave basin will be intense, as the projected annual water demand will increase from 129,000 acre-feet (AF) in 2023 to over 160,000 AF by 2065 (Mojave Water Agency 2024).

Stabilizing and increasing groundwater levels, in part by recharging overdrafted sub-basins, are essential to maintaining riparian habitats and allowing riparian-dependent wildlife to return to several areas of the Mojave River and adjacent streambeds. For example, the Mojave Water Agency as the Court appointed Watermaster for the Mojave Basin Area Adjudication, collects fees from groundwater pumpers that are used to purchase water from the State Water Project (SWP) and other sources, which can be distributed by pipeline for the purposes of groundwater recharge.

Groundwater overdraft also imperils the Amargosa River basin riparian habitat and wetlands. Groundwater pumping in the Amargosa Valley and in the upstream watershed is expected to increase. Increasing water use by expanding small residential communities is projected in the upper basin region of Amargosa Valley and Pahrump, Nevada. Ten thousand new homes have already been approved for construction in the small community of Pahrump. In addition, the city of Las Vegas also is seeking to tap into the groundwater basins of the surrounding rural areas in Nye County, Nevada. The Pahrump Valley is itself short of water for predicted local growth and is among the areas being examined to export water to Las Vegas (CDFG 2005). If the Amargosa River Basin is overdrafted, wildlife diversity will decline in Ash Meadows, the Amargosa Canyon, and in Death Valley National Park as the Amargosa riparian corridor withers.

Fish Slough, a spring-fed wetland that supports a diverse groundwater-dependent ecosystem, is threatened by groundwater pumping in a portion of the source aquifer. Spring discharge has been in decline since 1922 (DWR 1964; Jayko and Fatooh 2010; Los Angeles Department of Water and Power 2017), decreasing at a rate of 16%–20% per decade. These changes pose an imminent risk to the wetland writ large and critical habitat for aquatic and shallow-groundwater-dependent-species that are endemic to the area. If current trends continue it will result in the extinction of two species and the irretrievable loss of a culturally and biologically unique habitat. As the result of the long-term declines in groundwater and spring discharge, there have been documented habitat changes including the loss of shallow aquatic habitat previously occupied by Owens Pupfish and Amargosa Speckled Dace (Owens) in northern Fish Slough where two of the primary spring systems are located. Based on the long-term trend and ongoing monitoring, CDFW anticipates that this trend will continue, impacting additional aquatic species and propagating outward to other groundwater dependent ecosystems (Warner and Hendrix 1984; Center for Biological Diversity 2020).

Water Transfers and Diversions

With the natural aquatic and wetland systems of the desert dramatically altered and diminished, wildlife species in the region must depend on the water features related to irrigated agricultural lands. The once-arid landscape is now transected by a network of water delivery and drainage canals. Imperial Valley’s 475,000 irrigated acres and Coachella Valley’s 75,000 acres receive 3.2 million AF of Colorado River water annually (Cohen et al. 1999; Cohn 2000). Orchards and date palm plantations in the Coachella Valley and fields of cotton, alfalfa, Sudan grass, lettuce, sugar beets, onions, and melons in the Imperial Valley have replaced native desert communities.

The New and Alamo rivers, created when the Colorado River formed the Salton Sea, are now fed principally by agricultural drainage water, urban runoff and industrial waste, and provide isolated pools, marshlands, and mudflats used by shorebirds. The drains and canals used to transport water now support wetland vegetation communities and a number of sensitive species, including California black rail, western burrowing owl, and desert pupfish. Agricultural fields also provide wintering habitat for mountain plover, long-billed curlew, and sandhill crane (CDFG 2005).

In recent years, a number of regional agreements have been negotiated to transfer water from agricultural use to meet growing urban needs in other parts of the state. These water transfers will help the state to reduce its use of Colorado River water to its federal apportionment of 4.4 million AF/year.

In 2003, the Quantification Settlement Agreement (QSA) and related agreements allowed the transfer of 300,000 AF/year of Colorado River water from the Imperial Irrigation District (IID) to urban areas, primarily in coastal Southern California. The parties to these agreements included the IID, San Diego County Water Authority, the Metropolitan Water District of Southern California, USBR, and the State of California. Ultimately, water conservation through irrigation efficiency measures and lining canals with concrete (to prevent water loss through seepage) will supply the water for the transfer. Initially, however, large-scale fallowing of agricultural fields will provide surplus water for transfer.

In addition to the water transfers covered by the QSA agreements, other changes in the management of Colorado River water are planned in California and in the lower Colorado River basin states. These changes include additional agriculture-to-urban water transfers, increased water-transport efficiency, and changes in diversion points and dam release schedules to meet water supply and power generation needs. The environmental effects of these changes are addressed in the 2005 Lower Colorado River Multi-Species Conservation Program (LCRMSCP). The LCRMSCP allows changes in diversion points and dam release schedules on the Colorado River by water and power agencies in California, Arizona, and Nevada, as well as by USBR and sovereign Native American tribes. The program allows total water transfers of up to 1.574 million AF of Colorado River water per year. In California, the program allows up to 800,000 AF of Colorado River water to be transferred annually. These include transfers to urban areas, including some areas in Coachella Valley, from the IID, the Palo Verde Irrigation District, and the Bard Water District.

Under the Supplement to the Colorado River Interim Guidelines for Lower Basin Shortages and Coordinated Operations for Lake Powell and Lake Mead (2007 Interim Guidelines; USBR 2008), in all Lake Mead operating conditions, the three lower division states will target a cumulative Reservoir Protection Conservation volume of 3 million acre-feet or more of additional conserved water in total for calendar years 2023 through 2026, with a minimum of 1.5 million acre-feet physically conserved by the end of calendar year 2024. This conserved water is in addition to required shortage reductions as specified in the 2007 Interim Guidelines and water savings contributions as specified in the Lower Basin Drought Contingency Plan Agreement.

Several reservoir and water management decisional documents and agreements that govern the operation of Colorado River facilities and management of the Colorado River are scheduled to expire at the end of 2026. These include the 2007 Interim Guidelines, the 2019 Drought Contingency Plans, as well as international agreements between the United States and Mexico pursuant to the United States-Mexico 1944 Water Treaty. The Post-2026 process will be a multi-year NEPA process that will identify a range of alternatives and determine operations for Lake Powell and Lake Mead and other water management actions for potentially decades into the future.

If unmitigated, these water transfers would have substantial effects on the region's aquatic habitats and the wildlife species that depend on them. With less water applied to agricultural fields, less tailwater will flow through drains and be available to sustain the Salton Sea. Canal, drain, and irrigation-fed river habitats will be reduced. Lining canals with concrete will prevent groundwater recharge, reducing the amount of water that feeds seeps and springs as well as the Salton Sea. At the sea, lower water levels will affect shoreline habitat, and salinity will increase more rapidly with less incoming fresh water. Additionally, changes in water diversion points and in the timing of dam releases in the upper Colorado River basin will affect flows, habitats, and species in the lower Colorado River.

To address these effects, parties to the QSA and the LCRMSCP committed to a number of conservation measures to mitigate for the water transfers. Permits issued in conjunction with these agreements will allow for the take of protected species under the California and federal Endangered Species Acts (CESA, ESA) that result from the water management activities covered by these agreements. The QSA also includes commitments to work toward restoration of the Salton Sea.

Housing and Urban Areas; Roads and Railroads

The western Mojave region has experienced growth as residential development spread eastward from the Los Angeles Basin. Existing water planning provides for residential growth in the western Mojave to increase from current levels by 35% by 2065 (Mojave Water Agency 2024). Significant growth is not anticipated in the eastern Mojave of California, where there is little infrastructure. But growth across the California-Nevada state border, in Pahrump and Las Vegas, will likely have an increasing effect on California's eastern Mojave Desert.

Mojave Desert

In the western Mojave, sprawling development replaces and fragments desert habitat. Growing communities require additional rights-of-way for power lines, pipelines, and roads, which further fragments habitat. The addition of high-speed rail, connecting Mojave communities to Las Vegas and Los Angeles, as well as expansion of existing railroad facilities are projected to further increase growth in these areas. This pattern and density of growth dramatically increases the severity of development's effects on wildlife (CDFG 2005). Development also increases pressure to overdraft groundwater. Groundwater levels began dropping as a result of overdraft in the 1950s, drying up riverbeds, springs, and seeps and diminishing riparian ecosystems that depend on flowing water and saturated soils. The new water demands of rapid growth also reduce the options for recharging and restoring groundwater levels and increase reliance on transferred and imported water.

The West Mojave Plan was finalized by BLM in 2006 after a 15-year long planning process during which federal, state, and local wildlife- and land-management agencies worked to develop a multispecies regional conservation plan for the rapidly growing western Mojave. This amendment to the 1980 BLM California Desert Conservation Area (CDCA) Plan was prepared to conserve and protect the threatened desert tortoise, Mohave ground squirrel, and nearly 50 other sensitive plants and animals and their corresponding natural communities, while accommodating anticipated growth and development in the region (BLM 2005, 2006). The challenge of developing the conservation plan is to design scientifically supported conservation measures and land-use restrictions that will ensure the long-term survival of all native species. Under the West Mojave Plan (BLM 2006), the conservation of species would occur primarily on existing public lands managed by BLM. A very limited amount of additional private lands within the proposed conservation area would be purchased or protected, in conjunction with facilitating development and expansion of desert cities and communities. This is not consistent with the other Southern California regional conservation planning efforts, because it will provide BLM funding to be used for conservation of species on lands they already manage rather than securing protection of species on important lands at risk of being developed (CDFG 2005). The Apple Valley Multiple Species Habitat Conservation Plan (AVMSHCP) is also being developed for a subsection of the Mojave Desert and is based on the West Mojave Plan as its foundational framework (Town of Apple Valley 2025).

Colorado and Sonoran Deserts

The Colorado Desert region does not face the level of population and development pressures experienced across most of California, and is one of the state's least populous regions. However, some areas of the Colorado Desert have seen significant growth in recent decades and are facing the resulting challenges to regional wildlife. The two most notable examples are the Coachella Valley and southern Imperial County near the U.S.-Mexico border cities of Calexico and Mexicali.

Communities stretching from Palm Springs eastward to Indio, including outlying communities of Mecca, Coachella, Thermal, and North Shore in the southeast, have experienced continued growth. For example, Cathedral City continued to grow by 1.7 percent between 2020 and 2023; Palm Desert grew by 1.5 percent (U.S. Census Bureau 2023). New residential development, resort complexes, and golf courses have expanded, moving further up the canyons onto the lower slopes of the Peninsular Mountain Range and spreading across the natural communities and agricultural areas of the valley floor. Population in the valley's nine cities and surrounding unincorporated areas is projected to increase from approximately 330,000 in 2000 to 884,000 by 2035 (Boegle 2013).

The Coachella Valley's unique and diverse habitats host several sensitive, rare, and endemic species. Conflicts between these species and the rapid pace of development and recreational uses are at the forefront of wildlife agencies' concerns. Federal, state, and local agencies, along with conservation organizations, are addressing these issues through the regional habitat conservation plan, the Coachella Valley Multi-Species Habitat Conservation Plan.

The cities of El Centro and Calexico located on the US-Mexico border represent significant population centers in southern Imperial County. Some residents, drawn from coastal areas by affordable housing, commute up to two hours to the San Diego area. As of 2023, El Centro's population was 43,772 and Calexico's was 38,224 people (World Population Review 2025). Conversion of agricultural fields to residential development is a major pressure on wildlife populations. As previously described, irrigated agricultural fields are a critical component of the habitat mosaic that sustains the great diversity and number of birds in this region. Among the species most reliant upon the Imperial Valley's agricultural fields are mountain plover and western burrowing owl, California black rail, and sandhill crane.

Expanding communities also increase the need for infrastructure, including roads, powerlines, and water supply. As in other areas of the state, pressures on wildlife populations include direct destruction of habitat, pollution, fragmentation of habitats, blockage of migratory corridors, and introduction of non-native and potentially invasive species. Population growth in neighboring regions, especially along the South Coast and across the larger Sonoran Desert, also puts demands on the resources of the Colorado Desert. Utility corridors that traverse the desert—including electric lines, gas and oil pipelines, aqueducts, and supporting service roads—are continually expanded; increasing amounts of Colorado River water are directed to growing urban areas; and visitors seek recreation opportunities in the desert's open landscapes.

Invasive Plants/Animals

Many of the conservation actions described below address prevention, early detection, and rapid response to new invasive plants to prevent them from becoming widespread. Distribution maps and summary reports for invasive plants, as well as regional strategic plans for prioritized invasive plant species can be found on the CalWeedMapper). Some of the invasive species affecting the province are discussed below. Invasive species are discussed in more detail in Appendix E.

Mojave Desert

Numerous non-native plants have altered plant communities across large areas of the Mojave Desert, outcompeting native species and degrading upland and riparian habitats for native wildlife.

Invasive annual grasses and forbs have displaced native plants, often greatly diminishing the native forage for the desert tortoise, lizards, birds, and small mammals. These non-native grasses and forbs now dominate plant communities throughout the region. In desert tortoise critical habitat of the western Mojave, non-native plants account for more than 60 percent of the annual vegetative biomass (CDFG 2005). Some invasive plants, such as Saharan mustard, continue to spread across the region.

The abundance of non-native forbs and annual grasses (particularly common mediterranean grass , Arabian schismus, and foxtail brome) increases the fuel and continuity of fuels, facilitating more-frequent and hotter fires. This changes the fire frequency and fire intensity that native plants evolved with and favors other non-native plants that thrive in disturbed areas, further transforming the plant communities (CDFG 2005).

Imported tamarisk, a plant of inferior habitat value for native wildlife, has replaced native cottonwoods and willows in much of the riparian habitat of the Mojave River and of other watercourses in the region. A 1995 survey found that tamarisk dominated half of the 10,000 acres of riparian corridor along the Mojave River (Lines 1999; CDFG 2005). The leaves of tamarisk concentrate and shed salts, thus degrading soil conditions for native plants (Smith 1999). Tamarisk is more drought tolerant than native cottonwood trees and willows. In areas where groundwater levels are receding, tamarisk outcompetes water-stressed native plants (Cleverly et al. 1997; CDFG 2005).

In 2002, local, state, and federal agencies signed the Mojave Weed Management Area Memorandum of Understanding (MOU), which spells out a coordinated planning effort to prevent, control, and eradicate weeds and to educate the public about weed control in the region (Desert Managers Group [DMG] 2002). The MOU identifies a priority list of species to control in the Mojave.

The Mohave tui chub no longer occurs in the Mojave River, the only watershed to which it was native. The population of this endangered fish likely declined as a result of hybridization with arroyo chub, which was introduced into the headwaters of the Mojave River in the 1930s. The remaining populations of Mohave tui chub are all located in artificial ponds and natural springs. CDFW is currently looking for fishless waters within the Mohave River watershed where additional restoration and translocation could occur.

Burros and horses have inhabited the West since the end of the 16th century and grazed the California desert in significant numbers after being released by settlers and miners in the 1800s (Beever 2003; McKnight 1958). Descendants of wild asses from northeastern Africa, burros are well-adapted to the desert environment, and they readily propagate in Mojave Desert habitats where water and forage occur. Horses, although less adapted to the desert, have established herds in a few areas, can act as a disease vector and prey upon pupfish eggs.

Feral burros and horses compete with native ungulates for forage and burros aggressively exclude natives from water sources and can be particularly damaging to riparian areas and springs. Feral horses reduce vegetation cover, compact soils, and may increase erosion. Along the Colorado River and around springs in the Chocolate Mountains where they congregate, burros consume available forage, increase sediment runoff, and compete with bighorn sheep and other native wildlife for access to drinking water.

The 1971 Wild Free-Roaming Horses and Burros Act requires BLM to manage wild free-roaming horses and burros "in a manner designed to achieve and maintain a thriving natural ecological balance on public lands." BLM is also required to remove horses and burros where overpopulation exists "in order to restore a thriving ecological balance to the range." BLM established appropriate management levels (AMLs) for burro and horse herds in the Mojave Desert pursuant to the amended California Desert Plan of 1980. The levels were mostly established in the 1980s, based on the range capacity for grazing rather than on limits that would protect wildlife habitat and sensitive plant and animal species.

Because of the requirement under the Wild Horse and Burro Act that burros be managed through capture and relocation, herd control is time-consuming, labor-intensive, and costly. Burros have high reproduction rates. Thus, even where target herd-size limits have been set, herd sizes routinely exceed target numbers. The AML for burro and horse numbers are often greatly exceeded. Between 1981 and 1987, 18,700 burros were removed from the desert, but, since 1987, efforts to control burros have been limited because of lack of funding. Today there are 13 burro- and a few horse-herd areas in the Mojave region. Burro numbers exceed the AML in five of the 13 herd areas. In one management area, there are 280 horses where the AML is 168 horses (CDFG 2005).

Excessive burro numbers have led to overgrazing and degradation of desert resources. Riparian habitats associated with seeps and springs are often denuded and trampled by burros and horses. Water quality at seeps and springs frequented by burros or horses is usually poor because of accumulated sediment, urine, and feces. Feral burros and horses, non-native animals in the desert, place additional stress on the natural ecological balance of sensitive desert habitats (CDFG 2005).

Colorado and Sonoran Deserts

In the Colorado and Sonoran Desert regions the invasive tamarisk tree/shrub presents the greatest challenge. Tamarisk is virtually ubiquitous in riparian areas along the Colorado River. Alteration of the river's natural flow regime favors invasive tamarisk over native vegetation, in part because some native species are adapted to the historical seasonal flooding regime for dispersal and germination. Decreased flooding frequency results in salt buildup in riparian soils, and native species are less salt-tolerant than tamarisk. Tamarisk can also withstand reduced sediment deposition and lowered groundwater levels. In many places, tamarisk has completely replaced native cottonwood, willow, and mesquite and grows in dense mono-species stands. Even where native riparian trees remain, tamarisk usually grows among them (Glenn et al. 2001). It can also be found along most of the region's other waterways and aquatic habitats, including irrigation canals and drains and some springs. Tamarisk provides lower-quality habitat than native trees for nesting birds and other wildlife (including the southwestern willow flycatcher) and uses larger quantities of water than native vegetation, lowering groundwater levels and drying up desert springs while raising soil salinity.

In dune habitats, invasive plant species stabilize dunes with extensive root systems or block sand movement preventing natural migration and shifting. These invasive species often spread from adjacent development or along road corridors. Principle species of concern include Russian thistle, Saharan mustard, annual grasses of the genus Schismus, and tamarisk.

The brown-headed cowbird thrives in human-altered habitats, including fragmented landscapes like suburban developments and golf courses as well as in agricultural and grazing lands, where they are attracted to livestock droppings and feed. With the expansion of these land uses over the last century, cowbird populations have increased substantially in the Colorado Desert region, particularly in the Imperial and

Coachella valleys. Brown-headed cowbird parasitize the federally endangered southwestern willow flycatcher and are a main cause of this listed species' decline. Brown-headed cowbirds lay eggs in flycatcher nests, and the flycatcher parent birds may desert the nest or raise the cowbird young at the expense of their own. In California, brown-headed cowbirds have been reported using from 50 percent to 80 percent of flycatcher nests (Coachella Valley Association of Governments 2007).

Four of five endemic fishes in the Owens River basin have been excluded from nearly their entire natural habitat by the presence of introduced sport fishes, particularly largemouth bass and several species of imported trout. Competitive exclusion by mosquitofish is believed to play an important role in the imperilment of Long Valley speckled dace.

Another regionally sensitive species that is threatened by aquatic non-native species is the desert pupfish, a state and federally endangered species. Desert pupfish face many threats from non-native aquatic species that directly compete for resources or prey upon pupfish, their eggs, and offspring. These species include but are not limited to bullfrog (Lithobates catesbeiana), western mosquitofish (Gambusia affinis), and red swamp crayfish (Procambarus clarkii). Red-rim melania (Melanoides tuberculata) is a species of freshwater snail that

As in the Mojave Desert, Feral burros and horses are a significant issue in the Colorado Desert. Under the BLM Northeastern Colorado Desert Plan, target limits were set for burro herd size.

Livestock, Farming, and Ranching

Excessive livestock grazing has altered ecosystems across the desert. Grazing has been particularly detrimental to the wetland and riparian habitats, which are important for maintaining wildlife diversity in the desert, denuding and eroding fragile soils around rivers, springs, and seeps and polluting scarce surface water. Livestock reshape streambeds and trample and consume vegetation and seedlings of native trees and shrubs, preventing regeneration. Grazing has also altered the desert scrub ecosystems, reducing preferred native shrubs and herbaceous plants that support the desert tortoise and other reptiles, the Mohave ground squirrel, and other small mammals, birds, and butterflies (Avery 1999). Heavy grazing also facilitates the spread of cheatgrass and other invasive annual grasses, replacing native grasses, herbs, and perennial shrubs, further diminishing habitat conditions for wildlife (CDFG 2005). In turn, fires are more frequent where invasive annual grasses are abundant, preventing the natural restoration of native vegetation and further disturbing habitat for native wildlife.

Livestock and other non-native species can also carry and transmit pathogens with serious implications for native species' population viability. For example, there is significant professional and peer-reviewed consensus on the disease risk that domestic sheep and goats present to bighorn sheep (The Wildlife Society 2020). Currently the only available management strategy to mitigate this disease transmission is effective separation of domestic sheep and goats from the Desert Province's desert bighorn sheep, including the federally endangered population of Peninsular desert bighorn sheep. The susceptibility of these animals to disease is only heightened with multiple stressors (e.g., decreasing habitat connectivity, less reliable water sources, competition for forage, etc.).

Public agencies are altering grazing management on public lands to benefit desert species. For example, BLM removed grazing on nearly 1,214,000 hectares (3,000,000 acres) within the California portions of the Mojave and Sonoran deserts (USFWS 2011). The NPS has also dramatically reduced grazing in the Mojave National Preserve and sheep grazing has been halted in tortoise habitat of San Bernardino County, based on agreement among scientists and resource agencies that sheep grazing significantly degraded feed and habitat for the threatened desert tortoise. However, sheep and cattle continue to graze in wildlife habitats, including desert tortoise habitat, in the western Mojave areas within Inyo and Kern Counties. Cattle graze within Areas of Critical Environmental Concern (ACEC) and in areas designated as critical habitat for the desert tortoise, and they continue to degrade riparian habitats vital to numerous birds and mammals (CDFG 2005).

The extent of irrigated agriculture has decreased in the Mojave Desert during the last few decades due primarily to groundwater management activities, however crops such as alfalfa remain a significant use of groundwater in the Mojave Desert. In the Mojave River groundwater basin agricultural use was over 26,000 AF, with longer term water demand for agriculture expected to stabilize at 16,000 AF (Mojave Water Agency 2024).

Recreational Activities

The impacts of off-highway vehicles (OHVs) on fragile desert landscapes have been described by scientists and resource managers for more than 30 years. The 1980 California Desert Conservation Area Plan referred to OHVs as the "most pervasive management issue in the area." Along with direct collisions with desert tortoises and other wildlife, and the crushing of animal burrows, OHVs compact soils, induce erosion, spread invasive plant species, ignite fires, trigger ill-timed emergence of toads from their hibernacula, and denude the landscape of vegetation. Off-highway driving or riding has essentially a nonrestorable impact on some desert habitat; damaged soils and perennial vegetation are not likely to recover for several hundred years or more (CDFG 2005).

The number of OHV registrations in California has more than doubled since 1980, and the rapid growth of the numbers of OHV recreationists continues. In addition to resident recreationists, the Mojave Desert attracts millions of OHV visitors annually. While most motorcyclists and all-terrain vehicle riders are responsibly recreating at designated OHV parks or on designated trails and roads on public lands, many others are carving new trails across threatened desert tortoise and Mohave ground squirrel habitat, often across sensitive habitats in closed portions of designated ACEC. For example, BLM closed the 18,000-acre West Rand ACEC to OHV use in 2002 because of extensive damage to critical habitat for the desert tortoise. However, OHV users have routinely violated the closure (DMG 2002).

While desert planning efforts attempt to minimize OHV damage to natural resources by designating open, limited use, and closed areas, damage to natural resources continues. The lack of public education regarding the rules and road networks, lack of adequate enforcement staff, and outright defiance by a small segment of the OHV community have thwarted efforts to protect wildlife and vegetation, including areas around desert springs and other sensitive sites.

There are a limited number of BLM rangers per the million acres they are assigned to patrol, so the risk of receiving a citation for riding in restricted areas is very small. Agencies have posted signs indicating where vehicles are prohibited, but in many areas this is futile. BLM concluded in a June 2003 Record of Decision for the Western Mojave Desert Off-Road Vehicle Designation Project that "The least effective short-term action taken in the Ord Mountains was signing the closed route network. Not only did this effort consume a great deal of staff time; in addition, signs were removed almost as quickly as they were put up. The need to resign routes placed additional demands on scarce staff time and material."

The 2003 Record of Decision also revealed that BLM was unable to keep OHVs out of sensitive areas. The frequent destruction of signs led BLM to sign the open route network and to cease signing the closed areas, reasoning that people are less likely to destroy "open area" signs than "closed area" signs. While this saves signs, this policy makes it difficult to inform recreationists where OHV activities are prohibited, providing less protection for important habitats.

This earlier route designation project was updated by BLM in the West Mojave Route Network Project and final 2019 Record of Decision, however, in late 2024 a federal judge issued an order concluding that the route designation process did not adequately minimizes potential impacts to desert tortoise and other biological resources and indicated that further review and analysis of impacts is needed.

Sensitive habitats are particularly at risk where OHV parks or open areas are located on lands adjacent to those habitats. For example, riparian vegetation in the Jawbone-Butterbredt ACEC is routinely crossed by vehicles straying from the Jawbone and Dove Spring Canyon OHV open areas. The El Mirage and the Spangler Hills OHV open areas are contiguous to the Fremont-Kramer Desert Wildlife Management Area (DMG 2002).

In the Colorado Desert region, some of the greatest levels of OHV use occur in sand dune habitats. OHV use and trespass also has substantial effects on areas along the U.S.-Mexico border in Anza Borrego Desert State Park, and in stream beds and washes surrounding the Salton Sea. OHVs are particularly problematic in dune environments because compaction can inhibit the sand movement that is vital to dune replenishment and migration. Sand compaction may also negatively affect fringe-toed lizards, which can only burrow in fine, loose sand.

Renewable Energy

Renewable energy projects, including geothermal energy, wind energy, solar energy, and battery energy storage systems (BESS) have been constructed and are proposed throughout the Deserts Province. Siting, construction, decommissioning, and operational activities associated with wind turbine development and solar array installations, as well as transmission facilities result in loss of native vegetation and habitat for wildlife. California's deserts contain some of the highest rated solar energy resources in the world.

BLM and county planners have received a large number of applications for wind and solar energy development projects, many of which are located in remote parts of the region, raising concerns over the possible negative environmental effects associated with construction, maintenance, and access. Wind power expansion is a particular concern for birds and bats, because poorly designed or sited wind turbines and transmission lines can interfere with flight corridors and cause direct mortality (CDFG 2005). Renewable energy construction, maintenance, and access may increase the potential for introducing and spreading invasive plant species. Small and large-scale renewable energy development pose significant threats to habitat and vulnerable desert species.

Recognizing the pressures exerted on the desert ecosystem, preparation of the Desert Renewable Energy Conservation Plan (DRECP) was initiated in 2008 with a MOU between the California Energy Commission (CEC), CDFW, BLM, and USFWS, also known as the Renewable Energy Action Team (REAT). DRECP is a major conservation planning effort that was finalized in 2016, which helps provide effective protection and conservation of desert ecosystems while allowing for the appropriate development of renewable energy projects. The DRECP was prepared through a collaborative effort between REAT agencies. Approximately 22.5 million acres of federal and non-federal California desert land are in the DRECP Plan Area (CEC et al. 2014).

Bird collisions with power towers, heliostats, solar arrays, and injury or mortality from exposure to concentrated solar flux, are all known impacts of solar generation facilities (CEC et al. 2014). Based on planned development most collision and injury risk to avian and bat species would occur in the Colorado Desert and western edge of the Mojave Desert portions of the Province.

Both large transmission lines and networks of smaller collector lines present collision and electrocution hazards to bird species. Lines running perpendicular to migratory corridors or close to bird refuges represent greater hazards.

The Imperial Valley Geothermal Project in the Salton Sea Geothermal Field is the second largest geothermal field in the United States. There are 10 power plants located on private lands in this area, with 437 megawatts of installed capacity. There are about 28 production wells in the field producing over 265 billion pounds of brine annually, and 41 injection wells reinjecting just over 220 billion pounds of produced brine. Efforts to develop lithium and other metals from the geothermal brine in “Lithium Valley” are underway (CA State Lands Commission 2025).

Fire and Fire Suppression

While wildfire is a natural ecosystem process and an ecologically important disturbance in much of the state, wildfire within the Desert Province has historically been used for land management practices and as a result has shaped plant communities within the province. Prior to European colonization, fire events in this province were caused by Native American cultural burning practices and rare lightning strikes which have influenced the development of distinct plant communities and fire regimes within the different subregions and habitat types of the province. While today’s frequency of fire and annual acreage burned in the majority of California remains lower than pre-colonization levels, the size and severity of wildfires has increased over the past three decades. Accurate records of California’s wildfire history began in 1932, however historical evidence for fire in the Desert Province is limited due to the lack of long-lived trees to capture tree-ring records of fires (Keeley 2002; Anderson 2005), and European colonization accounts are inconsistent. Since accurate records began, 18 of the 20 largest wildfires occurred in the last 20 years, and none of those fires have occurred in the Desert Province (CAL FIRE 2024)).

Human-caused ignitions of fires that result from operational and maintenance activities associated with renewable energy facilities can destroy the natural communities found in the surrounding area. Desert scrub natural communities are naturally slow to recover from fire episodes. Desert scrub is also vulnerable to invasion of non-native grasses that often successfully compete with and overcome native assemblages (Brooks and Minnich 2018) and create a connection between larger shrubs that otherwise is often bare soil. This pressure has come to the forefront as the frequency of wildfire increases because of the invasion of desert habitats by non-native plant species has increased (Brooks 1999). OHV activity, roads, livestock grazing, agricultural uses, and other activities contribute to the spread of non-native species and the displacement of native species, and the direct loss and degradation of habitats (Avery 1998; Brooks and Lair 2005). For example, unmanaged livestock grazing, especially where plants are not adapted to large herbivorous mammals or where the non-native species are less palatable than the natives, can preferentially remove native vegetation, leaving non-native plants to grow under reduced competition (Wittenberg and Cock 2005). Changes in plant communities caused by non-native plants and reoccurring fire can negatively affect the desert tortoise by altering habitat structure and species available as food plants (Brooks and Esque 2002). Similarly, invasion of invasive brome grasses created a vector for the 2020 Dome Fire to spread between woody species, including Joshua tree, of which over one million died. Like many species in this province, Joshua tree is not adapted to frequent fire, which has hampered recovery efforts.

Climate Change

The climatic changes presented below will likely affect all conservation targets identified in this province. Climate change has only been included as a pressure for a subset of targets that are considered more vulnerable to climate impacts, and/or in instances where it was determined that interactions between climate change and other pressures could be addressed in a meaningful way through a conservation strategy.

The climate projections that follow are presented as averages across the entire province, except where otherwise indicated. While these projections provide more insight into the expected magnitude and direction of change in important climate variables compared to the statewide estimates in Chapter 2, climate change will not in fact unfold uniformly across the province. For additional information on regional variability in climatic change and associated vulnerabilities within the desert region, refer to the following resources (not an exhaustive list):

- Inland Deserts Summary Report: California's Fourth Climate Change Assessment (Hopkins et al. 2018)
- Climate change effects on southern California deserts (Bachelet et al. 2016)

Temperature and Precipitation

Climatic changes in the Desert Province are expected to include increased mean maximum temperatures of approximately 5.9°F by mid-century (2035–2064, centered on the year 2050) and 9.6°F by end-of-century (2070–2099, centered on the year 2085), compared to a historical baseline period (1961–1990); minimum temperatures are projected to increase across the province on average by 5.3°F by 2050 and 9.1°F by end-of-century (Pierce et al. 2018). Projections were generated based on a high-end greenhouse gas emissions scenario (RCP 8.5).

Across the Mojave, Sonoran, and Colorado Deserts, changes in annual precipitation will vary geographically, but annual precipitation rates are projected to decrease slightly throughout the century, compared to a historical baseline (Pierce et al. 2018).

Wildfire Risk

Wildfire risk is determined using several factors. Acres burned and re-burned, fire regime, and probability of ignition, are some of those factors. Over the last 20 years approximately 2%, or 380,000 of 25,400,000 acres have burned in the Desert Province (2004–2023, CALFIRE FRAP fire perimeters). Although the acreage burned is relatively low, most of the vegetation communities are not adapted to fire and therefore the cumulative impacts of fire with other stressors can be very detrimental to species and their habitats. The largest fires in this province over the last 20 years (York, Dome, and Wildhorse, totaling approximately 190,000 acres) have all occurred within the Mojave Desert ecoregion in a concentrated area less than 800,000 acres in size.

Based on a climate adaptation planning analysis conducted in 2012, most areas in the Desert climate impact region are projected to have the same or slightly increased likelihood of wildfire risk by 2085. The major exceptions to this projection were the Mecca San Gorgonio and San Jacinto Mountains, where wildfire was projected to be 1.5 and 2.0 times more likely, respectively (CalEMA and CNRA 2012).

This projection has been updated using more recent 2018 Cal-Adapt wildfire data for California's Fourth Climate Assessment. Annual area burned across the footprint of this province is expected to increase by approximately 23% by mid-century and up to 49% by the end of the century under a high-end emissions scenario, compared to a 1961-1990 baseline (Westerling 2018). The Western Region Climate Center's (WRCC) report on the Sonora Desert Climate Region indicates a 52% increase in annual area burned is projected from 2025 to the mid-century average (2035 - 2064) and a 44% increase is projected from 2025 to the end-century average (2070 - 2099). For the WRCC Mojave Desert Climate Region, a 26% increase in annual area burned is projected from 2025 to the mid-century average and a 20% increase is from 2025 to the end-century average. The average annual wildfire probability for both the Sonora Desert and

Mojave Desert climate regions is not projected to increase by 2100. Based on these datasets, wildfire is expected to significantly affect fish and wildlife and their habitats in the Desert province for the foreseeable future.

Western Joshua Tree Conservation Plan

Western Joshua tree (*Yucca brevifolia*) is an iconic species in southern California that is both ecologically and culturally important. The species provides food, nesting habitat, and shelter for wildlife. Western Joshua tree is also an important food source, used in traditional materials, and used for medicinal purposes. The Western Joshua Tree Conservation Act (Conservation Act) was passed by the California Legislature in July 2023 to conserve the species and its habitat while supporting the State's priorities, such as renewable energy and available housing. As part of the Conservation Act, CDFW developed the Western Joshua Tree Conservation Plan (WJTCP) in collaboration with California Native American tribes (tribes), governmental and non-governmental agencies, and the public.

The focus area of the WJTCP includes the known California range of western Joshua tree across Inyo, Kern, Los Angeles, Mono, Riverside, and San Bernardino counties, as well as occupied and unoccupied areas identified as climate refugia (i.e., future suitable habitat). Within the focus area, conservation management units are identified. These management units are based on climate, habitat quality, existing management authorities, and land ownership. Management actions are then organized and prioritized within each management unit based on the greatest benefit to the species and its habitat within that unit.

Much like SWAP 2025, the WJTCP focuses on providing a holistic, comprehensive set of management actions and effectiveness criteria necessary to conserve western Joshua tree and its habitat, while protecting cultural values, ensuring ecological resilience, integrating tribal co-management, and outlining a process for adaptive management.

In developing the WJTCP, meaningful tribal engagement was a priority for CDFW from the beginning. Engagement with tribes has been ongoing and respects the interests, priorities, and time and resource constraints of tribes. Collaborating with tribes has resulted in the inclusion of actions to establish co-management principles, incorporate Traditional Ecological Knowledge (TEK), and provide for the relocation of western Joshua trees to tribal lands upon request. This approach ensures that the Conservation Plan is built upon the wealth of knowledge from a diversity of sources.

5.6.6 Conservation Strategies

SWAP 2025 presents conservation strategies, including strategy objectives and targeted pressures, for the Desert Province. Actions that were identified for specific conservation units are listed with the strategy. Table 5.0 summarizes conservation targets for the province.

Target: Big Sagebrush Scrub

Big Sagebrush Scrub is emblematic of the valleys and lower slopes of the Great Basin Desert and occurs in California from the Modoc Plateau in the north, south and east of the Cascades and Sierra Nevada, into the higher mountains of the Mojave desert. It also occurs in isolated patches in the Transverse and Peninsular ranges, the south and the inner north Coast Ranges sporadically northward to the eastern Klamath Mountains.

Conservation Strategy 1 (Land Acquisition/Easement/Lease): Protect land through acquisition and easements; Identify land for protection of high-quality sagebrush habitat within the Desert Creek/Fales, Bodie, and South Mono sage-grouse population management units (PMUs) within the Bi-State DPS.

Objective(s):

- Identify high quality sagebrush habitat for protection within the Fales, Bodie, and South Mono PMUs
- Acquire land in fee title, conservation easement, or lease with the goal of protecting high priority sagebrush habitat within the Fales, Bodie, and South Mono PMUs

Targeted pressure(s): Housing and urban areas

Conservation action(s):

- Identify conservation and funding partners
- Coordinate with Wildlife Conservation Board (WCB)
- Coordinate with state and federal agencies and private landowners
- Develop inter-disciplinary team to facilitate land acquisition and conservation
- Determine what areas are already conserved, identify gaps
- Develop regionally appropriate criteria for conservation
- Identify and prioritize potential areas for acquisition and conservation
- Identify willing landowners of suitable habitat
- Develop conservation plans or agreements
- Identify and obtain funding for implementation of strategy
- Acquire land or conservation easements

Conservation Strategy 2 (Data Collection and Management): Prioritize and coordinate sage-grouse research efforts with landowners, land managers, and tribes, and monitor pinyon-juniper and cheatgrass invasions per the 2012 Bi-State Sage-Grouse Action Plan and the 2025 Action Plan Update (Partnership 2012, 2024)

Objective(s):

- Prioritize and coordinate sage-grouse research efforts with landowners, land managers, and tribes
- Monitor pinyon-juniper and cheatgrass invasions

Targeted pressure(s): Invasive plants/animals; parasites/pathogens/diseases

Conservation action(s):

- Participate with efforts to map cheatgrass and conifer expansion in sage scrub habitat
- Coordinate with land management agencies, private landowners, and tribes
- Coordinate use of decision support tools to guide restoration and enhancement efforts as outlined in the Bi-State Sage Grouse Action Plan and Updates
- Set priorities for treatment of invasive species
- Coordinate with stakeholder/expert groups
- Identify and obtain funding to implement strategy
- Conduct management treatments in high priority areas
- Coordinate research with Bi-State Cooperative

Conservation Strategy 3 (Economic Incentives): Provide economic incentives and purchase leases, acquisitions, or conservation easements on important sage grouse habitat with various funding sources

Objective(s):

- Purchase leases, acquisitions, or conservation easements of important sage grouse habitat with various funding sources

Targeted pressure(s): Housing and urban areas

Conservation action(s):

- Coordinate with state and federal agencies and tribes as well as nonprofit land conservation partners
- Identify and evaluate incentive programs applicable to private and public lands
- Identify willing landowners/lease holders
- Identify funding sources and obtain funding for implementation of strategy
- Design or support existing incentive programs
- Create coalition of conservation partners to help implement strategy

Conservation Strategy 4 (Direct Management): Implement resource management to promote healthy sagebrush ecosystems through the use of prescribed fire (where appropriate and not in conflict with sage-grouse conservation), and control of invasive species

Objective(s):

- Implement management actions to promote healthy sagebrush ecosystems, including prescribed fire and invasive species control

Targeted pressure(s): Fire and fire suppression; invasive plants/animals; parasites/pathogens/diseases

Conservation action(s):

- Coordinate with state and federal agencies, California Cattleman's Association, California Farm Bureau Federation, and private landowners to implement grazing best management practices (BMPs)
- Coordinate with state and federal agencies and private landowners to conduct prescribed fire projects
- Coordinate with state and federal agencies and tribes to manage conifer expansion through thinning where appropriate
- Develop management plan for invasive species
- Identify and prioritize areas for habitat restoration
- Obtain funding to implement strategy

Conservation Strategy 5 (Partner Engagement): Establish partnerships, coordinate efforts, and identify and combine funding sources with other agency funding for protecting, restoring, and enhancing sagebrush habitat

Objective(s):

- Local agencies, counties, and tribes coordinate efforts for protecting, restoring, and enhancing sagebrush habitat
- Funding sources are identified and combined with other agency funding for protection, restoration, and enhancement of sagebrush habitat
- Ensure consistency of SWAP conservation strategies with DRECP

Targeted pressure(s): Fire and fire suppression; invasive plants/animals; parasites/pathogens/diseases; housing and urban areas

Conservation action(s):

- Coordinate with state and federal agencies, California Cattleman's Association, California Farm Bureau Federation, and private landowners to implement grazing best management practices (BMPs)

- Coordinate with state and federal agencies and private landowners to conduct prescribed fire projects

Target: Great Basin Pinyon-Juniper Woodland

Great Basin Pinyon-Juniper Woodland includes all mixed and pure pinyon and juniper stands in trans-montane California. These are largely found in the Mojave Desert mountains, and in the mountains of the Modoc Plateau and Great Basin. They also occur on the eastern slopes of the Sierra Nevada and the Peninsular Ranges and the northern slopes of the Transverse Ranges.

Conservation Strategy 1 (Data Collection and Analysis): Research impacts of climate change on pinyon-juniper woodland viability and distribution

Objective(s):

- Conduct research and increase CDFW knowledge on climate change impacts on target habitat
- Land management agencies, tribes, non-governmental organizations (NGOs), and research scientists are able to research initiation and access data
- Areas have been prioritized for restoration, protection, or fuels treatments; and findings are used to design management actions

Targeted pressure(s): Climate change

Conservation action(s):

- Collect additional information on climate change projections on ecosystem health and distribution within the ecoregion
- Collect data that answers relevant questions on climate change impacts on ecoregional habitat
- Prepare and publish papers on research of underlying mechanisms or climate change emission impacts

Conservation Strategy 2 (Direct Management): Identify highest priority areas for restoration to pinyon woodland and native upland shrub communities and rehabilitation to manage and protect from annual grass and weed invasion

Objective(s):

- Restoration is implemented in burn areas and invasive species are treated

Targeted pressure(s): Climate change; invasive plants/animals

Conservation action(s):

- Restore areas of burned pinyon woodland habitats by seeding or planting pinyon pine, native shrub, forbs and grasses to restrict invasion by annual invasive species

- Treat invasive species using the best available tools
- Monitor success of restoration and vegetation management treatments

Conservation Strategy 3 (Direct Management): Identify highest priority areas and manage for restoration and rehabilitation to lower or eliminate fire risk: increase the use of prescribed fire and managed thinning in areas of post-settlement (1860) conifer expansion or old growth pinyon-juniper stands with high canopy cover and fire risk; protect old growth pinyon-juniper and juniper; and continue implementation of Bi-State Action Plan

Objective(s):

- Implement management actions and prioritize for management the highest fire-risk areas;

Targeted pressure(s): Fire and fire suppression

Conservation action(s):

- Identify priority areas for restoration and rehabilitation to reduce fire risk and protect old growth pinyon-juniper woodlands
- Implement Bi State Greater Sage-Grouse Action Plan
- Expand partnerships and agreements to increase the use of beneficial prescribed fire

Conservation Strategy 4 (Partner Engagement): Maintain partnerships through the Bi-state Action Plan, with BLM, USFS, NPS, tribal governments, and U.S. Geological Survey (USGS) to help coordinate data collection and implement management plan

Objective(s):

- Current partnerships such as the Bi-State Action plan are maintained, management plan is being implemented, and data are being collected for plan
- Areas of removal, restoration, or protection of target habitat are prioritized and implemented
- Ensure consistency of SWAP conservation strategies with DRECP and other conservation plans in the Deserts Province

Targeted pressure(s): Climate change; invasive plants/animals; fire and fire suppression

Conservation action(s):

- Prioritize and implement areas of removal, restoration or protection of macrogroup habitat
- Collect data in coordination with partnership groups

Target: Shadscale-Saltbush Scrub

Shadscale-Saltbush Scrub includes shrubby cool-desert saltbush species that often form distinct bands above closed basins and below extensive sagebrush belts in the Great Basin Desert. This conservation target addresses those saltbush scrubs, which typically do not grow in strongly saline or alkaline soils, but do tolerate higher pH (alkalinity) and often finer soil texture than *Artemisia tridentata* and related taxa of sagebrush.

Conservation Strategy 1 (Land Acquisition/Easement/Lease): Protect high-quality alkali desert scrub habitat through acquisition and easements

Objective(s):

- Increase the amount of acreage that is protected through purchase or conservation easement and identify high quality habitat for protection through purchase or easement

Targeted pressure(s): Roads and railroads; renewable energy; commercial and industrial areas; utility and service lines

Conservation action(s):

- Identify and prioritize potential areas for acquisition/easement
- Identify areas already conserved
- Evaluate availability of suitable habitat
- Acquire land or conservation easements
- Develop habitat conservation plan
- Develop advance mitigation plan
- Establish criteria for minimum and maximum habitat size (conserved)
- Evaluate feasibility of acquisition/easement
- Create interdisciplinary team to facilitate land acquisition and conservation
- Develop database to track acquisition/tracking
- Develop standard protection criteria for conservation easement
- Obtain funding for acquisition/easements

Conservation Strategy 2 (Data Collection and Analysis): Gather and analyze data, particularly on the distribution of invasive species and their impacts on shadscale-saltbush scrub

Objective(s):

- The distribution of invasive species and impacts to the target habitat are understood through research, and the distribution of invasive species within conserved lands is understood

Targeted pressure(s): Housing and urban areas; invasive plants/animals; annual and perennial non-timber crops; recreational activities

Conservation action(s):

- Identify basic tools needed for data and analysis
- Gather baseline information
- Develop scope of involvement
- Develop survey design and implementation plan
- Conduct economic impact analysis
- Evaluate ecosystem impacts
- Evaluate species impacts
- Identify and evaluate existing data
- Obtain funding to implement strategy
- Integrate climate change influence and modeling
- Conduct Geographic Information Systems (GIS) analysis
- Evaluate impacts to other ecoregions

Conservation Strategy 3 (Data Collection and Analysis): Gather data and conduct research to better understand alkali desert scrub ecology (e.g., population size, distribution, habitat relationships), pressures, and climate change effects; Collect and analyze baseline assessment information for alkali desert scrub

Objective(s):

- Alkali desert scrub ecological parameters are better understood, and baseline assessment information have been collected and analyzed

Targeted pressure(s): Roads and railroads; renewable energy; commercial and industrial areas; utility and service lines

Conservation action(s):

- Identify goals and objectives
- Coordinate with state and federal agencies and universities
- Design monitoring and implementation plan
- Prepare summary reports
- Obtain funding for strategy implementation
- Evaluate feasibility/efficacy of study design

Conservation Strategy 4 (Education and Outreach): Develop and implement an outreach program on the impacts of invasive species

Objective(s):

- Desert land managers are more knowledgeable about the impacts of invasive species

Targeted pressure(s): Housing and urban areas; invasive plants/animals; annual and perennial non-timber crops; recreational activities

Conservation action(s):

- Participate in efforts to conduct outreach about the impacts of invasive species
- Develop additional outreach programs where needed

Conservation Strategy 5 (Education and Outreach): Provide outreach and education on resource conservation practices

Objective(s):

- Desert managers and users are more knowledgeable, aware, concerned and participating in resource conservation practices

Targeted pressure(s): Roads and railroads; renewable energy; commercial and industrial areas; utility and service lines

Conservation action(s):

- Participate in efforts to conduct outreach about resource conservation practices
- Develop additional outreach programs where needed

Conservation Strategy 6 (Management Planning): Develop and implement management plans to guide maintaining or restoring connectivity for alkali desert scrub and SGCN

Objective(s):

- Develop and implement management plans to guide maintaining or restoring connectivity for alkali desert scrub and SCGN

Targeted pressure(s): Roads and railroads; renewable energy; commercial and industrial areas; utility and service lines

Conservation action(s):

- Develop management plans to guide maintaining or restoring connectivity for alkali desert scrub and SCGN
- Implement management plans to guide maintaining or restoring connectivity for alkali desert scrub and SCGN

Conservation Strategy 7 (Partner Engagement): Establish joint partnerships with desert land managers, tribes, and local governments (such as the Town of Apple Valley) to manage invasive species on conserved lands

Objective(s):

- Establish joint partnerships with desert land managers to manage invasive species on conserved lands
- Develop a mutually agreeable project after engaging with the partners
- Ensure consistency of SWAP conservation strategies with DRECP

Targeted pressure(s): Airborne pollutants; military activities; industrial and military effluents; housing and urban areas; invasive plants/animals; annual and perennial non-timber crops; recreational activities

Conservation action(s):

- Establish and participate in joint partnerships with desert land managers
- Develop projects to manage invasive species on conserved lands

Conservation Strategy 8 (Partner Engagement): Establish and develop co-management partnerships, use partnerships with desert land managers to manage invasive species on conserved lands, and integrate climate change considerations into management plans for species and habitats

Objective(s):

- Establish joint partnerships with desert land managers to manage invasive species on conserved lands

Targeted pressure(s): Roads and railroads; renewable energy; commercial and industrial areas; utility and service lines

Conservation action(s):

- Establish and participate in co-management partnerships
- Manage invasive species on conserved lands with partners
- Integrate climate change considerations into management plans for species and habitats developed with partners

Conservation Strategy 9 (Partner Engagement): Partner for joint advocacy, increase political awareness for conservation of alkali desert scrub in the Mojave ecoregion through education and outreach, and secure additional funding through grants or legislation; and ensure renewable energy development is consistent with DRECP conservation strategies.

Objective(s):

- Increase political awareness of conservation of alkali desert scrub in the Mojave ecoregion through education and outreach
- Establish additional funding through grants or legislation

- Ensure that renewable energy development is consistent with Desert Renewable Energy Conservation Plan strategies

Targeted pressure(s): Roads and railroads; renewable energy; commercial and industrial areas; utility and service lines

Conservation action(s):

- Coordinate with WCB; Office of Communication, Education, and Outreach; and Legislative Office
- Conduct bill analysis related to renewable energy
- Identify partners such as NGOs to advocate position
- Advocate science-based decisions and process
- Develop renewable energy BMPs
- Identify and prioritize conservation areas
- Conduct economic impact analysis
- Identify existing funding options
- Obtain funding to implement strategy

Conservation Strategy 10 (Training and Technical Assistance): Provide training on invasive species control and management

Objective(s):

- Increase the knowledge of managers about invasive species management and control techniques

Targeted pressure(s): Invasive plants/animals

Conservation action(s):

- Conduct regular training (e.g., annually) for CDFW staff and make available to other organizations

Target: Desert Wash Woodland and Scrub

Desert Wash Woodland Scrub occurs in the warm desert washes of the Sonoran and Colorado Desert. These washes have trees and large shrubs associated with them while the cooler Mojave Desert has fewer trees but several shrub species. Stands vary depending upon subsurface water availability, minimum winter temperature, and intensity and frequency of flooding. Also called microphyll woodland. Consists of drought-deciduous, small-leaved (microphyllous), mostly leguminous trees of riparian or wash areas. This plant community is considered an Important Bird Area by the Audubon Society. Wildlife species richness is much higher in this community than other community types in the desert, and this community is slow to recover from disturbance.

Conservation Strategy 1 (Data Collection and Analysis): Gather biological data and conduct research on SGCN and response to disturbance.

Objective(s):

- Collect ecological/biological data on SGCN and responses to disturbance

Targeted pressure(s): Roads and railroads

Conservation action(s):

- Identify partner agencies and organizations
- Conduct literature review-develop study design
- Develop budget
- Identify funding sources and apply for funding
- Determine SGCN-friendly structure designs
- Determine extent of disturbance from railroad use
- Define movement and habitat use patterns of SGCN
- Define distribution of SGCN

Conservation Strategy 2 (Outreach and Education): Provide education, including to BLM and USFWS on impacts from operations and maintenance activities within railroad right-of-ways (ROW)

Objective(s):

- BLM and USFWS are knowledgeable about the impacts from operations and maintenance activities within railroad ROW

Intended pressure(s) reduced: Roads and railroads

Conservation action(s):

- Develop materials and presentations about the impacts from operations and maintenance activities and provide to partners
- Identify opportunities to share information about the impacts from operations and maintenance activities and provide to partners
- Provide presentations, workshops and materials on this topic

Conservation Strategy 3 (Land Use Planning): Develop BMPs for roads and railroads

Objective(s):

- BMPs for road maintenance and construction are implemented
- Agreement is reached with Caltrans and counties on construction and repair of roads to minimize sediment effects
- Railroad employees become knowledgeable about seasonality of conditions and presence of listed and other sensitive species

- When Caltrans is implementing BMPs, look for opportunities for alignment of BMPs through the implementation of SWAP strategies and existing processes such as those in place at Caltrans

Targeted pressure(s): Roads and railroads

Conservation action(s):

- Develop BMPs for roads and railroads
- Complete agreements with Caltrans, counties, and railroads to protect natural resources

Conservation Strategy 4 (Partner Engagement): Partner for joint advocacy, with focus on conservation of SGCNs that use railroad ROW, and development of BMPs for ROW maintenance activities

Objective(s):

- BLM offices are more knowledgeable about SGCN that use railroad right-of-ways
- BMPs to protect SGCN are established for right-of-way maintenance practices
- When Caltrans is implementing BMPs, look for opportunities for alignment of BMPs through the implementation of SWAP strategies and existing processes such as those in place at Caltrans
- Ensure consistency of SWAP conservation strategies with DRECP

Targeted pressure(s): Roads and railroads

Conservation action(s):

- Develop partnerships to promote the conservation of SGCN occurring along railroad ROWs
- Work with partners and lead agencies on the development of BMPs for ROW maintenance

Target: Sparsely Vegetated Desert Dune

Sparsely Vegetated Desert Dune vegetation contains both annual and perennial species with special adaptations to deal with the shifting sands and the dry and unpredictable climate. Vegetation cover is variable depending upon unpredictable rainfall patterns.

Conservation Strategy 1 (Data Collection and Analysis): Collect data on plant community and SGCN status within ecoregion through range-wide surveys, climate change studies, and monitoring invasive species population trends

Objective(s):

- Appropriate audiences are accessing data

- Data are being used to inform conservation actions
- Research clearly provides answers to relevant questions on needs identified
- Research informs conservation actions

Targeted pressure(s): Climate change; invasive plants/animals

Conservation action(s):

- Collect data on macrogroup and SCGN status within ecoregion through range-wide surveys, climate change studies, and monitoring invasive species population trends
- Study climate impacts and invasive species impacts

Conservation Strategy 2 (Land Use Planning): Continue to provide input on local land use plans

Objective(s):

- At each annual review, the behaviors of local entities are consistent with input
- Local land use planners receive input on land use plans
- A land use plan is approved that is consistent with the input provided; Relevant land use plans include Imperial Sand Dunes Regional Advance Mitigation Plan (RAMP), Heber Dunes State Vehicular Recreation Area (SVRA) General Plan, Lower Colorado Multiple Species Conservation Plan (MSCP), San Diego East County MSCP, Coachella Valley Multiple Species Habitat Conservation Plan (MSHCP), IID, and DRECP

Targeted pressure(s): Climate change; housing and urban areas; recreational activities; invasive plants/animals

Conservation action(s):

- Provide input on local land use plans during development and annual review
- Ensure that approved land use plans are protective of natural resource protection objectives

Conservation Strategy 3 (Direct Management): Support implementation of existing habitat conservation plans (HCPs) to protect, restore, or enhance those areas of target habitat that are prioritized for such or have been degraded by invasive species or OHV; Enhance enforcement of existing HCPs, including illegal OHV use (Existing HCPs include Imperial Sand Dunes RAMP, Heber Dunes SVRA General Plan, Lower Colorado River MSCP, San Diego East County MSCP, Coachella Valley MSHCP, IID, and the DRECP)

Objective(s):

- Implement management actions

Targeted pressure(s): Recreational activities; invasive plants/animals

Conservation action(s):

- Prioritize plant communities requiring invasive weed treatment or restoration from OHV or grazing impacts
- Remove invasive weeds with mechanical, manual or other means from target habitats
- Plant prioritized areas denuded of vegetation or invaded with weeds with appropriate plants
- Enhance enforcement activities
- Fund the activities identified in any HCPs

Conservation Strategy 4 (Management Planning): Support the development and implementation of ongoing/existing management plans

Objective(s):

- Ensure that management plans include strategies, actions, and monitoring plans for SGCN, habitats, and natural processes
- The plan recommendations are being used to inform conservation actions

Targeted pressure(s): Climate change; housing and urban areas; recreational activities; invasive plants/animals

Conservation action(s):

- Acquire funding for planning, implementation, monitoring and management of the planning area
- Identify priorities for management plan development
- Create management and monitoring plans for priority areas

Conservation Strategy 5 (Partner Engagement): Maintain partnership presence in the planning process of HCPs to ensure the conservation of this target

Objective(s):

- The HCP/Natural Community Conservation Plan (NCCP) continues to be implemented

Targeted pressures(s): Climate change, renewable energy, housing and urban areas; recreational activities; invasive plants/animals

Conservation action(s):

- Active engagement by CDFW in HCPs and NCCPs in the planning and implementation process

Target: American Southwest Riparian Forest and Woodland

Warm desert riparian forests and thickets are included in the American Southwest Riparian Forest and Woodland target. The range of the main indicator trees and shrubs are the southwestern U.S. and northern Mexico. Most stands of this target occur below 4,000 feet elevation and are replaced by the cool-temperate version of riparian (Montane and North Coast Riparian Forest and Scrub) in the mountains and on the north coast. Diagnostic species include Fremont cottonwood, arroyo willow, and narrow-leaf willow. Most stands are found in permanently moist settings or riparian settings where sub-surface water is available year-round.

Conservation Strategy 1 (Data Collection and Analysis): Identify critical or sensitive riparian habitats in areas that may require special protections

Objective(s):

- Identify critical or sensitive riparian habitats in areas that may require special protections

Targeted pressure(s): Invasive plants/animals; parasites/pathogens/diseases

Conservation action(s):

- Identify degraded riparian habitats
- Inventory riparian habitats within the range of Inyo California towhee
- Monitor riparian habitats within the range of Inyo California towhee
- Obtain funding to implement strategy

Conservation Strategy 2 (Direct Management): Manage invasive species: control invasive and problematic vegetation, control invasive mammals (feral horse and burro), and prevent degradation of riparian habitat and springs from feral horses and burros.

Objective(s):

- Implement procedures (e.g., vegetation removal projects and long-term monitoring) to control invasive and problematic native vegetation
- Implement procedures to control invasive mammals (e.g., feral horse and burro populations)
- Implement procedure to prevent riparian (springs) habitat degradation (e.g., construct feral horse and burro exclusion fencing around severely degraded riparian habitat)

Targeted pressure(s): Invasive plants/animals; parasites/pathogens/diseases

Conservation action(s):

- Conduct invasive and problematic native plant removal projects

- Collaborate with appropriate agencies to conduct invasive animal roundups (e.g., feral horse and burro)
- Construct exclusion fencing
- Monitor post-project habitat conditions
- Obtain funding to implement strategy

Conservation Strategy 3 (Partner Engagement): Establish co-management partnerships, including with tribal governments, to conserve target habitat

Objective(s):

- Establish cooperative partnerships with all interested groups to conserve target habitat target

Targeted pressure(s): Invasive plants/animals; parasites/pathogens/diseases

Conservation action(s):

- Identify and contact NGOs interested in conserving target habitat (riparian springs)
- Create working alliance between all interested parties (e.g., tribes, BLM, USFS, CDFW, NGOs, NPS, China Lake Naval Weapons Station [CLNWS])
- Ensure consistency of SWAP conservation strategies with DRECP
- Identify conservation needs of riparian (springs) habitat
- Identify funding sources to implement projects

Conservation Strategy 4 (Land Use Planning): Engage in decision-making process and share information and agency priorities

Objective(s):

- Share information and agency priorities. Pool all entity information and conservation priorities to formulate a more comprehensive, complete habitat conservation strategy that satisfies all entity conservation concerns.

Targeted pressure(s): Invasive plants/animals; parasites/pathogens/diseases

Conservation action(s):

- Create a list of conservation goals from each partner in the group
- Prioritize the conservation goals from the list
- Develop a collaborative conservation management plan

Target: High Desert Wash and “Rangeland” Scrub; Great Basin Upland Scrub

High Desert Wash and “Rangeland” Scrub is a cool desert plant community that is most common in the eastern portions of the state from Modoc Plateau, southward and east of the Cascades and Sierra Nevada into the mountains of the Mojave

Desert. Stands form when fire or other clearing and disturbance remove stands of *Artemisia* (in big sagebrush scrub) or other shrubs characteristic of the Great Basin Upland Scrub community.

Conservation Strategy 1 (Data Collection and Analysis): Monitor and map invasive species, and study fire and climate-related effects on target habitats

Objective(s):

- Identify the locations of priority invasive species
- Ensure that NGOs, land managers, and landowners can access data and are using it to design management actions
- By the end of the project, data are being used to prioritize areas of restoration, rehabilitation, and protection

Targeted pressure(s): Climate change; fire and fire suppression; invasive plants/animals

Conservation action(s):

- Prioritize areas for restoration, rehabilitation, and protection
- Protect intact target habitat areas from fire
- Restore and rehabilitate target habitat areas

Conservation Strategy 2 (Direct Management): Restore and protect priority areas: identify highest priority areas for restoration, rehabilitation, and protection from fire, invasive species, or wild burros.

Objective(s):

- Implement management actions

Targeted pressure(s): Fire and fire suppression; invasive plants/animals

Conservation action(s):

- Identify and remove pockets of invasive species from otherwise intact target habitat in prioritized areas within ecoregion
- Conduct managed thinning in areas where undesirable conifer expansion has occurred, as well as decadent bitterbrush and mahogany groups in the ecoregion
- Restore and rehabilitate of target habitat that has been impacted by fires
- Identify intact stands of target habitats and identify and implement fuels reduction and protection treatment areas
- Fence areas damaged by wild burros or remove wild burros in prioritized areas

Conservation Strategy 3 (Management Planning): Comment on and amend management plans

Objective(s):

- Maintain current partnerships such as the Bi-State Local Area Working Group
- Implement management actions consistent with the management plans

Targeted pressure(s): Climate change; fire and fire suppression; invasive plants/animals

Conservation action(s):

- Participate in species and land use planning groups and plan preparation and review

Conservation Strategy 4 (Partner Engagement): Maintain and enhance partnerships, particularly with NPS; form a collaborative group for data collection and research, especially with BLM

Objective(s):

- Maintain current partnerships such as the Bi-State Local Area Working Group
- Implement management plan and collect data
- Form a collaborative group aimed at conservation and management of target habitat and collect data on climate-related impacts
- Ensure consistency of SWAP conservation strategies with DRECP

Targeted pressure(s): Climate change; fire and fire suppression; invasive plants/animals

Conservation action(s):

- Identify and contact tribes and NGOs interested in conserving target habitat (riparian springs)
- Create working alliance between all interested parties (e.g., tribes, BLM, USFS, CDFW, NGOs, NPS, and CLNWS)
- Identify conservation needs of riparian (springs) habitat
- Identify funding sources to implement projects

Target: Mojave and Sonoran Desert Scrub

Mojave and Sonoran Desert Scrub is found on hill slopes and alluvial fans throughout the arid southwest where winter temperatures are not as cold as in the Great Basin Desert and summer temperatures are very hot. The Mojave Desert has frost and occasional winter snows; the Sonoran Desert rarely has any frost. The warmer Sonoran Desert tends to have more summer rain, and more distinctive emergent arborescent species, such as saguaro, ocotillo, and the Mojave is cooler with fewer large cacti and large thorny trees but has Joshua trees and other Yucca species.

Conservation Strategy 1 (Land Acquisition/Easement/Lease): Conserve lands to maintain long-term viability of SGCN

Objective(s):

- Maintain long-term viability of SGCN through conservation of land

Targeted pressure(s): Renewable energy

Conservation action(s):

- Identify availability of prime habitat
- Prioritize acquisition
- Evaluate feasibility of acquisition
- Evaluate connectivity to existing conserved or preserved lands
- Consider protection using conservation easement
- Conduct appropriate project/document review
- Establish/foster partnerships with conservation NGO
- Ensure coordination with HCPs/NCCPs
- Collect data on SCGN to identify priority lands
- Identify and address data gaps
- Implement interagency coordination/acquisition

Conservation Strategy 2 (Outreach and Education and Partner Engagement): Partner for joint advocacy; Increase political awareness for conservation of desert scrub in the Sonoran Desert ecoregion; Secure additional funding through grants or legislation; Advocate for development consistent with strategy

Objective(s):

- Increase political awareness for conservation of desert scrub in the Sonoran Desert ecoregion
- Solicit additional funding through grants or legislation
- Advocate for development consistent with strategy

Targeted pressure(s): Housing and urban areas; invasive plants/animals; utility and service lines; annual and perennial non-timber crops

Conservation action(s):

- Develop partnerships to increase awareness for conservation of desert scrub
- Participate in land management planning efforts and environmental review to ensure protection of natural resources

Conservation Strategy 3 (Land Use Planning): Provide input on project planning and decision-making process; Conserve stream habitats and flows through participation in the planning and decision-making process

Objective(s):

- Conserve stream habitats and flows through participation in the planning and decision-making processes

Targeted pressure(s): Housing and urban areas; invasive plants/animals; utility and service lines; annual and perennial non-timber crops

Conservation action(s):

- Conduct environmental (California Environmental Quality Act [CEQA]/National Environmental Policy Act [NEPA]) review
- Participate in review of general plans/amendments
- Develop master Fish and Game Code (FGC) section 1600 et seq. permit (Lake and Streambed Alteration [LSA] Agreement) template consistent with strategy
- Develop standard permit requirements/criteria
- Identify and prioritize areas for conservation/protection
- Encourage establishment of mitigation banks
- Develop mitigation alternatives consistent with strategy
- Define success criteria for adaptive management
- Obtain funding to maintain mitigation areas and implement strategy
- Conduct Property Analysis Record analysis for mitigation sites
- Maintain mitigation and project tracking database

Conservation Strategy 4 (Management Planning): Develop HCP, NCCP, and management plans, with an emphasis on minimizing impacts of housing and urban growth

Objective(s):

- Minimize the impact of housing and urban growth through the establishment of conservation plans

Targeted pressure(s): Housing and urban areas; roads and railroads; invasive plants/animals; utility and service lines; annual and perennial non-timber crops

Conservation action(s):

- Participate in the development of HCPs, NCCPs, and management plans, to minimize impacts of growth on natural resources

Conservation Strategy 5 (Partner Engagement): Establish co-management partnerships, including with tribal governments

Objective(s):

- Establish cooperative partnerships with all interested groups to conserve target habitat
- Increase funding opportunities through combined funding and resources
- Share management responsibilities
- Develop and share baseline data for conservation of SGCN and target habitat
- Ensure consistency of SWAP conservation strategies with DRECP

Targeted pressure(s): Renewable energy

Conservation action(s):

- Identify and contact tribes and NGOs interested in conserving target habitat
- Create working alliance between all interested parties (e.g., Tribes, BLM, CDFW, NGOs, NPS, and CLNWS)
- Identify conservation needs of desert scrub habitat
- Identify funding sources to implement projects

Conservation Strategy 6 (Training and Technical Assistance): Provide training to agency staff on renewable energy issues, including technology, relevant research, ecological impacts, and conservation strategies

Objective(s):

- Educate agency staff on new renewable energy technology, current scientific research, and conservation strategies
- Provide training to renewable energy companies/contractors on pre-project planning process and ecological needs, areas to avoid, and mitigation

Targeted pressure(s): Renewable energy

Conservation action(s):

- Identify target audience
- Conduct interagency coordination
- Develop training curriculum
- Obtain funding for strategy implementation

Target: Walker River Native Fish Assemblage

SGCN associated with the Walker River Native Fish Assemblage include but are not limited to Lahontan cutthroat trout, mountain sucker, and mountain whitefish. Other, non-SGCN species include freshwater mussels.

Conservation Strategy 1 (Data Collection and Analysis): Collect data on the impacts of diversions, water management, water use, and the distribution of introduced genetic material on the native fish community

Objective(s):

- Understand the impacts of diversions, water management and water use to the native fish community
- Understand the distribution of introduced genetic material and impacts to the native fish community within the hydrologic unit

Targeted pressure(s): Introduced genetic material; invasive plants/animals; dams and water management/use

Conservation action(s):

- Collect data on the impacts of water management on native fish
- Collect data on the impacts of introduced genetic material on native fish

Conservation Strategy 2 (Outreach and Education): Provide outreach and education on native aquatic resource conservation efforts

Objective(s):

- Ensure that the public is aware, concerned, and participating in native aquatic resource conservation efforts within the hydrologic unit

Targeted pressure(s): Invasive plants/animals

Conservation action(s):

- Participate and host outreach and education events and share information about native aquatic resource conservation efforts
- Develop and share information about native aquatic resource conservation efforts through appropriate media (newspaper, websites, social media)

Conservation Strategy 3 (Law and Policy): Implement effective enforcement of laws

Objective(s):

- Increase Law Enforcement Division capacity to allow greater enforcement of water laws

Targeted pressure(s): Dams and water management/use

Conservation action(s):

- Identify laws and regulations governing riparian areas and work with governing agencies to apply effectively

- Design and implement instream flow studies to collect empirical evidence to support/defend enforcement actions to protect aquatic public trust resources
- Increase the number of branch and regional scientific staff working on water rights and instream flow studies
- Make recommendations to enhance enforcement of existing laws and regulations
- Provide law enforcement with maps of critical problem areas
- Provide funding for CDFW enforcement to enforce laws protecting streams and flows
- Obtain funding for strategy implementation
- Develop Law Enforcement Division Academy curriculum emphasizing water law
- Conduct Office of Training and Development (OTD) training for non-enforcement water policies

Conservation Strategy 4 (Direct Management): Manage water for beneficial uses by native aquatic species

Objective(s):

- State and federal agencies manage water for beneficial uses by native species (e.g., provide adequate water for species survival); Engage with the Walker Lake Acquisition/Transfer Program under desert terminal lakes program

Targeted pressure(s): Dams and water management/use; recreational activities; invasive plants/animals

Conservation action(s):

- Coordinate with water agencies
- Identify/coordinate with key stakeholders
- Collaborate with state and federal agencies for management plan development and review
- Identify and quantity water needs for native SGCN, non-SGCN, and introduced trout species
- Evaluate existing occupied habitats

Conservation Strategy 5 (Direct Management): Translocate or reintroduce native fish species

Objective(s):

- Establish self-sustaining and genetically viable native fish populations in the basin

Targeted pressure(s): Dams and water management/use; recreational activities; invasive plants/animals

Conservation action(s):

- Identify source populations
- Remove invasive or problematic species from historic native fish habitat
- Create georeferenced map/data base for native fish habitats
- Complete basin-wide native fish surveys and develop basin plan for native fish management
- Obtain funding for strategy implementation
- Coordinate management actions with natural resource agencies, NGOs and private landowners
- Collect/analyze genetic data to define priorities

Conservation Strategy 6 (Direct Management): Remove introduced brook trout in the context of recovery of listed Lahontan cutthroat trout

Objective(s):

- The extent and distribution of invasive species are known and a plan is developed by federal agencies and landowners to remove or control invasive species within the hydrologic unit

Targeted pressure(s): Invasive plants/animals

Conservation action(s):

- Update data on extent and distribution of native and non-native species
- Develop strategy for removal
- Coordinate with USFS and private landowners
- Secure permits and conduct environmental review
- Apply for funding
- Conduct treatments
- Conduct post-treatment monitoring
- Initiate long-term monitoring and management plan
- Monitor for re-establishment of invasive species
- Develop a management and control plan for invasive species

Conservation Strategy 7 (Direct Management): Implement direct management activities to restore aquatic habitats and ensure that SGCNs are maintained or enhanced

Objective(s):

- Direct management activities to restore aquatic habitats are implemented to ensure SCGN are maintained or enhanced within the watershed

Targeted pressure(s): Introduced genetic material

Conservation action(s):

- Conduct and support projects that restore aquatic habitats to ensure that SGCs are maintained or enhanced

Conservation Strategy 8 (Management Planning): Ensure that planning and decision-making processes support the conservation of stream habitats and flows as a result of CDFW input

Objective(s):

- Ensure that planning and decision-making processes support the conservation of stream habitats and flows as a result of CDFW input

Targeted pressure(s): Dams and water management/use

Conservation action(s):

- Participate in planning and decision-making processes to ensure that stream habitats and flows are represented and protected

Conservation Strategy 9 (Management Planning): Develop, update, and implement grazing BMPs

Objective(s):

- Land managers within the watershed implement BMPs for grazing practices that reduce impacts to aquatic habitats

Targeted pressure(s): Livestock, farming, and ranching

Conservation action(s):

- Identify partners and stakeholders
- Identify and review existing grazing management policies
- Develop MOU/MOA between partners
- Schedule regular working group meetings
- Develop BMPs including enforcement policy
- Provide input to land management agencies on grazing policies
- Implement BMPs
- Link to education and outreach strategy
- Identify funding sources, apply for funding

Conservation Strategy 10 (Management Planning): Reduce impacts to native fish as a result of roads and railroads and invasive species through development and use of BMPs

Objective(s):

- Land managers implement BMPs to reduce impacts to native fish community from roads and railroads
- BMPs for road and rail maintenance activities are established and used by land managers to reduce impacts to native fish community from invasive species
- When Caltrans is implementing BMPs, look for opportunities for alignment of BMPs through the implementation of SWAP strategies and existing processes such as those in place at Caltrans

Targeted pressure(s): Invasive plants/animals; roads and railroads

Conservation action(s):

- Collaborate with partner in development or updating of BMPs
- Collaborate with state and federal agencies and landowners
- Identify existing BMPs, develop BMPs database
- Establish working group to define BMPs
- Obtain funding to implement strategy

Conservation Strategy 11 (Partner Engagement): Establish and develop co-management partnership to affect change in dams and/or water management and use following interagency agreement

Objective(s):

- Establish a joint partnership to affect change in dams and/or water management and use following interagency agreement
- Ensure consistency of SWAP conservation strategies with DRECP

Targeted pressure(s): Dams and water management/use

Conservation action(s):

- Establish and develop co-management partnerships related to water management
- Coordinate with other agencies on water management agreements

Target: Ciénegas

Ciénegas includes springs and marshy areas at the base of a mountain, in a canyon, or on edges of grasslands where groundwater flows to the surface. Ciénegas are often isolated features (i.e., not draining into a stream) and evaporate, forming a small playa. SGCN associated with this target include but are not limited to: Long Valley speckled dace, Amargosa speckled dace, Owens pupfish, and desert pupfish.

Conservation Strategy 1 (Land Acquisition/Easement/Lease): Protect high-quality ciénegas through acquisition/easement/lease

Objective(s):

- Increase the protection of high quality ciénegas habitat through acquisition/easement/lease

Targeted pressure(s): Livestock, farming, and ranching

Conservation action(s):

- Identify potential areas
- Identify what is already conserved
- Prioritize acquisition sites
- Determine availability of suitable habitat
- Acquire conservation easements
- Develop habitat conservation plan
- Develop advance mitigation plan
- Determine minimum and maximum habitat size (conserved)
- Determine feasibility
- Develop interdisciplinary team to facilitate land acquisition and conservation
- Develop database to track acquisition/tracking
- Develop protection criteria for conservation easement language

Conservation Strategy 2 (Data Collection and Analysis): Gather and analyze data on impacts of water management and water use, renewable energy projects, groundwater use for farming and livestock, and invasive species on native species within ciénegas

Objective(s):

- Understand impacts of water management and water use, renewable energy projects, groundwater use for farming and livestock, and invasive species to ciénegas and associated species

Targeted pressure(s): Annual and perennial non-timber crops; livestock, farming, and ranching; renewable energy; invasive plants/animals

Conservation action(s):

- Develop partnerships and interagency agreements to participate in monitoring networks for water management and use, renewable energy, groundwater, agriculture, and invasive species
- Identify existing data gaps in the monitoring network
- Implement additional data collection and monitoring where necessary

Conservation Strategy 3 (Outreach and Education): Provide outreach and education about the need for resource management of ciénegas

Objective(s):

- The public is aware of the need for resource management of ciénegas

Targeted pressure(s): Invasive plants/animals; fire and fire suppression

Conservation action(s):

- Develop partnerships to provide outreach and education about the management of ciénegas
- Develop outreach and education materials regarding ciénega management

Conservation Strategy 4 (Direct Management): Translocate or reintroduce native aquatic SGCN and establish genetically viable populations

Objective(s):

- Self-sustaining and genetically viable populations of native aquatic SGCN species established are reintroduced and reproduced one generation in the wild

Targeted pressure(s): Invasive plants/animals

Conservation action(s):

- Identify source population
- Remove invasive or problematic species
- Map suitable habitats
- Develop management plan
- Secure funding
- Connect to barrier aspects
- Engage in cooperative management with agencies and NGOs
- Perform genetic analysis
- Develop a genetic management plan

Conservation Strategy 5 (Direct Management): Participate in interagency review of water management and use, particularly groundwater withdrawals

Objective(s):

- Reduce groundwater withdrawals through agreements with water agencies and private landowners

Targeted pressure(s): Dams and water management/use; housing and urban areas; annual and perennial non-timber crops; livestock, farming, and ranching; renewable energy

Conservation action(s):

- Participate in water management and use planning discussions and project/plan review
- Provide education about surface and groundwater dependent ecosystems
- Ensure the protection of groundwater dependent ecosystems

Conservation Strategy 6 (Partner Engagement): Establish and develop co-management partnerships, including with tribal governments

Objective(s):

- Establish partnerships in the following areas:
- fire management and fire suppression
- water use
- management of invasive species
- impacts from renewable energy projects
- Ensure consistency of SWAP conservation strategies with DRECP

Targeted pressure(s): Dams and water management/use; renewable energy; invasive plants/animals; fire and fire suppression

Conservation action(s):

- Establish a joint partnership with USFS and CAL FIRE to affect change in fire management and fire suppression
- Develop a joint partnership with water agencies focused on management of impacts from water use
- Establish a joint partnership with CIPC, USDA, and NRCS to address management of invasive species
- Develop a joint partnership with BLM focused on managing impacts from renewable energy projects

Target: Springs and Spring Brooks

SGCN associated with Springs and Spring Brooks include but are not limited to: Cabin Bar tui chub, Cottonball Marsh pupfish, Long Valley speckled dace, Owens pupfish, Owens tui chub, Amargosa Speckled Dace (Owens), Shoshone pupfish, Saratoga Springs pupfish, southwestern pond turtle, black toad, Hydrobiidae springsnails, and arroyo toad.

Conservation Strategy 1 (Land Acquisition/Easement/Lease): Protect high-quality springs and spring brooks through acquisition/easement/lease

Objective(s):

- Protect high-quality springs and spring brooks

Targeted pressure(s): Annual and perennial non-timber crops; livestock, farming, and ranching

Conservation action(s):

- Identify potential areas
- Identify what is already conserved
- Prioritize acquisition sights
- Determine availability of suitable habitat
- Acquire conservation easements
- Develop habitat conservation plan
- Develop advance mitigation plan
- Determine minimum and maximum habitat size (conserved)
- Determine feasibility
- Develop interdisciplinary team to facilitate land acquisition and conservation
- Develop database to track acquisition/tracking
- Develop protection criteria for conservation easement language

Conservation Strategy 2 (Data Collection and Analysis): Study and document impacts of invasive species, renewable energy projects, and dams and water management and use on spring ecosystems and associated species for future management actions

Objective(s):

- Document the impacts of invasive species on spring systems and aquatic species
- Impacts of renewable energy projects to spring systems and species
- Impacts of dams, water management, and water use to the spring systems for future management actions

Targeted pressure(s): Livestock, farming, and ranching; recreational activities; commercial and industrial areas; renewable energy; introduced genetic material; invasive plants/animals; marine and freshwater aquaculture

Conservation action(s):

- Develop partnerships and interagency agreements to participate in monitoring networks for water management and use, renewable energy, groundwater, agriculture, and invasive species
- Identify existing data gaps in the monitoring network
- Implement additional data collection and monitoring where necessary

Conservation Strategy 3 (Outreach and Education): Provide outreach and education, with emphasis on improving public awareness, concern, and participation in resource conservation that leads to improved conditions for native fish

Objective(s):

- Improve public awareness, concern, and participation in resource conservation within the watershed, leading to improved conditions for native fish

Targeted pressure(s): Livestock, farming, and ranching; recreational activities; commercial and industrial areas; renewable energy; invasive plants/animals; marine and freshwater aquaculture

Conservation action(s):

- Develop partnerships to provide additional outreach and education about native fish
- Develop outreach and education materials regarding native fish

Conservation Strategy 4 (Direct Management): Translocate or reintroduce native aquatic SGCN and establish genetically viable populations

Objective(s):

- Establish self-sustaining and genetically viable populations of native fish species within the watershed

Targeted pressure(s): Livestock, farming, and ranching; recreational activities; commercial and industrial areas; renewable energy; introduced genetic material; invasive plants/animals; marine and freshwater aquaculture

Conservation action(s):

- Identify source populations
- Remove invasive or problematic species from historic native fish habitat
- Create georeferenced map/data base for native fish habitats
- Develop basin plan for native fish management
- Obtain funding for strategy implementation
- Coordinate management actions with natural resource agencies, NGOs and private landowners
- Collect/analyze genetic data to define priorities

Conservation Strategy 5 (Direct Management): Manage dams and other barriers to control fish passage

Objective(s):

- Agreement is reached by state and federal agencies, and water agencies, to modify management of Mono Lake springs, brooks, dams, and barriers to encourage fish passage and prevent genetic mixing with non-native fish

Targeted pressure(s): Invasive plants/animals; dams and water management/use

Conservation action(s):

- Create/develop geospatial database of barriers and dams
- Conduct literature review, consult with experts to gather species distribution information
- Conduct viability study of barrier designs to determine optimal design
- Obtain required permits for installation of barriers
- Evaluate barrier design and efficiency
- Develop manmade barrier maintenance protocol
- Obtain funding to implement strategy

Conservation Strategy 6 (Direct Management): Manage invasive species to expand range of native fishes

Objective(s):

- Treat areas with invasive species within the watershed

Targeted pressure(s): Invasive plants/animals

Conservation action(s):

- Update data on extent and distribution of native and non-native species
- Develop strategy for removal
- Coordinate with USFS and private landowners
- Obtain permits and environmental review
- Apply for and obtain funding
- Conduct treatments
- Conduct post treatment monitoring
- Initiate long-term monitoring and management plan
- Monitor for re-establishment of invasive species
- Develop a management and control plan for invasive species

Conservation Strategy 7 (Management Planning): Provide input on local planning decisions

Objective(s):

- Ensure that local plans account for the need to conserve Mono Lake tributary stream habitats and flows

Targeted pressure(s): Livestock, farming, and ranching; recreational activities; commercial and industrial areas; renewable energy; introduced genetic material; invasive plants/animals; marine and freshwater aquaculture

Conservation action(s):

- Coordinate early and often with lead agencies

- Identify and prioritize ACE and refine ACE for aquatic and riparian communities
- Identify existing conserved areas
- Direct project mitigation to priority areas needing conservation
- Direct and use conservation banking
- Create ACE database viewable by all CDFW staff
- Incorporate conservation goals and BMPs into CEQA comment letters
- Provide input at meetings
- Obtain funding for plan implementation
- Participate in CEQA review, General Plan review
- Develop standard permit requirements, master FGC section 1600 et seq. LSA Agreement permit template

Conservation Strategy 8 (Partner Engagement): Establish and develop co-management partnerships, including with tribal governments

Objective(s):

- Establish joint partnerships with water agencies, land managers, state and federal agencies, tribes, and other interested stakeholders
- Ensure consistency of SWAP conservation strategies with DRECP

Targeted pressure(s): Livestock, farming, and ranching; recreational activities; commercial and industrial areas; renewable energy; invasive plants/animals; marine and freshwater aquaculture

Conservation action(s):

- Establish a joint partnership with water agencies and users to affect change in dams and/or water management and use
- Establish a joint partnership with land managers and landowners to manage invasive species
- Establish a joint partnership with state and federal agencies to manage renewable energy project impacts and mitigation

Target: Anthropogenically Created Aquatic Features

Various man-made features including agricultural drainage ditches, irrigation canals, roadside ditches, flood control basins, borrow pits, railroad berms, golf course ponds, cattle stock ponds, and duck club ponds. These features were not created with the intent of providing fish or amphibian habitat. Species of Greatest Conservation Need associated with target is desert pupfish.

Conservation Strategy 1 (Data Collection and Analysis): Collect data on the distribution of invasive species and impacts to the target habitat, species utilization of anthropogenic waterways, and the distribution of temporary aquatic habitats associated with roads and railroads to inform management.

Objective(s):

- Document the distribution of invasive species and impacts to target habitat, distribution of native and invasive species, and the extent of created aquatic habitats to inform management

Targeted pressure(s): Roads and railroads; dams and water management/use; invasive plants/animals; agricultural and forestry effluents

Conservation action(s):

- Scientifically study the distribution of invasive species and impacts to the target and use study results to inform management
- Understand species utilization of anthropogenic waterways and sources through surveys and reporting
- Study the distribution of aquatic species in temporary aquatic habitats associated with roads and railroads and use study results to inform management

Conservation Strategy 2 (Outreach and Education): Provide outreach and education, with emphasis on improving public awareness, concern, and participation in resource conservation

Objective(s):

- Improve public awareness, concern, and participation in resource conservation

Targeted pressure(s): Dams and water management/use; invasive plants/animals; agricultural and forestry effluents

Conservation action(s):

- Develop partnerships to provide additional outreach and education about created aquatic features and associated species
- Develop outreach and education materials regarding created aquatic features and associated species

Conservation Strategy 3 (Law and Policy): Develop and implement BMPs for managed grazing, maintenance of drains/canals, and road and railway maintenance

Objective(s):

- Establish BMPs for maintenance of drains/canals, and for road and railway maintenance

Targeted pressure(s): Roads and railroads; agricultural and forestry effluents

Conservation action(s):

- Coordinate with USFS, NRCS, Tribes, and private landowners
- Consult with University of California, Extension
- Conduct education and outreach
- Create stakeholder group
- Review and update BMPs

Conservation Strategy 4 (Land Use Planning): Provide input on project planning and decision-making process; conserve anthropogenic aquatic habitats through participation in the planning and decision-making process

Objective(s):

- Conserve anthropogenic aquatic habitats through participation in the planning and decision-making process

Targeted pressure(s): Roads and railroads; dams and water management/use; invasive plants/animals

Conservation action(s):

- Conduct environmental (CEQA/NEPA) review
- Participate in review of general plans/amendments
- Develop master FGC section 1600 et seq. LSA permit template consistent with strategy
- Develop standard permit requirements/criteria
- Identify and prioritize areas for conservation/protection
- Encourage establishment of mitigation banks
- Obtain funding to maintain mitigation areas and implement strategy

Conservation Strategy 5 (Direct Management): Manage invasive species to expand range of aquatic/semi-aquatic SGCN

Objective(s):

- Manage invasive species on public lands and ROW

Targeted pressure(s): Roads and railroads; dams and water management/use; invasive plants/animals; agricultural and forestry effluents

Conservation action(s):

- Update data on extent and distribution of native and non-native species
- Develop strategy for removal
- Coordinate with USFS and private landowners
- Obtain permits and conduct environmental review
- Apply for funding

- Conduct treatments
- Conduct post-treatment monitoring
- Initiate long-term monitoring and management plan
- Monitor for re-establishment of invasive species
- Develop a management and control plan for invasive species

Conservation Strategy 6 (Partner Engagement): Establish co-management partnerships and cooperative management plans with land management agencies, tribes, water agencies, private landowners, regional land trusts, environmental organizations, railroads, and transportation agencies.

Objective(s):

- Establish co-management partnerships and cooperative management plans with partners
- Ensure consistency of SWAP conservation strategies with DRECP

Targeted pressure(s): Roads and railroads; dams and water management/use; invasive plants/animals

Conservation action(s):

- Establish cooperative management plans with water agencies, railroads, tribes, and transportation agencies

5.7 Marine Province

5.7.1 Geological and Ecological Description of the Province

California's Marine Province is part of a highly productive coastal ecosystem in the northeastern Pacific Ocean known as the California Current marine ecosystem (NOAA 2023). Within the Marine Province the combination of California's bathymetry, ocean currents, and seasonal wind patterns support a large array of ecosystems and habitats associated with a high level of plant and animal biodiversity and abundance (CDFW 2016, 2018). Examples of this unique province's many types of habitats and features include ridges, submarine canyons, and kelp forests. Because of its productivity, many Californians depend on marine resources for their livelihoods and enjoyment. Examples of consumptive and non-consumptive uses include fishing, aquaculture, collecting, surfing, diving, and sight-seeing. In addition, California leads the United States in terms of fisheries generated revenue and is second to only one state in terms of fisheries related jobs (NMFS 2024).

The Marine Province includes the portion of the Pacific Ocean stretching along the entire 1,100 miles of California's coastline. This includes both California's state waters, defined as the territorial sea and depicted as the "three-nautical mile (nm) maritime limit" on National Oceanic and Atmospheric Administration (NOAA) navigational charts, and areas farther offshore to as far as the 200 nm Exclusive Economic Zone (EEZ) boundary. In some places the state jurisdictional boundary extends beyond 3 nm from the shoreline. For information about these boundaries explore NOAA's US Maritime Limit's and Boundaries. California's 5,285 square miles (sq mi) of state marine waters include the coastlines of the California mainland, islands, and offshore rocks seaward of mean high tide, and out to 3 nm of ocean that extend between selected points across the mouth of some coastal bays (primarily Monterey Bay).

Typically, no wider than five miles, California's shallow continental shelf is quite narrow compared to the Atlantic and Gulf coasts. For much of the year, the California Current brings colder northern waters southward along the shore as far as Baja California, while the Southern California Countercurrent flows into the Santa Barbara Channel. These currents, and other minor currents, are critical for driving connectivity and larval dispersal across the coastline and among Marine Province targets. Seasonal changes in wind direction commonly create seasonal patterns for these currents. For example, northwesterly winds help trigger upwelling of cold, nutrient-rich water from the depths, which lead to high levels of primary productivity that attracts foraging marine life. When these northwesterly winds die down each fall, a surface current, known as the Davidson Current, develops and flows in a northerly direction north of Point Conception. Laid over this pattern are both short-term and long-term changes arising from sources such as massive changes in atmospheric pressure (El Niño and La Niña), large-scale change in ocean temperatures, local winds, topography, tidal motions, and discharge from rivers (see (CDFW 2016) and references therein). Because of the diversity of its ecosystems, California's Marine Province is home to an array of macroscopic and microscopic animals (mammals, birds, reptiles, fish and invertebrates, zooplankton, algae and plants (vascular and non-vascular). Seasonal upwelling fosters high productivity and biodiversity in nearshore marine waters, supporting biogenic habitats such as extensive kelp forests and animals that depend on them, like sea otters, rockfish, greenlings, lingcod, and kelp crabs. Offshore islands and rocks provide important breeding and resting sites for marine birds and mammals (see Appendix G Offshore Islands).

While being one of the most biologically diverse ecosystems, the combined 220,000 sq miles of the state's Marine Province, including federal waters between 3 and 12 nm from shore and the EEZ also support some of the busiest shipping lanes and ports in the world, multibillion-dollar commercial and recreational fisheries, and coastal tourism. These waters also offer unparalleled opportunities for wildlife viewing and other non-consumptive forms of recreation. The coast's natural beauty and economic opportunities support residents and attract many visitors. In 2018 more than 67 percent of the state's 39.44 million residents lived in coastal counties (NOAA 2018). With such a significant portion of the population residing along California's coast, there are many pressures and impacts to consider and address, such as habitat loss, pollution, invasive species, resource extraction, and global climate change (CDFW 2016, 2018).

Because of its global significance, productivity, and biodiversity, the activities implemented in the Marine Province have consequences for marine fauna and flora across the Pacific Ocean. In recognizing this regional and global significance, the Marine Province boasts a number of marine managed areas (MMA) including, but not limited to, marine protected areas (MPA); MPAs include State Marine Reserves (SMR), State Marine Conservation Areas (SMCA), State Marine Parks (SMP), State Marine

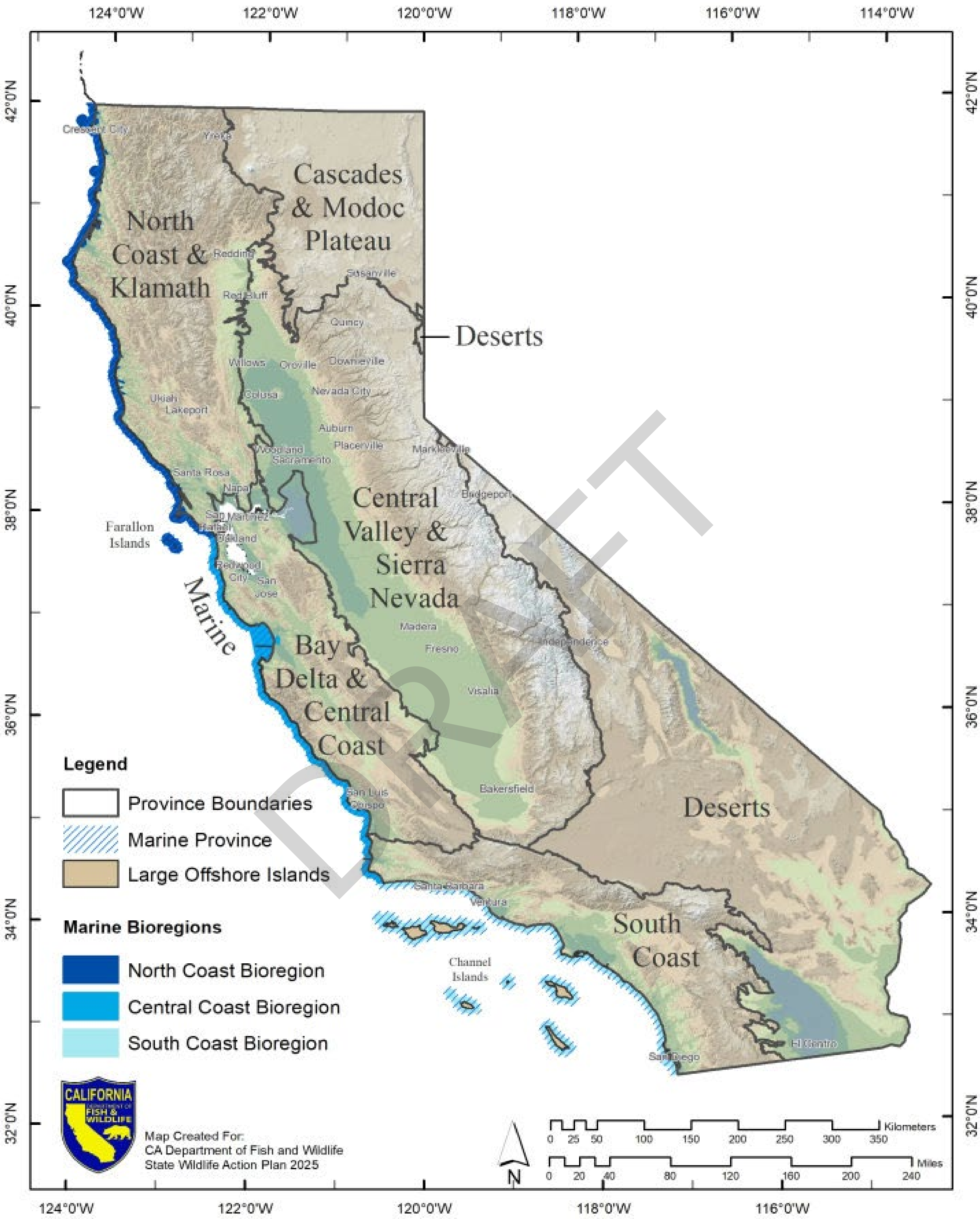
Recreational Management Areas (SMRMA), and Special Closures. To learn more about each type of managed or protected area, please see the CDFW Marine Protected Areas website. More detail on these State managed and protected areas is provided in the sections below. Augmenting state-protected and managed areas, federal protected and managed areas exist including, but not limited to, National Marine Sanctuaries (e.g., the Greater Farallones National Marine Sanctuary, the Chumash Heritage National Marine Sanctuary), National Parks (e.g., the Channel Islands National Park), National Wildlife Refuges (e.g., Castle Rock National Wildlife Refuge), National Seashores (e.g., Point Reyes National Seashore), and National Estuarine Research Reserves. In addition, specific fishery closures have been designated in regulation, such as the Rockfish Conservation Areas and Special Closures to protect birds and marine mammals.

The marine environment includes a variety of ecosystems, including (1) embayments, estuaries, lagoons; (2) intertidal zone; (3) nearshore subtidal zone (0 to 30 m deep); (4) mid-depth zone (30 to 100 m deep); (5) deep zone (100 to 3,000 m deep); and (6) offshore rocks and islands up to the mean high tide line. These six ecosystems represent the Marine Province conservation targets. Water depth, temperature, salinity, light penetration, wave energy, substrate type, available nutrients, currents, and many other factors contribute to creating marine habitats.

5.7.2 Marine Province Conservation Unit and Bioregions

The Marine Province is a single Marine Conservation Unit (MCU) but is divided into three Marine Bioregions (bioregions) for planning purposes. These bioregions are recognized in the CDFW and Ocean Protection Council (OPC) MPA Monitoring Action Plan and are based on data collected during baseline monitoring that identified clusters of similar biota, ecological communities, and key habitats (CDFW and OPC 2018). Although the conservation strategies for the Marine Province were developed across the province as a whole and are not differentiated by the bioregions, the bioregions provide the spatial foundation for future planning efforts. The bioregions include the North-Coast Bioregion, from the California/Oregon border to the entrance of San Francisco Bay, the Central Coast Bioregion, from entrance of San Francisco Bay to Point Conception, and the South Coast Bioregion, from Point Conception to the U.S./Mexico border (CDFW and OPC 2018)(Figure 5.7-1).

Since San Francisco Bay is part of an ecologically and economically important region of the state (the San Francisco Bay Delta), a separate interdisciplinary team including CDFW staff from Marine Region, Bay Delta Region, Water Branch, and Fisheries Branch developed conservation strategies for this area, designated as the Bay Delta conservation unit. Information on this unit can be found in Chapter 5.3.



Data Source: Marine Protected Area Monitoring Action Plan. California Department of Fish and Wildlife and California Ocean Protection Council, California, USA, October 2018.
U.S.Geological Survey (hillshade).

Figure 5.7-1 Marine Bioregions

Each of the previously stated marine conservation targets is characterized by the following: a high level of diversity that may include endangered, threatened, and/or sensitive species; a variety of ecosystem services it provides; its vulnerability to climate change impacts (such as sea level rise or ocean warming events), and potential impacts from invasive species, extractive and non-extractive uses, and marine debris. As described in Section 1.4.4, the Open Standards process included developing key ecological attributes (KEAs); identifying stresses and pressures for each KEA; ranking these stresses and pressures for the target; and developing strategies, goals, and activities.

North Coast Marine Bioregion

The North Coast Bioregion encompasses approximately 1,619 sq mi of state waters from the California/Oregon border south to the entrance to San Francisco Bay. A network of 43 MMAs, including 15 SMRs, 24 SMCAs, four SMRMAs and six special closures, cover approximately 271.3 sq mi, or about 16.8 percent of the bioregion's state waters (CDFW 2016). The following major rivers or portions of these rivers flow into the North Coast MCU: Eel River, Klamath River, Mad River, Navarro River, Noyo River, Smith River, Ten Mile River, and Russian River (CDFW 2016).

Thousands of species, including invertebrates, plants, fish, marine mammals, and seabirds, live in the North Coast Bioregion. Seasonal upwelling along the coast contributes to its high productivity and biodiversity. With this upwelling, nutrients travel from the depths to surface waters where they support plankton blooms and serve as the basis for the unit's food web. Some of the key species include bull kelp, rockfishes, lingcod, Dungeness crab, and red abalone. A unique and significant feature of the North Coast Bioregion is the Farallon Islands, which serve as key habitat for the ashy storm-petrel and dozens of other threatened or endangered bird species. The islands also serve as a rookery for one of the largest concentrations of nesting seabirds in the United States. Appendix G details the Offshore Islands.

In the offshore portions of the North Coast Bioregion, several submarine canyons (such as Mendocino, Mattole, Delgada, and Spanish) shelter and/or serve as forage areas for fish, marine mammals, and invertebrates, including deep-water corals. Offshore rocks and islands also support key marine bird nesting and foraging sites. For example, the largest population of common murres resides at Castle Rock, near Crescent City, while numerous marine mammals (primarily California sea lions, northern elephant seals, and harbor seals) use rocky islands, shores, sandy beaches, tidal flats, and estuaries as haul-out sites (Bolster 2010).

The brackish waters of estuaries along the shores of the North Coast Bioregion play an important part in marine plant and animal life cycles. Many fish depend on estuaries for breeding, foraging, and transit between fresh water and seawater including sharks, staghorn sculpin, surf perches, Chinook salmon, steelhead, lampreys and smelt. Many shorebirds and seabirds roost and forage in estuaries, while numerous invertebrates such as crabs, shrimps, and snails inhabit estuaries. Humboldt Bay is the state's second largest estuary and supports nearly 29 percent of the state's eelgrass beds (Gilkerson and Merkel 2024). Estuary plants, such as eelgrass, are beneficial for humans and wildlife; not only do they support diverse marine species, but they also cushion shorelines from wave energy and break down pollutants (Bolster 2010).

The North Coast Bioregion provides habitat for productive commercial fisheries, targeting a wide diversity of species that helps support economies of coastal communities. Recreational consumptive use opportunities include shore- and vessel-based fishing, kayak angling, clamming, and diving. Recreational non-consumptive use activities include diving, surfing, kayaking, beach-going, swimming, and shore- and boat-based wildlife viewing, including whale watching (Bolster 2010).

Central Coast Marine Bioregion

The Central Coast Bioregion encompasses approximately 1318 sq mi of state waters from the entrance to San Francisco Bay south to Point Conception. Within these waters, a network of 31 MMAs, including 13 SMRs, 15 SMCAs, three SMRMAs, and one special closure cover approximately 225.3 sq mi, or about 17.1 percent of the bioregion's state waters (CDFW 2016).

Habitats found in this bioregion range from rocky tide pools to large submarine canyons. This bioregion receives nutrient rich water from upwelling, which supports the area's high biodiversity. The coastal intertidal includes sandy beaches, rocky shores, coastal marsh, and tidal flats. Estuaries, where coastal streams meet the sea, provide habitat for fish, invertebrates, plants, birds, and mammals. It includes kelp forests dominated by bull kelp and by giant kelp, the latter in nearshore areas south of the Monterey Bay Submarine Canyon. There are two regionally important estuaries in this bioregion, Elkhorn Slough (part of the National Estuarine Research Reserve System) and Morro Bay (part of the National Estuary Program). Monterey was home to one of California's most iconic commercial fisheries, the sardine fishery, and remains an important port area for market squid, rockfish, salmon and other species.

Like the other two bioregions, the Central Coast Bioregion supports fishing (commercial and recreational) and also offers diving, kayaking, fishing, and whale-watching (CDFG 2005a).

South Coast Marine Bioregion

The South Coast Bioregion covers approximately 2,351 sq mi of state waters from Point Conception in Santa Barbara County to the California-Mexico border and includes state waters around the offshore islands. Within these waters, nearly 355 sq mi (approximately 15 percent) are protected by 50 MMAs, including 19 SMRs, 31 SMCAs, and two Special Closures (CDFW 2016). Specifically, the South Coast Bioregion includes the eight California Channel Islands. Key mainland rivers or portions of rivers flowing into this unit include the Santa Clara, Los Angeles, San Gabriel, and Santa Ana rivers (CDFG 2009).

A unique feature of the South Coast Bioregion is that it is part of the Southern California Bight, where waters from two major oceanographic currents intersect: cold water from the north, and warmer water from the south. The South Coast Bioregion includes a wide range of habitats from soft and hard-bottomed deep water to nearshore rocky reefs. Its giant kelp-dominated kelp forests support species such as white seabass and California spiny lobster. Market squid flourish and are fished along the coastline of both the offshore islands and mainland, fueling one of California's largest fisheries in both weight and value. The estuaries and lagoons provide opportunities for foraging and/or breeding, as well as serve as nurseries for young animals. Anaheim Bay, Upper Newport Bay, and Bolsa Chica lagoons are a few of the nearly 40 estuaries and lagoons found in the South Coast Bioregion.

Like the two other bioregions, the South Coast Bioregion provides for productive fisheries, including the highly valuable spiny lobster fishery, and offers diverse recreational opportunities such as diving, surfing, kayaking, beach-going, swimming, and shore and boat-based wildlife viewing. The island waters also offer unparalleled recreation opportunities including diving, kayaking, and wildlife viewing. The South Coast Bioregion is adjacent to several large urban centers, which contribute to water quality challenges (CDFG 2009).

5.7.3 Marine Province Ecosystems

The California marine ecosystem can be divided in any number of ways into sub-habitats or ecosystems based upon depth, location, substrate, and other biotic and abiotic factors. For the purposes of SWAP, the marine province has been divided into six general marine ecosystems, consistent with the California Marine Life Protection Act Master Plan for Marine Protected Areas (CDFW 2016). These six marine ecosystems are divided by depth range, with the sub-habitats (e.g., rock or sand) combined within the broader depth zones. The SWAP marine ecosystems include:

- Embayments, estuaries, and lagoons
- Intertidal zone
- Nearshore subtidal zone
- Mid-depth zone
- Deep zone
- Offshore rocks and islands

Embayments, estuaries, and lagoons

Many embayments occur along the California coast. They are bordered on the landward side by shoreline and/or estuarine habitats. Although there is often reduced wave and tidal energy in embayments, there is still a predominant influence of seawater and association with the marine environment (Shaffer 2002). Many species of fish, such as Pacific herring and Chinook salmon, and invertebrates like Dungeness crab, rely on embayments for food, shelter, and spawning habitat. Depending on their life cycles, they may use local watersheds, shallow mud flats, or tidal marshes, as well as deeper portions of the embayment. Like embayments, estuaries are bodies of water that have constant exchanges and interactions with ocean water or marine embayments. There are 184 California estuaries covering 1,640 square kilometers (405,253 acres; Heady et al. 2014). As a water passage where the tide meets a freshwater source, estuaries provide food and habitat for a diverse range of species such as invertebrates, fishes, marine mammals, and shorebirds. Coastal lagoons are bodies of water often separated from ocean water exchange by a strip of terrestrial substratum such as sand dunes, gravel, or mud berms. Breaching of these land barriers can be infrequent and unusual in lagoons and may not occur annually or for several years. Lagoon salinities fluctuate accordingly. In addition, lagoons are often frequented by terrestrial vertebrates, and when breached are occupied by marine and estuarine aquatic species (CDFG 2005a, 2007, 2009, 2010).

Intertidal zone

The intertidal zone includes all coastal habitats that are subject to periodic tidal inundation and exposure to air. The intertidal zone can include different types of habitats, such as intertidal rocky areas, sandy beaches, beach wrack, seagrass and algal beds, wetlands, or mudflats. The intertidal zone along with headlands, offshore rocks, and islands provide crucial habitat for marine birds and mammals. These areas also provide habitat for numerous types of marine algae, fish, crustaceans, mollusks, sponges, and other invertebrates. Examples of important species which inhabit this conservation target include red abalone, black abalone, Pismo clam, gaper clam, keyhole limpet, sea palm, and Pacific sand crab (CDFG 2005a, 2007, 2009, 2010).

Nearshore subtidal zone

The nearshore subtidal zone contains seafloor and open ocean habitats bounded inshore by the coastal intertidal zone and extending out to where the ocean bottom reaches a depth of 30 meters. This area of shallow water adjoining the coast provides habitat for different plant and animal species including marine algae and plants, fish, and invertebrates (Shaffer 2002). Importantly, these areas support highly productive seagrass beds, kelp forests, subtidal reefs, and vast expanses of muddy or sandy bottom, as well as open water where birds and marine mammals feed upon coastal pelagic species like anchovies and squid. Examples of species which inhabit this zone include giant kelp, bull kelp, red abalone, spiny lobster, squid, rockfish, lingcod, California halibut, and kelp bass (CDFG 2005a, 2007, 2009, 2010).

Mid-depth zone

The mid-depth zone includes the water column and substrate between 30- and 100-meters depth. The mid-depth zone supports rocky reefs and outcrops that provide habitat for sea anemones, sponges, and a variety of fish and invertebrates, as well as large expanses of soft bottom. Tops of ridges and canyon heads may be found in this zone. Examples of important species which inhabit this zone include Dungeness crab, white seabass, rockfish, and lingcod (CDFG 2005a, 2007, 2009, 2010).

Deep zone

The deep zone includes the water column and substrate found below 100 meters (Shaffer 2002). The deep zone supports expanses of both rocky, and muddy or sandy bottoms, where species such as rockfish, flatfish, hagfish, and spot prawns inhabit this ecosystem. The base of underwater mountain ridges, as well as canyon walls and floors, occur in this zone.

Offshore rocks and islands

The marine province includes offshore rocks and islands seaward of mean high tide stretching the length of the California coast from shore out to 12 nm. They are included within the California Coastal National Monument (CCNM), the land area of which is protected and managed by the Bureau of Land Management (BLM). CDFW and California State Parks are partners with BLM for managing the CCNM.

This chapter introduces offshore rocks and island habitats; additional information along with a map, and conservation strategies can be found in Appendix G, Offshore Islands. The California coastline is dotted with thousands of rocks and islets, many of which house important populations ranging from small aquatic invertebrates and algae to large dense colonies of marine birds and mammals, including rare listed species such as the Ashy Storm Petrel. These rocks and islets also include estuarine islands which are within the San Francisco Bay estuarine complex (BLM 2013). Large offshore islands consist of the Channel Islands in the Southern California Bight and the Farallon Islands situated approximately 27 miles due west of San Francisco. The Channel Islands encompass two island groups, the Southern and Northern Channel Islands. The Southern Channel Islands are located due west of the stretch of the mainland coast from San Diego to Huntington Beach, and the Northern Channel Islands lie due south of the coast from Oxnard to Point Conception. The Channel Islands are comprised of eight large islands (San Clemente, Santa Catalina, Santa Barbara, San Nicolas, Anacapa, Santa Cruz, Santa Rosa, and San Miguel) and many offshore rocks and islets, totaling 906 km2 (350 mi^2).

The Channel Islands are home to two of the three largest northern elephant seal rookeries and the largest California sea lion rookery. The Channel Islands are vital habitat for both shorebirds and seabirds, providing nesting and feeding grounds for 99% of seabirds in southern California, and important wintering areas and stopover points for shorebirds (NPS 2024). These islands have the only breeding colonies in California of California Brown Pelicans and Scripps's Murrelet and are home to eight seabird species of which are granted special protected status under federal or California state law: ashy storm-petrel, black storm-petrel, California brown pelican, California least tern, double-crested cormorant, rhinoceros auklet, Scripps's murrelet, and western snowy plover.

The Channel Islands have also become climate refugia for migrant species, with the subtropical Brown Booby (*Sula leucogaster brewsteri*) consistently nesting since 2017 and single nests of the rare Guadalupe Murrelet found on multiple islands since 2021 (American Bird Conservancy 2025; NPS 2025). To the north, the Farallon Islands are part of the Farallon Islands National Wildlife Refuge land consists of the South, Middle and

North Farallon islands totaling 211 acres (83 ha.). Smaller in size, the Farallones have the largest U.S. seabird rookery south of Alaska, with over 300,000 breeding birds of thirteen species. The world's largest colonies of Ashy Storm-Petrels, Brandt's Cormorants and Western gulls occur there. Five species of marine mammals breed and haul out there, including Northern Elephant Seal, Northern Fur Seal, Harbor Seal, Northern Sea Lion, and California Sea Lion.

5.7.4 Marine Conservation Targets

Within the six identified marine ecosystems, four conservation targets represent those ecosystems where anthropogenic impacts are most likely to occur and are listed in a searchable, sortable table (Table 5.0). The conservation targets are summarized in Section 5.7.8 along with the strategies for each. The conservation targets include:

- Embayments, Estuaries, and Lagoons
- Intertidal Zone
- Nearshore Subtidal Zone
- Offshore Rocks and Islands

Appendix G includes information, a map, and conservation strategies for Offshore Islands.

Embayments, estuaries, and lagoons are more accessible to both user groups and conservation actions. These areas act as bridges between freshwater and marine ecosystems and can be heavily impacted by both terrestrial development and other anthropogenic pressures. They act as nurseries and breeding habitat for many marine species and, as such, are a key target for conservation.

The intertidal zone is a dynamic area that experiences both natural environmental extremes as well as human impacts of species extraction, habitat alteration, and trampling. These areas provide opportunities for conservation efforts on a variety of fronts.

The nearshore subtidal zone is where most recreational and commercial fishing activities, non-consumptive activities, and other human uses occur. Deeper water areas are afforded some degree of natural protection due to their inaccessibility. The bulk of marine fisheries management actions within state waters occur within this zone.

Offshore rocks and Islands include all three of the above ecosystems along with terrestrial zones. These unique and sometimes pristine habitats are home to endemic species, listed species, and sensitive habits in need of conservation focus.

5.7.5 Key Ecological Attributes

There are many Key Ecological Attributes (KEAs) for the Marine Province, given the broad variety of habitats. These attributes are considered the most important for the viability of the targets and their associated species. Some of the primary examples are provided here:

- Area or extent of the ecosystem communities, such as total area or the area of eelgrass beds in estuaries, or total kelp canopy
- Relative abundance of key species populations as indicated by metrics, such as the relative abundance of species harvested outside of MPAs compared with that within MPAs for species in which harvest is prohibited
- Species age or size class heterogeneity
- Diversity in species composition inside and outside of MPA
- Relative abundance of native versus invasive or non-native species
- Changes in abiotic parameters over time, such as average sea surface temperature or dissolved oxygen
- Changes in human use patterns over time

5.7.6 Species of Greatest Conservation Need in the Marine Province

The SWAP identified the Species of Greatest Conservation Need (SGCN) for the entire state and identified ecoregion(s) and province(s) associated with each SGCN; data is summarized in Appendix C. The conservation strategies are aimed at benefiting the SGCN via the conservation targets.

For those SGCN that do not occur within the conservation targets identified for the province, conservation actions that target SWG funding should align with existing recovery plan documents where applicable, or demonstrate they address a critical conservation need for the species.

SWAP 2005 identified 638 vertebrate species that inhabit the Marine Province at some point in their life cycle, including 163 birds, 62 mammals, 15 reptiles, four amphibians, and 394 fish (CDFG 2005b) due to specific concerns related to their sustainability and the potential for impact from identified stressors such as climate change, habitat loss, and impacts from other human activities. During the 2025 review, species were removed that are found in or near, but are not reliant on, the marine environment, to focus more specifically on marine species. For SWAP 2025, the following number of species were added: six marine plants and algae, eight invertebrates, 21 finfish, four marine reptiles,16 birds, and nine marine mammals.

5.7.7 Pressures on Conservation Targets

Using the Open Standards of Conservation, a stress is an impaired aspect of a conservation target, equivalent to a degraded KEA (Conservation Measures Partnership 2020). Pressures are primarily human activities, or natural phenomena influenced by humans, that amplify environmental stress and further degrade conservation target(s).

The diversity and abundance of marine wildlife in California are affected by human activities in, on, and alongside the water. The focus of this subsection is on most commonly identified pressures by the California Department of Fish and Wildlife (CDFW) Marine Region. The conservation strategies presented in Section 5.7.6 describe ways to address the pressures.

Because of large-scale shifts in oceanographic conditions, marine stresses need to be considered in the context of the natural variation, such as intra-annual (strengthening and relaxing of the Davidson Current), and decadal variations (Pacific Decadal Oscillation), as well as climate change impacts (such as sea level rise, ocean acidification, storm surge, and deoxygenation). These shifts create a background of natural anthropogenic-driven change that has a profound impact on marine diversity.

For example, the distribution and abundance of marine species depend on the strength and temperature of the California Current, which itself varies on a scale measured in decades. When atmospheric pressure in the north Pacific is high, the California Current is stronger, the water temperature is colder, and significant upwelling drives high productivity of the ecosystem, allowing populations of many species adapted to colder water to flourish. When atmospheric pressure in the far northern Pacific is lower, the California Current weakens, water temperatures rise, and there is less upwelling of nutrient-laden water. As a result, the planktonic biomass shrinks, as do the size and range of populations of marine wildlife positioned higher in the food web and adapted to colder water (CDFG 2005a). Another possible response is a range shift, particularly for mobile species.

An oceanographic process that also affects the distribution and abundance of marine species is the El Niño–Southern Oscillation (ENSO), a warm water trend caused by weakening of high-pressure systems in the central South Pacific. When ENSOs are particularly strong, warming of ocean water extends further north of the equator than usual, affecting the California Current. Warmer ocean temperatures off the coast favor the presence of species that prefer warmer water and are less hospitable for the cold-water species, which then typically move offshore or to the north. The opposite occurs during a La Niña when the waters off the coast become cooler than usual. Emerging studies support that the historical patterns associated with ENSO are changing in their intensity and frequency and the changes may be partially linked anthropogenic-caused climate change impacts (McPhaden et al. 2020).

The historical pattern of regime shifts in oceanographic conditions means that, over millions of years, marine organisms have evolved life-history strategies (growth processes, feeding preferences, movement patterns, and reproductive behaviors) that enable populations of species to survive periods of low food availability or years when ocean temperatures or ocean current characteristics do not favor successful reproduction and/or recruitment. The distribution and abundance of marine species naturally fluctuate over time with shifts and changes in the ocean, and populations and ecosystems remain intact because they are large and resilient enough to make it through years with unfavorable conditions (CDFG 2005b).

In addition to these shifts in oceanographic conditions, global warming and climate change are also beginning to play a role in altering the physical and chemical conditions, such as ocean acidification and deoxygenation, and physical conditions, such as sea level rise and storm surge. The latter two factors may have more significant habitat impacts in embayments, estuaries, and lagoons because if vertical accretion is not matched with sea level rise and storm surge changes, these habitats may be converted to more open water habitat types (SCWRP 2001).

The SWAP Marine Province regional team identified the primary human-caused potential pressures that affect the Marine Bioregion. These marine-specific pressures and stresses are defined in Table 5.7-1. They are also listed in Table 5.0 as they relate to the four Marine Province conservation targets.

Table 5.7-1 Pressures and Stresses on Marine Province Conservation Targets

Pressure	Stresses
Agricultural and Forestry Effluents	Indirect effects through increased sediment loading in coastal rivers and streams
Airborne Pollutants	Indirect effects through greenhouse gas emissions as drivers of climate change
Climate Change	Increasing occurrence of disruptive events like marine heatwaves, ocean warming causing species range shifts and population impacts, ocean acidification causing impacts to invertebrate species
Dams and Water Management/Use	Indirect effects through reduced water flow from coastal rivers and streams and reduced sand supply to beach habitat and impacts to anadromous fish spawning habitats
Other Ecosystem Modifications - Modification of Mouth/Channels	Indirect effects through tidal flow changes and nearshore spawning habitats
Other Ecosystem Modifications - Ocean/Estuary Water Diversion/Control	Indirect effects through reduced water flow, tidal flow changes, and nearshore spawning habitats
Fishing and Harvesting Aquatic Resources (fishing, harvesting, collecting)	Direct effects on species abundance and indirect impacts to habitats and predator/prey relationships

Pressure	Stresses
Fishing and Harvesting Aquatic Resources-(Interactions of non-target animals with fishing gear)	Direct effects on non-target species abundance and survivorship
Garbage and solid waste (Discarding of solid waste)	Direct effects on habitats
Housing and Urban Areas; Commercial and Industrial Areas - Shoreline Development	Direct effects through intertidal habitat alteration or destruction, and indirect effects of increased sedimentation, wave action, and freshwater runoff
Industrial and Military Effluents (Oil spills)	Direct effects on habitat destruction and wildlife fouling
Invasive Plants/Animals	Direct effects on species survivorship through competition and predation and indirect effects on habitats and ecosystems
Marine and Freshwater (estuarine) Aquaculture	Direct effects on habitats and water quality and indirect effects on prey species used for aquaculture feed
Other Ecosystem Modifications - Artificial Structures	Direct effects on habitats through installation of structures and indirect effects through altered migratory routes, spatial utilization patterns, and changes to local species abundance or biological productivity
Utility and Service Lines	Direct effects on habitat through offshore energy transmission line installation and maintenance
Renewable Energy	Direct effects on habitat through offshore energy installation and potential indirect effects on ocean currents, upwelling, and species distribution and abundance

Pressure	Stresses
Parasites/Pathogens/Diseases	Direct and indirect effects to biological productivity of native and aquaculture species
Shipping Lanes - Ballast Water	Direct and indirect effects of invasive species introduction

Invasive Plants/Animals

Biological invasions of non-indigenous species (NIS) pose significant threats to the marine environment (Mack et al. 2000; Grosholz 2002; Preisler et al. 2009; Simberloff 2010). Invaders can out compete native species for resources affecting the structure and function of native ecosystems (Caselle et al. 2018). Impacts from NIS in the marine environment include displacement of native species, alteration and degradation of habitats, shifts in trophic structure, and the introduction of novel pathogens. The primary pathway of NIS spread in marine ecosystems is commercial and recreation vessels via ballast water and biofouling (Costello et al. 2022), however NIS can also invade new systems through natural dispersal and climate driven range shifts. Human activities, including the intentional or accidental release of NIS into the marine environment via the aquarium trade, aquaculture, and other sources, are also known vectors for introductions and an on-going source of concern.

The California Ballast Water Management for Control of Nonindigenous Species Act of 1999 (Ballast Water Act) initiated regulations regarding handling and disposal of ballast water. The Ballast Water Act also established baseline surveys to document NIS distribution in coastal marine and estuarine waters by CDFW and mandated that these surveys continue in the public resources code (Ca. Pub. Res. Code §§ 71210 -71213). To conduct this work, CDFW established the Marine Invasive Species Program (MISP) within the Office of Spill Prevention and Response to conduct surveys to document the distribution and spread of NIS in California Marine waters, and to help inform the evaluation of the efficacy of existing NIS management and policies for reducing the rate of new invasions. The Marine Invasive Species Act of 2003 (Ca. Pub. Res. Code Division 36) and subsequent amendments including the Coastal Ecosystems Protection Act of 2006 further defined program elements and extended the monitoring program indefinitely to enable the tracking of new introductions and the spread of NIS in California coastal waters. CDFW regularly collaborates with the California State Lands Commission (CSLC), who administers implementation of regulations involving invasive species introductions through shipping, via ballast water discharge and hull fouling.

The MISP has partnered with the Smithsonian Environmental Research Center (SERC) and the Molecular Ecology Laboratory of Moss Landing Marine Laboratories (MLML) to produce a robust, quantitative baseline of marine invasive species distributions in California coastal waters by combining traditional morphological species identification methods with molecular metagenetic species determinations from whole-sample bulk DNA. In 2012, CDFW launched the California Non-native Estuarine and Marine Organisms (Cal-NEMO) online database to aggregate existing information from monitoring and research. Cal-NEMO is an ongoing research project that also documents new NIS species introductions and updates existing records as new research becomes available.

Data used for DNA analyses have largely been collected from Bays with high levels of shipping and recreational activity (e.g., San Francisco and San Pedro bays). These areas have a high likelihood of being the locations where new invasions are most likely to appear first. Additionally, data have been collected from eight other estuaries spanning the coastline where marine invasive species have been introduced and support persistent populations.

Known marine invasions of NIS in California span across taxa and have resulted in significant costs for control and eradication efforts. As of 2024, 33 species of algae, 50 species of fishes, and 333 invertebrates have been reported in California marine or estuarine waters (Cal-NEMO - Nemesis). Not all reported NIS have established populations; however, many have been present for many decades and have established populations which continue to spread while other populations remain localized and stable (Kaplains et al. 2016).

There have been successful eradication efforts in the past including the effort to eradicate *Terebrasabella heterouncinata,* a small sabellid worm that burrows into gastropod shells including abalone. In1996, *T. heterouncinata* was discovered in the ocean in the discharge area of an aquaculture facility near Cayucos, CA where it was infesting native red abalone (*H. rufescens*) and other gastropods (primarily *Tegula funebralis*, the Black Turban Snail). An eradication program was implemented that removed infected animals to break the chain of transmission. Over 1.6 million snails were removed. Surveys of shoreline mollusks adjacent to 25 other California abalone aquaculture facilities, from Crescent City to La Jolla, conducted from 2001 to 2009, found no other cases of *T. heterouncinata* (Moore et al. 2007; Moore et al. 2013).

Although ongoing efforts continue to track and monitor NIS, there are not any active marine NIS eradication efforts underway except for those directed at the algal species in the genus *Caulerpa*. There was a previous successful eradication effort for *Caulerpa taxifolia* that occurred from 2000–2006 in Aqua Hedionda Lagoon and Huntington Harbor that resulted in approximately $7 million in costs (Anderson 2005). In 2021, a new infestation of *Caulerpa prolifera* was discovered in Newport Bay and a second, separate infestation in San Diego Bay was discovered in 2023. In both cases, active eradication efforts are underway (See the CDFW Website for Caulerpa). There are targeted control efforts for other marine NIS that continue on a case-by-case basis throughout the state. These efforts are determined through collaborative efforts to identify areas of concern that could be addressed with coordinated focused control efforts (Giakoumi et al. 2019).

On-going surveillance continues to allow rapid response resources to be directed to newly identified invaders or outbreaks while educational efforts continue to be focused on preventing behaviors that lead to novel NIS introductions or spread existing populations. CDFW continues to coordinate with federal agencies to develop coordinated control and management plans like the recently updated European Green Crab Management Plan and through involvement in the Aquatic Nuisance Species Task Force Western Regional Panel. Invasive species are discussed in more detail in Appendix E.

Other Ecosystem Modifications - Artificial Structures

Artificial structures in the marine environment come in a variety of shapes and sizes that reflect a wide range of intended uses (Giakoumi et al. 2019). This includes waterfront infrastructure like piers and pilings to objects further offshore like pipes, outfalls, and platforms associated with oil and gas extraction or renewable energy. These structures have a range of environmental and ecological impacts including changes to habitat (e.g., converting soft sediment to hard structure), water quality, current velocities, chemical composition, species behavior, and species composition including invasive species abundance (Easton et al. 2024).

Artificial structures placed in the marine environment specifically designed to create positive environmental and/or ecological effects, or "artificial reefs", are distinguished from industrial and urban structures (e.g., oil and gas platforms) Artificial structures may produce some positive impacts (Caselle et al. 2002; Langhamer 2012), but they are different from an "artificial reef". Artificial reefs are defined to be a manmade or natural object(s) intentionally placed in selected areas of the marine environment to duplicate those conditions that induce production of fish and invertebrates on natural reefs and rough bottoms, and that stimulate the growth of kelp or other midwater plant life which creates natural habitat for those species (FGC, §6421(a)).

Renewable Energy

The Bureau of Ocean and Energy Management has designated five lease areas in federal waters (approximately 20 miles offshore; two offshore Humboldt Bay and three offshore Morro Bay) for offshore wind energy development. Associated development within state waters to support offshore wind energy generation includes transmission cable corridors (addressed further under Utility and Service Lines) and port development. Potential stressors to the marine environment associated with offshore wind lease areas include:

- Disturbance to benthic habitats from anchors and cables
- Hydroacoustic impacts to marine life from turbines and vessels
- Risks to marine life from floating cable systems (e.g., entanglement)
- Introduction of new artificial structures, including potential impacts to species distribution and spread of invasive species
- Electromagnetic field effects on marine life
- Bird and bat interactions with offshore wind energy infrastructure
- Increased vessel traffic
- Impacts to oceanographic and atmospheric processes (e.g., upwelling, sea surface winds, nutrient cycling)
- Entrainment of larval fish from substation once-through-cooling systems
- Impacts to commercial and recreational fishing grounds

The Port of Long Beach and Port of Humboldt Bay have been identified as California ports to support the staging and integration of turbines for offshore wind lease areas. Potential stressors from offshore wind related port development to the marine environment include:

- Hydroacoustic impacts to marine species from pile driving
- Fish entrainment and impacts to water quality from dredging operations
- Habitat conversion and loss (e.g., conversion of intertidal habitat to subtidal habitat)
- Impacts to eelgrass and kelp habitat
- Increased over-water shading and light pollution
- Impacts to port usage by commercial and recreational fisheries

Utility and Service Lines

Cable corridors to transmit energy generated from the offshore lease areas located off Humboldt Bay and Morro Bay to the onshore grid system are currently being planned. As mentioned above, potential stressors to the marine environment from offshore wind cable transmission corridors and associated substations include disturbance to benthic habitats, introduction of new artificial habitat, entrainment of larval organisms, electromagnetic field effects, and impacts to commercial and recreational fisheries.

5.7.8 Conservation Strategies

The SWAP Marine Region team developed conservation strategies aimed at reducing the impacts of the pressures on all four of the marine conservation targets. The strategy descriptions list the specific objectives and pressures addressed by each strategy. Some strategies address all pressures, while others are targeted to specific pressures. In addition, related strategies share the types of activities that could be used to implement each strategy described.

Conservation Strategy 1 (Management Planning; Land Use Planning; Partner Engagement; Environmental Review): Improve engagement in decision-making process

Objective(s):

- Increase capacity by procuring staff and appropriate funding for planning, environmental review, and partnership engagement
- Increase time spent on internal and external communication and coordination
- Increase participation in California Environmental Quality Act (CEQA) reviews of project proposals
- Review and provide CDFW input on all relevant permits and monitoring programs
- Continue existing collaborations with local and state agencies and other relevant partners to address pressures

Targeted pressure(s): All pressures

Conservation Strategy 2 (Law and Policy; Partner Engagement): Support development, implementation, and enforcement of effective regulations

Objective(s):

- Work with CDFW staff to ensure that adopted regulations will be effective at conserving resources
- Streamline regulatory process for CDFW staff and other entities to implement invasive species control and eradication work
- Work with agencies and partners to review coastal maintenance activities including those related to dredging and infrastructure (piers, seawalls) to determine how to effectively incorporate maintenance activities into regulations (e.g., those for MPAs), where needed
- Support adoption of effective regulations on terminal market for shellfish and aquarium imports
- Work with agencies and other partners to leverage resources (financial and human) to increase implementation and enforcement of regulations

Targeted pressure(s): All pressures

Conservation Strategy 3 (Data Collection and Analysis; Direct Management): Support target monitoring, compile results, and integrate data into management

Objective(s):

- Continue to modernize and wherever possible automate data collection systems and processes
- Continue to assess what data are available within CDFW and from external sources to manage the target and its key species
- Encourage support for physical/chemical monitoring network that includes target (such as the Integrated Ocean Observing System network)
- Provide support for biological monitoring of target, including monitoring of the State MPA network
- Provide support for compilation and maintenance of data into databases that are readily available to, and easily useable by, managers, as well as the public. A primary example are the set of Enhanced Status Reports for finfish and invertebrates on the Marine Region's web-based Portal
- Provide web access to databases and develop tools for accessing and using data
- Integrate with socio-economic data collected on resource users, and activities that affect resource and habitat conditions

Targeted pressure(s): All pressures

Conservation Strategy 4 (Data Collection and Analysis; Direct Management; Partner Engagement): Encourage research that addresses questions that would improve ability to manage this target

Objective(s):

- Increase the information available to manage target species
- Increase participation in collaborative partnerships

Targeted pressure(s): All pressures

Conservation Strategy 5 (Outreach and Education; Partner Engagement): Improve education and outreach activities

Objective(s):

- Increase public awareness of major pressures to target and ecosystem services that target provides
- Increase coordination with partners on education and outreach activities

Targeted pressure(s): All pressures

Conservation Strategy 6 (Training and Technical Assistance): Increase training

Objective(s):

- Provide training to increase staff abilities to achieve goals. Provide training on how to review environmental documents
- Provide training on how to evaluate damage from events that degrade the target (e.g., hazardous spills)
- Increase coordination between management and staff on training needs

Targeted pressure(s): All pressures

Conservation Strategy 7 (Direct Management; Partnership Engagement): Improve management approaches for fostering the sustainability and resilience of the target

Objective(s):

- Examine the effectiveness of the current MPAs within the target to increase the target's sustainability and resilience
- *Targeted pressure(s):* Climate change; Fishing, harvesting, and collecting aquatic resources

Conservation Strategy 8 (Data Collection and Analysis; Direct Management; Land Use Planning; Partner Engagement): Work with partners to identify effects on the target of climate change and to develop and implement responses to these effects

Objective(s):

- Identify the expected effects (from research and models) of climate change on the target's key attributes
- Work with partners to increase our understanding of the expected effects of climate change on the target (and associated species)
- Incorporate increased understanding of effects into marine resource management
- Provide guidance to other state agencies on how the key ecological attributes change because of climate change that affect marine resources and how these changes may be best addressed
- Work with other agencies and organizations to identify and prioritize lands around the target that are important for buffering changes in the target due to sea level rise

Targeted pressure: Climate change

Conservation Strategy 9 (Data Collection and Analysis; Management Planning): Improve Marine Province's management of resources vulnerable to climate change and ocean acidification

Objective(s):

- Work with partners to complete climate vulnerability assessment for key species
- Develop and implement plans (including management actions) to build resilience or decrease vulnerability of sensitive resources to climate change
- Conduct baseline survey of bivalve species in estuarine habitats
- Incorporate climate tools into management toolbox
- Collect data to inform a climate vulnerability assessment on marine mammals listed as SGCNs

Targeted pressure: Climate change

Conservation Strategy 10 (Outreach and Education; Environmental Review): Improve practices to reduce human error

Objective(s):

- Improve public recreational users' awareness of how to prevent and respond to hazardous spills
- Improve commercial users' awareness of how to prevent and respond to hazardous spills
- Coordinate with appropriate regulatory entities to require that an appropriate spill prevention and response plan be developed before proposed permit activities

Targeted pressure: Oil spills

Conservation Strategy 11 (Management Planning; Direct Management): Implement CDFW Aquatic Invasive Species Management Plan

Objective(s):

- Ensure plan objectives are met
- Adapt as needed and begin implementation of Aquatic Invasive Species Management Plan
- Increase content within, and accessibility to, the CDFW invasive species database
- Create early detection rapid response program for new occurrences of invasive species
- Conduct eradication and/or control measures for invasive species
- Support development and implementation of ballast water best management practices

Targeted pressure(s): Invasive plants/animals

Conservation Strategy 12 (Environmental Review; Direct Management; Law and Policy): Streamline processes that address control and eradication of invasive species

Objective(s):

- Streamline regulatory process for CDFW staff and other entities to implement control and eradication work
- Provide criteria on how to conduct eradication and/or control measures for invasive species

Targeted pressure(s): Invasive plants/animals

6 Anadromous Fishes

Anadromous fishes begin life in rivers and streams, migrate to the ocean to grow into adults, and then return to freshwater to spawn. Most anadromous fishes spend the majority of their life in marine environments and travel great distances between their marine habitat and spawning rivers or streams. Because the geographic ranges of anadromous fishes span many of the provinces developed for the SWAP, the organization of conservation strategies by hydrologic unit or even province does not adequately address their conservation needs. As such, conservation strategies for anadromous fishes have been developed separately, as discussed in this chapter, to capture their full life cycle and geographic range.

6.1 Vision

A fundamental objective for CDFW is to manage and conserve California's native anadromous fish species and their critical habitats, including nearshore marine environments, estuaries, and rivers. Management prioritizes not only their ecological significance, but also recreational, commercial, and tribal values of anadromous species that benefit both current and future generations.

This chapter describes California native anadromous fishes: Chinook and Coho Salmon, steelhead and Cutthroat Trout, Green and White Sturgeon, Eulachon, Longfin Smelt, Pacific Lamprey, and Western River Lamprey. It also discusses their estuarine and freshwater distribution, ecology, stressors, as well as CDFW's fundamental conservation targets and strategies to protect, enhance, and manage anadromous fish populations and habitats.

At the center of CDFW's recommendations and future actions for anadromous fishes are six core principles. These principles will guide CDFW in its actions and collaborations with federal, state, California Native American tribes, private, and public partners:

- Water Management: Identifying and implementing water management strategies designed to provide sufficient instream flow and water quality to meet suitable fish and habitat needs
- Habitat Restoration: Restoring and enhancing terrestrial and aquatic habitats, restoring unimpeded flows, supporting natural and healthy ecological processes, addressing future environmental stresses (sea-level rise, increased water temperature, prolonged drought), and eradication or control of invasive species

- Species Recovery: Identifying and implementing actions to recover species until protections under state and/or federal Endangered Species Act listing are no longer warranted
- Angling Opportunities: Ensuring the public and tribal communities have appropriate recreational, commercial, capture, and harvest opportunities of anadromous fisheries in California's ocean, estuaries, and rivers
- Hatchery Management: Improving the science of hatchery aquaculture and management, and ensuring hatchery practices maximize fish health and diversity while minimizing adverse effects on native stocks
- Promoting Partnerships: Pursuing inter-state, agency, tribal, private, and academic partnerships and cooperative efforts to conserve and manage California's anadromous species

6.2 Anadromy and Anadromous Species Diversity in California

California is home to several species of fishes that spend most of their lives in estuarine or marine waters and return to freshwater to spawn. This life history strategy in fishes is known as anadromy. Native anadromous fishes are represented by jawless lamprey (Petromyzontidae), cartilaginous, bony plated sturgeons (Acipenseridae), salmon and steelhead (Salmonidae), and small, short-lived smelts (Osmeridae). Some of these are widely recognized and managed for their commercial and recreational values, while others are less visible and seldom seen by the public.

Anadromous fishes are widely distributed in California, occurring in watersheds from San Diego to Del Norte counties (Figure 6.2-1). For each of these species, California represents the southern limit of the species range along the west coast of North America (Moyle et al. 2002). Anadromous species with viable populations occurring in California include two species of salmon (Chinook and Coho), two species of trout (steelhead and Coastal Cutthroat), two species of sturgeon (Green and White), two species of smelt (Longfin and Eulachon), and at least two species of lamprey (Pacific Lamprey and Western River Lamprey).

Several of the species are separated into unique population assemblages, referred to as Evolutionarily Significant Units (ESU; e.g., salmon) or Distinct Population Segments (DPS; e.g., steelhead, sturgeon, and smelt). The status and trends of populations, condition and function of habitat and ecosystem processes, and pressures and limiting factors of these species are determined at the ESU and DPS scale. Such evaluations are used in assessing the need for protection of each species. In California, many ESUs and DPSs of anadromous fishes are now formally protected by either the California or federal Endangered Species Act (CESA; ESA), or both (Appendix C).

Estuarine and riverine ecosystems across California represent critical habitat for anadromous fishes. These ecosystems are vital for egg incubation, juvenile rearing, emigration of young to estuaries or the ocean, and adult spawning (Table 6.2-1). Some species (e.g., Eulachon, Chinook Salmon) spend relatively short periods of time in freshwater, while other species (e.g., Pacific Lamprey, steelhead) can spend years in freshwater during earlier life stages. The same diversity of strategies is seen in estuaries, where salmonids spend relatively limited yet vital time, while white sturgeon and Longfin Smelt spend most of their lives in bays and estuaries.

6.2.1 Salmon

Two species of salmon, Chinook Salmon (Oncorhynchus tshawytscha), and Coho Salmon (O. kisutch), spawn and rear in watersheds in the northern half of California (Figure 6.2-2). Chinook Salmon live two to six years, mostly in the ocean. Adults return to spawn in rivers in overlapping groups of a similar age, i.e., cohorts. Coho Salmon typically live three to four years and return in distinct cohorts, with generations of fish from the same watershed usually having little overlap.

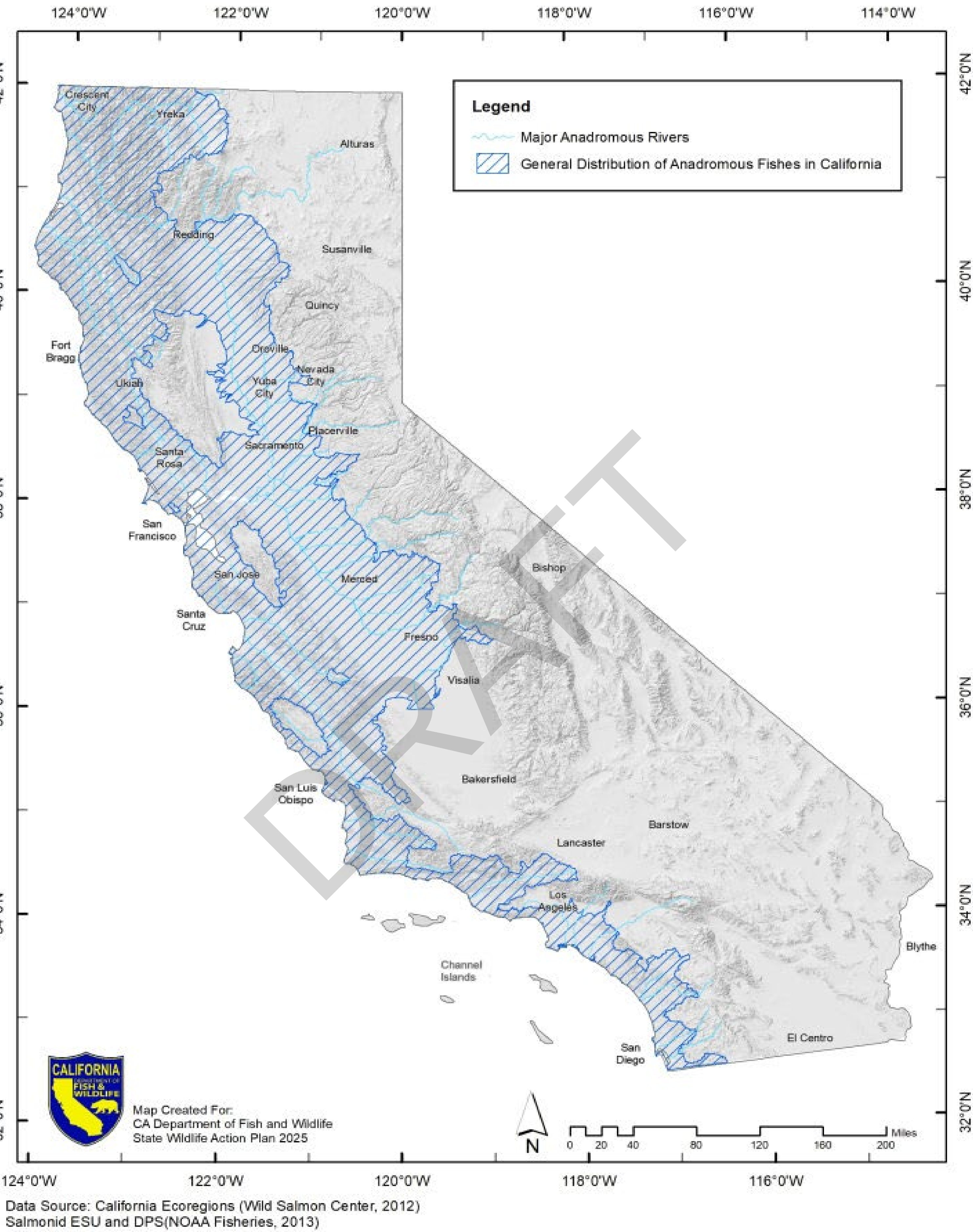
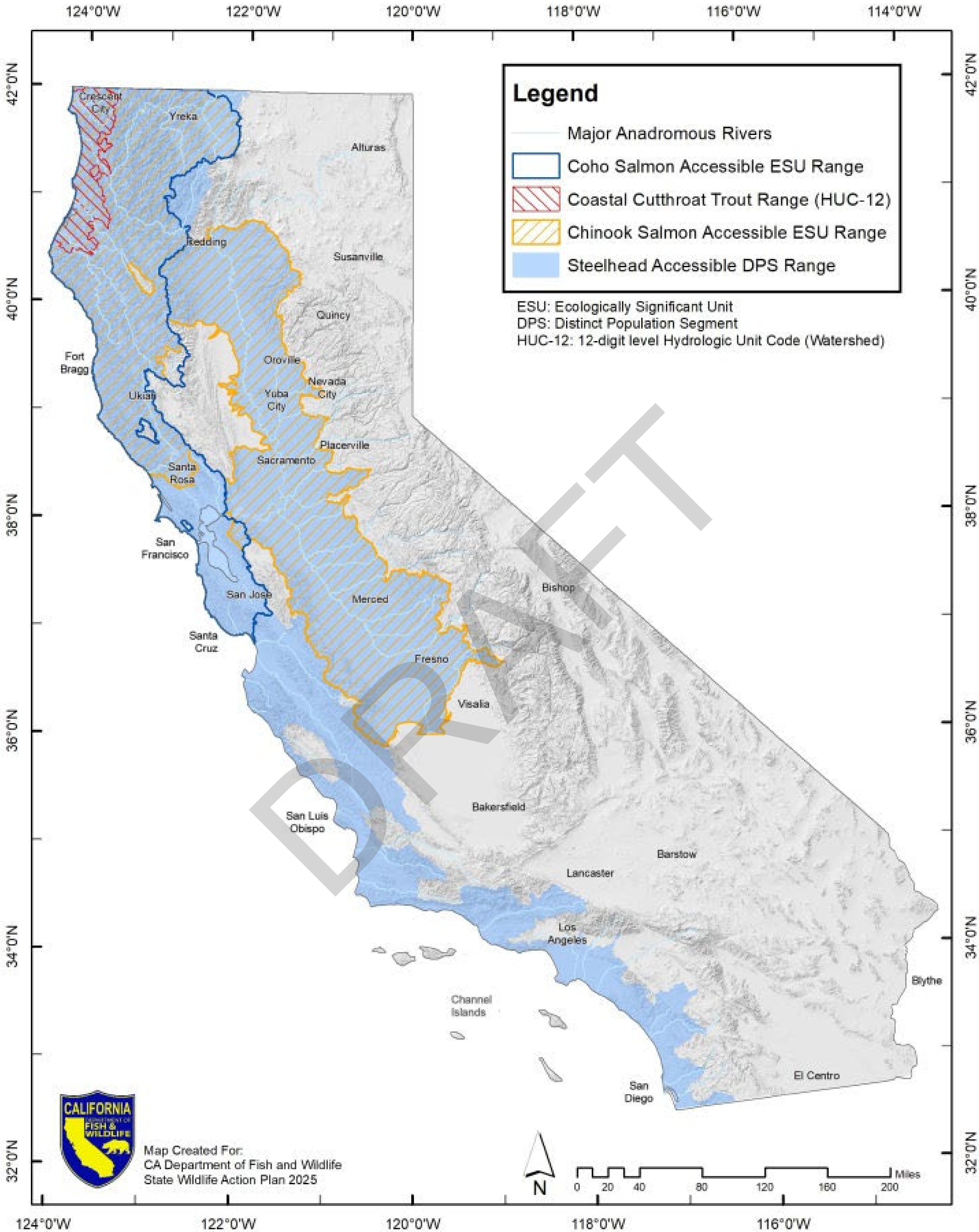


Figure 6.2-1 General Distribution of Anadromous Fishes in California



Data Sources: Salmonid ESU and DPS (NOAA Fisheries 2013); Coastal Cutthroat Trout Range (Coastal Cutthroat Trout Interagency Workgroup (2014)

Figure 6.2-2 Salmonid Distribution

Two Coho Salmon ESUs (Southern Oregon/Northern California Coast and Central California Coast) occupy coastal watersheds from Santa Cruz to Del Norte counties and the Klamath River, occurring in four salmonid ecoregions (North Coast, Klamath River, North-Central Coast, and Southern California). Both Coho Salmon ESUs are listed under the state and federal Endangered Species Acts. Since the early 1990s both inland and ocean fisheries for Coho Salmon have not been allowed in California waters.

Chinook Salmon are a physically larger and more broadly distributed species, occurring both along the coast and throughout the Central Valley. One ESU along the coast (California Coastal Chinook), one in the Klamath-Trinity watershed (Upper Klamath-Trinity River spring-run), and two in the Central Valley (spring-run and winter-run) are protected under the California and/or federal Endangered Species Acts. There are ocean, estuary, and inland fisheries for primarily fall-run and late fall-run Chinook Salmon in both the Central Valley and Klamath River ecoregions. Chinook Salmon harvest in the ocean is considered a mixed-stock fishery, where individuals from different runs are indistinguishable and are all harvested to some degree when fisheries are open.

Chinook Salmon are divided into seasonal stocks, based upon the time of year that adults return to rivers to spawn. In the Central Valley, three distinct "runs" (fall, winter, and spring) are identified for their evolutionary significance. Late fall-runs are recognized as being an important life strategy but grouped with the fall run ESU. In the Klamath-Trinity Rivers Basin, fall and spring runs are currently recognized life history strategies in a single ESU. There are also two coastal ESUs of Chinook salmon (California Coastal Chinook and Southern Oregon/Northern California Coastal Chinook) which collectively occur in coastal watersheds from the Russian River in Sonoma County to the Smith River in Del Norte County.

Pink Salmon (*O. gorbuscha*) and Chum Salmon (*O. keta*) periodically occur in streams or rivers in California but are not documented as having viable populations or a regular occurrence. Neither species are addressed in this chapter.

6.2.2 Steelhead and Coastal Cutthroat Trout

There are two species of trout that may exhibit an anadromous life history in the state, steelhead (O. mykiss) and Coastal Cutthroat Trout (O. clarkii clarkii). Unlike salmon, trout adults may spawn more than once (Goetz et al. 2024). Both Coastal Cutthroat Trout and steelhead range from California to Alaska. However, Coastal Cutthroat Trout have a relatively small range in California, occurring only in watersheds of the North Coast, the lower Klamath River, and the most northern waters of the North/Central Coast Ecoregion. Steelhead, on the other hand, are wide-ranging in California, occurring in all six salmonid ecoregions. Both trout species have a complex life history, spending variable time in fresh and marine waters. In addition, steelhead are the anadromous form of O. mykiss, and there is a resident form, commonly known as Rainbow Trout. Similarly, Coastal Cutthroat Trout possess life history variability, ranging from anadromous to resident forms. For both trout species, individual offspring from either form can assume the life history strategy of the other, meaning some offspring of anadromous fish mature into the resident form, and some resident fish offspring mature into the anadromous form. These factors likely contribute to these species having a broad distribution and range.

6.2.3 Sturgeon

Green Sturgeon *(Acipenser medirostris*) and White Sturgeon (*A. transmontanus*) both occur in coastal waters and watersheds along the North-Central Coast and Klamath River ecoregions and in the Central Valley (Figure 6.2-3). Both species reach large sizes (e.g., White Sturgeon can weigh approximately 1,400 pounds [630 kilograms]; Moyle et al. 2002), mature relatively late in life (White Sturgeon: 10–19 years), and are long-lived (White Sturgeon 100+ years; Green Sturgeon 60+ years). White Sturgeon spend most of their lives in bays and estuaries, while Green Sturgeon enter coastal marine waters as subadults and may migrate hundreds of miles. White Sturgeon are much more common than Green Sturgeon in the Central Valley and currently support a recreational fishery; however, the species was petitioned for listing under CESA, and their status is in review at this time. Green Sturgeon are more common than White Sturgeon in North Coast rivers and the southern DPS is federally protected. The two DPSs of Green Sturgeon mingle and co-occur in coastal waters and embayments along the west coast of North America.

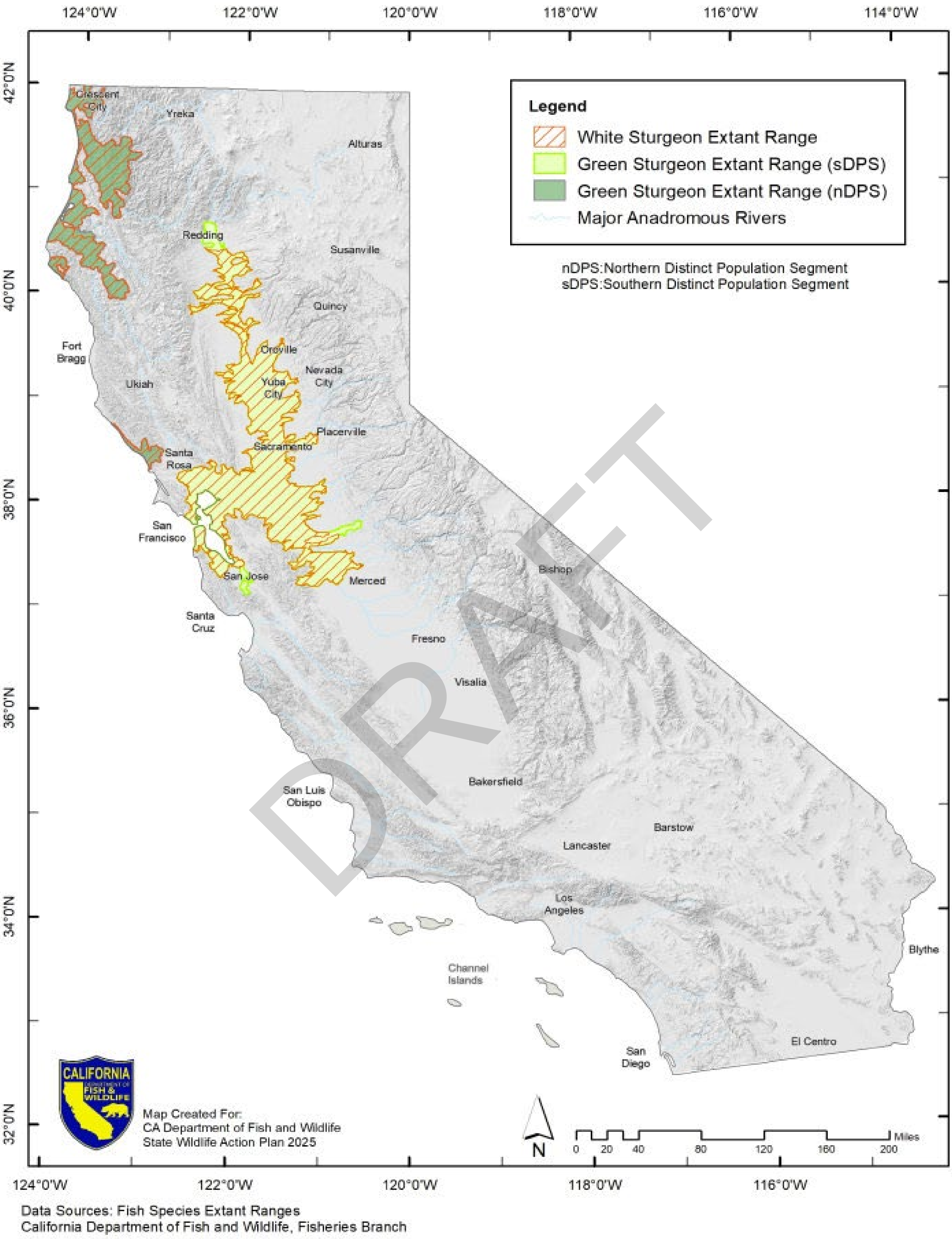


Figure 6.2-3 Sturgeon Distribution

6.2.4 Smelt

Two species of smelt are known to exhibit anadromous life history strategies, Eulachon (*Thaleichthys pacificus*) and Longfin Smelt (*Spirinchus thaleichthys*). Once Eulachon migrate into marine waters, they will spend one to two years foraging and rearing in nearshore coastal habitats before returning to spawn in freshwater in the spring. These are the largest smelt in California, averaging 5–10 inches (15–20 cm) and reaching almost 12 inches (30 cm). They occur only along the coast of northern California and are known to spawn primarily in the Klamath River and in the northern most rivers of the North/Central Coast Ecoregion (Figure 6.2-4). They once supported a productive tribal and recreational fishery on the Klamath River. Populations have severely declined since 1990. The species is now federally protected, and harvest is not allowed under California sport fishing regulations.

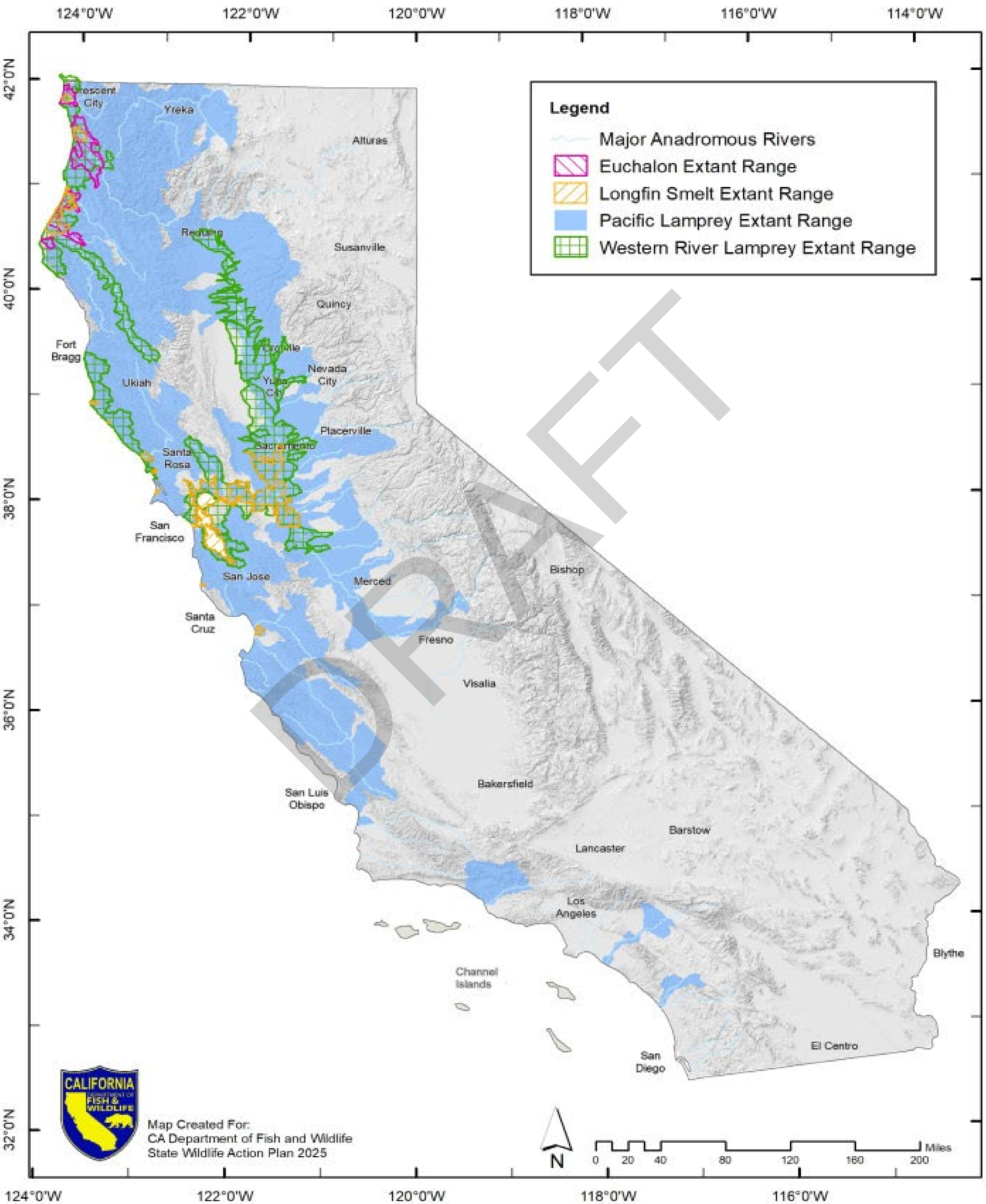
By comparison, Longfin Smelt are a smaller smelt species, rarely exceeding 5 inches (12 cm), which exhibit a similar migration pattern to Eulachon. In California, Longfin Smelt have been observed as far south as Moss Landing and as far north as Lake Earl (Garwood 2017), with the largest population within the San Francisco Estuary. Recently, the San Franisco Estuary population was determined to be a genetically distinct population and a source for smaller estuaries to the north (Sağlam et al. 2021). Longfin Smelt utilize nearshore marine waters, although focused nearshore sampling for this species is rarely done. Longfin Smelt are occasionally caught in groundfish trawls conducted by National Oceanic and Atmospheric Administration (NOAA) Fisheries. Many one-year-old Longfin Smelt leave the San Francisco Bay and enter the ocean during their second summer (Rosenfield 2010). There is some uncertainty as to whether Longfin Smelt are obligatory freshwater spawners or can spawn in brackish water too.

6.2.5 Lamprey

The last members of California's guild of anadromous fishes are Pacific Lamprey (Entosphenus tridentatus) and Western River Lamprey (Lampetra ayresii). They are members of a phylogenetically ancient group of jawless fishes.

Pacific Lamprey occur in coastal rivers and streams along the entire California coast and in the Central Valley (Figure 6.2-4). Little is known about current California populations, and archeological records are sparse. Pacific Lamprey was once common and abundant in the Central Valley as well as in larger, northern California rivers, including but not limited to the Eel and Klamath rivers. They also regularly occur in Southern California rivers, including the Santa Ynez, Ventura and Santa Clara rivers. Adults measure more than half a meter and after spending over three years in the ocean, they cease feeding and return in spring to create redds and spawn in gravels similar to salmon. Larvae, also called ammocoetes, live in fine river substrate for three to ten years, filter feeding in burrows before metamorphosizing into juveniles and migrating out to the ocean (Hess et al. 2022). This species is considered to be an important component of the food web for predators, as ecosystem engineers, and as a source of marine derived nutrients, and is considered a "first fish" for many California Native American tribes in the Pacific Northwest, including Northern California as a staple of their diet and a signal of the return of spring and summer harvests.

Western River Lamprey are found in the near and estuaries along the California coast as far south as the Sacramento-San Joaquin Estuary. The biology of Western River Lamprey is not well understood, but they share a similar life cycle to the Pacific Lamprey. They migrate upriver, spawn in redds constructed in small gravels and larva filter feed in fine sediment for several years. After metamorphosizing, Western River Lamprey juveniles move into marine waters in spring and early summer and become parasitic. Juveniles feed in the ocean for less than five months and then return to spawn in estuaries and coastal rivers in the late summer and fall of the same year.



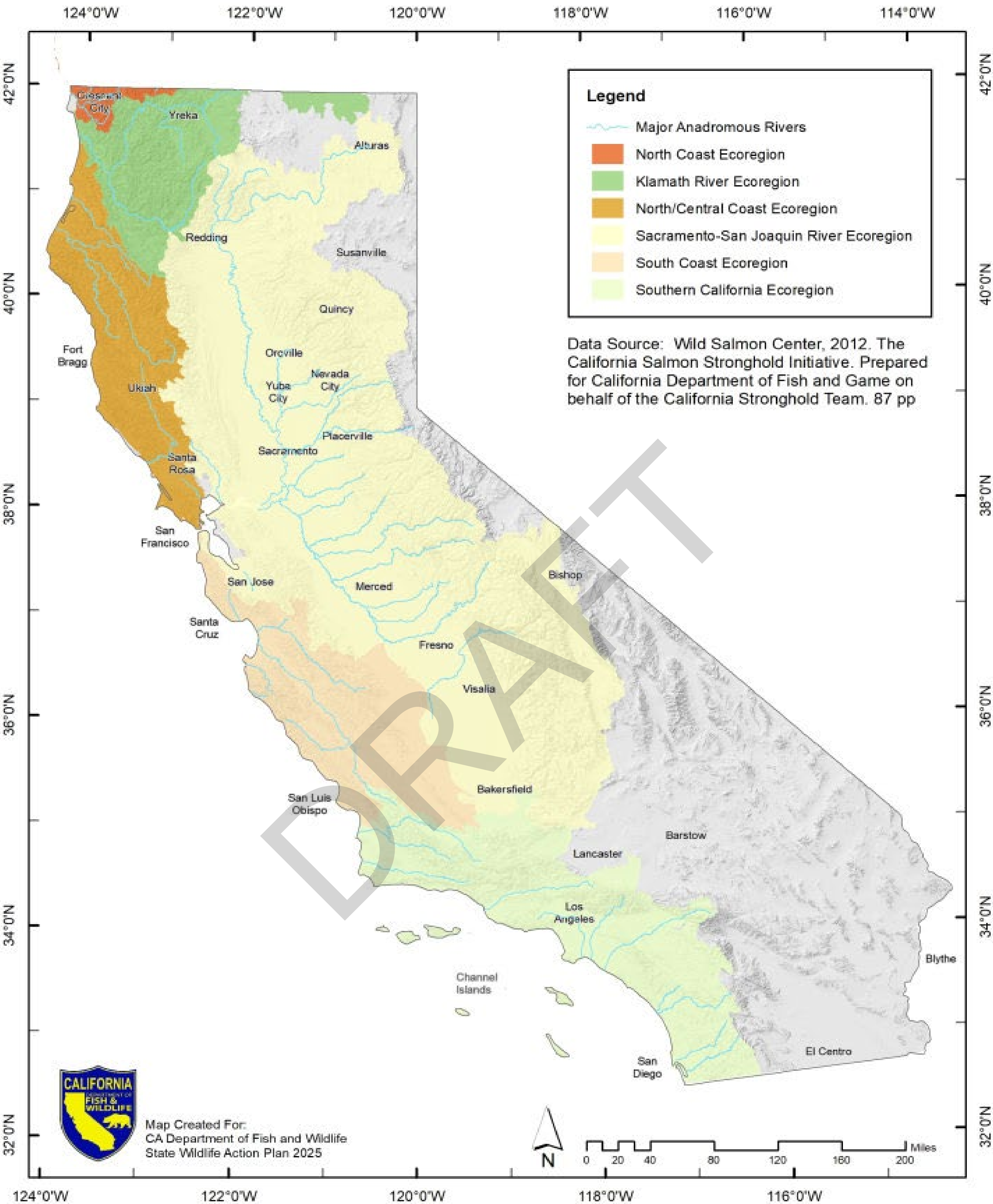
Data Sources: Western River Lamprey, Longfin Smelt and Euchalon Extant Ranges (Ca. Dept. of Fish and Wildlife, Fisheries Branch 2024)
Pacific Lamprey Extant Range (U.S. Fish and Wildlife Service 2021)

Figure 6.2-4 Smelts and Lamprey Distribution

6.3 Salmonid Ecoregions

SWAP 2025 separates California into terrestrial and marine provinces and salmonid ecoregions. For anadromous fish species, the salmonid ecoregion system has been applied. This ecological structure uses hydrology, geology, climate, tidal influence, nearshore ocean influence and currents, and limits to anadromy. The SWAP 2025 text on anadromous species is based on the analysis conducted in the prior 2015 SWAP, led by the Wild Salmon Center in collaboration with federal fisheries agencies, other Pacific state fisheries departments, and conservation groups working to protect anadromous species and watersheds.

For anadromous fishes, six salmonid ecoregions exist: North Coast, Klamath River, North/Central Coast, Sacramento-San Joaquin River, South Coast, and Southern California (Figure 6.3-1; Wild Salmon Center 2010). Broadly, the ecoregions are delineated by large river basins (Klamath River and Sacramento-San Joaquin rivers) and coastal ocean conditions. There is strong year-round upwelling in the North Coast and North/Central Coast, a weak upwelling cline in the South Coast, and the California Undercurrent in Southern California. Each of the ecoregions includes a different guild of anadromous species. For example, the South Coast Ecoregion is represented by only two species, Pacific Lamprey and steelhead, while the North/Central Coast and Klamath River ecoregions include every anadromous species occurring in California.



Data Source: Wild Salmon Center. 2012. The California Salmon Stronghold Initiative.
Prepared for California Department of Fish and Game on behalf of the California Stronghold Team. 87 pp

Figure 6.3-5 Anadromous Salmonid Ecoregions

6.4 Companion Conservation and Recovery Plans

Because of their dietary, commercial, recreational, tribal, ecological, and/or cultural significance, nearly every California anadromous species has been the focus of some conservation, protection, management, and/or recovery effort. Some of these efforts, such as Pacific Coast fisheries management, Pacific Lamprey conservation, and restoration of salmon and steelhead freshwater habitat, span the entire West Coast. These efforts have been focused in California:

- California Department of Fish and Game (CDFG) Restoring Central Valley Streams: A Plan for Action (Reynolds F.L. et al. 1993)
- California Department of Fish and Game (CDFG) Recovery Strategy for California Coho Salmon (CDFG 2004)
- California Salmon Strategy for a Hotter, Drier Future: Restoring Aquatic Ecosystems in the Age of Climate Change (California Governor's Office 2024)
- California Water Plan Conservation Strategy (DWR 2023)
- Central Valley Improvement Protection Act (CVPIA) (USFWS 1992)
- Conservation Strategy for Restoration (CDFW 2014)
- Final Restoration Plan for the Anadromous Fish Restoration Program (USFWS 2001)
- Lagunitas SHaRP Action Plan (CDFW and NOAA Fisheries 2022a)
- Recovery Plan for Sacramento River Winter-run Chinook, Central Valley Spring-run Chinook, and Central Valley steelhead (NOAA Fisheries 2012)
- Recovery Plan for the Southern Distinct Population Segment of North American Green Sturgeon (NMFS 2018b)
- Russian River SHaRP Action Plan (CDFW and NOAA Fisheries 2022b)
- South Fork Eel River Salmonid Habitat Restoration Priorities (SHaRP) Plan (South Fork Eel River SHaRP Collaborative 2021)

The National Marine Fisheries Service (NMFS) has developed, or is in the process of developing, recovery plans for all coastal and Central Valley salmon ESUs, as well as for steelhead and Eulachon DPSs. These plans cover federal Endangered Species Act (ESA) protected species and their habitats. Since 2013, NMFS has finalized seven recovery plans:

- Recovery Plan for the Evolutionarily Significant Units of Sacramento River Winter-run Chinook Salmon and Central Valley Spring-run Chinook Salmon and the DPS of California Central Valley Steelhead (NMFS 2014)
- Final Coastal Multispecies Recovery Plan for California Coastal Chinook Salmon, Northern California Steelhead and Central California Coast Steelhead (NMFS West Coast Region 2016)

- Final Recovery Plan for the Southern Oregon/Northern California Coast Evolutionarily Significant Unit of Coho Salmon (*Oncorhynchus kisutch*) (NMFS West Coast Region 2014)
- Recovery Plan for the Evolutionarily Significant Unit of Central California Coast Coho Salmon (NMFS 2012)
- Final Recovery Plan for South-Central California Steelhead (NMFS Southwest Region 2013)
- Southern California Steelhead Recovery Plan (NMFS West Coast Region 2012)
- Final Recovery Plan for the Southern Distinct Population Segment of North American Green Sturgeon (*Acipenser medirostris*) (NMFS 2018a)

Longfin Smelt are protected by CESA, and the San Francisco Bay-Delta distinct population segment (DPS) is protected by the ESA. The Longfin Smelt Science Plan was released in 2020 and was developed collaboratively by California Department of Water Resources, California Department of Fish and Wildlife, State Water Contractors, and the United States Fish and Wildlife Service (DWR et al. 2020).

The CVPIA, an act passed to mitigate for the impacts of the federal Central Valley water conveyance project, is a primary mechanism of working to recover and sustain all anadromous species in the Central Valley. The Anadromous Fish Restoration Program (AFRP), one of the CVPIA's programs, quantified doubling goals for Chinook Salmon to guide restoration planning and implementation. In 2014, federal partners commenced work with CDFW and other partners to develop a strategic decision-making plan to better select and implement projects on behalf of fisheries and water management.

White Sturgeon became a candidate species for statewide listing as threatened under CESA in July 2024. The Department is currently conducting a Status Review of the species and has initiated new abundance and spawning monitoring programs to inform management. The harvest fishery for White Sturgeon closed as a result of CESA protection from take; however, a catch and release fishery for White Sturgeon was approved in August 2024 under FGC § 2084, which permits hook and line angling if it is consistent with other CESA requirements. A White Sturgeon Science Plan is in development collaboratively with DWR.CDFW also sits on the federal recovery team managing and revising the recovery plan for green sturgeon in Central Valley rivers and Delta, along the north coast, and in the Klamath River Ecoregion.

The San Joaquin River Restoration Program commenced in 2006. It is a federal-state-private partnership developed in the mainstem reach of the San Joaquin River between Friant Dam and the Merced River confluence to achieve several objectives that benefit salmon and other anadromous fishes. It is meant to recover the mainstem San Joaquin River Chinook salmon river fishery, augment the basin's contribution to the ocean fishery, both re-establish and recover spring-run Chinook Salmon, maintain and protect river flow, and benefit other anadromous species, such as steelhead and sturgeon.

CDFW implements two habitat restoration programs, including one dedicated to coastal anadromous salmon and steelhead (Fisheries Restoration Grants Program [FRGP]) and one that supports ecosystem restoration, including significant projects for salmon, sturgeon, and Longfin Smelt (Ecosystem Restoration Program [ERP]). FRGP was founded in 1985 and grants $14–18 million annually in federal Pacific Coastal Salmon Funds for salmon and steelhead recovery.

The Klamath-Trinity Rivers Basin has several ongoing conservation and management efforts, including CDFW's Klamath River Fishery Program and the federal Trinity River Restoration Program. The Klamath River Basin will also be the center of recovery efforts for Eulachon, and NMFS leads the team developing the recovery plan. The Klamath Dam removal project is described in Section 6.6.3.

Several programs and plans guide the assessment of fish, habitat, and/or water data to inform management and recovery of anadromous species. The programs and plans that describe them include:

- California Fish Passage Assessment Database
- California Monitoring Plan for Anadromous Salmon and Steelhead
- California Recreational Fisheries Survey
- CDFW Bay Delta smelt survey projects
- CDFW Delta Investigation and Monitoring Program- smelt and sturgeon species
- CDFW Juvenile Sturgeon Telemetry Program
- CDFW Klamath-Trinity River Program and tribal and federal agency monitoring programs- anadromous salmonids, including the Yurok, Karuk, and Hoopa Klamath River Coho Ecolo Study, the Lower Klamath River Sub-Basin Central Valley Chinook Salmon In-River Escapement Monitoring Plan
- CDFW Ocean Salmon Project
- CDFW White Sturgeon Population Monitoring Program
- Central Valley Angler Survey
- Central Valley Steelhead Monitoring Pilot Program
- Central Valley Chinook Salmon Monitoring Program- interagency plan yet to be implemented
- A Comprehensive Monitoring Plan for Steelhead in the California Central Valley
- Eel River Coastal Monitoring Program
- Federal Central Valley Anadromous Fisheries Restoration Program- all species (primarily Chinook salmon
- Humboldt Bay Monitoring Program

- Interagency Telemetry Advisory Group and the Central Valley Enhanced Acoustic Telemetry
- Klamath-Trinity Fisheries Program
- Klamath Dam Removal (see section 6.6.3)
- Lower San Joaquin River Anadromous Fish Research and Monitoring Program
- North Coast Smelt Monitoring- needed for longfin smelt and eulachon in targeted rivers and estuaries on the north-central and north coast ecoregions
- Mendocino Coastal Monitoring Program
- North Coast Salmon Project
- North Coast Salmon Recreational Angling Report Card Program
- Pacific Lamprey and Western River Lamprey Monitoring Programs- needed in both the Klamath-Trinity and Central Valley ecoregions
- Priority Action Coho Team
- Redwood Creek Monitoring Program
- Restoration Plan and the Yurok's and Wiyot Pacific Lamprey monitoring programs
- Salmon Coded-Wire Tagging and Recovery Program
- Smith River Monitoring Program
- Southern California DPS Monitoring Program
- Steelhead Recreational Angling Report Card Program
- White Sturgeon Recreational Angling Report Card Program

In addition to these programs, other state agencies, California Native American tribes, local water districts, consulting groups, non-governmental organizations, and universities conduct a myriad of monitoring programs and studies designed to assess fish population abundance, habitat quantity/quality, and to guide management and recovery of anadromous fish species. CDFW has access to data collected by these entities through its Scientific Collecting Permit (SCP) program.

6.5 Pressures on Anadromous Species and Watersheds

Each anadromous fish species has limits to its historical freshwater range where spawning and initial rearing once occurred. Figure 6.3-1 illustrates the current limits of anadromy for California's salmonid ecoregions. For some species, adults die after spawning (e.g., salmon), while for other species adults can spawn multiple times (e.g., steelhead, sturgeon). Likewise, rearing of juvenile fish can be relatively short, such as a few months (e.g., fall-run Chinook Salmon), whereas some juvenile fish can spend a year or more in freshwater growing and developing before migrating to the ocean (e.g., spring-run Chinook Salmon, Coho Salmon, Green Sturgeon, Lamprey).

All of these species also have essential habitat and life history requirements in estuaries and bays. White Sturgeon and Longfin Smelt spend a considerable portion of their life cycle in estuarine waters. Eulachon are never far from estuaries, whether as juveniles or adults, and Coho Salmon and steelhead spend important months in estuaries preparing for adulthood in marine waters. For all species, estuaries are the connecting ecosystem between freshwater and the marine environment.

All anadromous fishes are threatened by the loss, degradation, fragmentation, and diminished functioning of freshwater, riparian, floodplain, and estuarine ecosystems, mostly due to the massive water development activities that have occurred in California watersheds over the last 150 years. These effects are apparent in all six salmonid ecoregions of California and have often resulted in insufficient water flow, poor water quality, degraded habitat, diminished food supply, and mismatches in timing between life history stages and seasonal environmental changes or events.

6.5.1 Housing and Urban Areas; Commercial and Industrial Areas; Roads and Railroads; Utility and Service Lines; Shipping Lanes

Human population growth is a founding reason for historic and current impacts to habitat and functioning of freshwater ecosystems in California. Community expansion requires increased infrastructure, such as transportation corridors and road networks, which have degraded riparian, stream, and estuarine habitat and water quality. This has contributed to increased stream sedimentation and has created barriers to fish migration. Associated land use practices (e.g., agriculture, forestry, and mining) have damaged, reduced, and fragmented habitat. Fragmented habitat, changes in climate, and modified hydrologic cycles have also allowed invasive plant and animal species to expand, impacting anadromous fishes through competition, predation, and habitat alteration.

6.5.2 Dams and Water Management/Use

The complex life cycle of each anadromous species, and differences in life history strategies between species, result in river and estuary use year-round across California.

Salmonids evolved with California's Mediterranean climate and associated hydrology. Water projects and water management have altered historical hydrology. The current system requires that reservoir operators manage water releases to maintain flow conditions that are suitable for fish health and life cycles. The amount and timing of water flow, as well as water temperature and quality, are key factors for all life stages of anadromous fishes.

These impacts have occurred in coastal, valley, and mountain ranges of anadromous species. Riverine and estuarine ecosystems have both been especially affected. Rivers are important spawning and migration corridors and estuaries represent both the conduit between marine and freshwater systems and are vital areas for anadromous fish rearing and development. Manipulation of river hydrology has negatively impacted spawning and migration conditions, as well as altering the salinity and productivity of estuaries coastwide.

Competing water needs, water quality degradation, altered hydrology, and unscreened or illegal diversions in many streams, rivers, and estuaries affect habitat quality and quantity, fish behavior, access to rearing and spawning areas, and ecological processes vital for sustainable fish populations. Many rivers and creeks are altered by small to moderate dams and thousands of water diversions that exist across the state. There are also a series of large dams on major rivers statewide (e.g., Klamath, Eel, Trinity, Sacramento, Feather, Russian, Mokelumne, Stanislaus, Tuolumne, Merced, San Joaquin, Santa Ynez, Santa Clara, and San Gabriel rivers; Lindley et al. 2007). These structures have not only altered hydrology, but have interfered with nutrient cycles, as well as altered wood and sediment transport cycles, which are vital to anadromous species. Perhaps their greatest effect has been creating permanent barriers to historical habitat. NMFS has estimated that over 75 percent of Central Valley anadromous habitat has been lost for Chinook salmon, steelhead, and green sturgeon.

6.5.3 Vulnerability to Climate Change

All natural aquatic ecosystems and native California fish species are vulnerable to the ecological stresses resulting from climate change. Anadromous species may be one of the most vulnerable guilds of aquatic species because they have complex, diverse life histories dependent on many different habitat types and aquatic communities. Some of the more significant stresses for California's anadromous fishes due to climate change include:

- Changes in upwelling, coastal currents, and warmer marine waters disrupting food supply for sturgeon, smelt, and juvenile salmonids

- Decreased stream flow, habitat connectivity, habitat availability, and water quality during summer months in rivers and estuaries, impacting migration, juvenile fish over-summer rearing, and adult spawning
- Increased and sporadic winter flooding, impacting over-winter rearing, degrading instream and riparian habitat, and disturbing spawning grounds and incubation of eggs
- Changes in rain- and snow-fall patterns, impacting reservoir water supplies essential for managing species below dams and decreasing snowpack, affecting spring and summer flows
- Increased water temperatures, reducing dissolved oxygen, increasing stress, increasing metabolic rate and food requirements, and increasing susceptibility to disease
- Increased and prolonged droughts, decreasing habitat connectivity, increasing mortality in both juvenile and adult populations where water supply and quality reach critical lows. This poses a high risk for species (e.g., winter-run Chinook Salmon, Eulachon) or populations (e.g., Coho Salmon south of San Francisco Bay) with limited distribution and low population size
- Increased occurrence and severity of wildfires, reducing riparian vegetation cover, increasing water temperature, increasing sedimentation, and altering water quality and food availability
- Proliferation of non-native and invasive species which out-compete native species for food, cover, and spawning areas, alter habitat, and increase predation risks
- Increased occurrence of harmful algal blooms, causing widespread mortality of aquatic species and presenting a particular challenge for sturgeon

6.6 Anadromous Fish Conservation Targets and Strategies

Anadromous species have been a focus of conservation and management for decades. Since the late 19th century, California's salmon have been the focus of research, management, and protection because of their economic, cultural, and ecologic value. In the late 1980s and early 1990s, all anadromous salmonids became a focus of increased management and conservation efforts. Since that time, the scientific and resource management communities have commenced efforts to understand, manage, and protect anadromous smelt species, sturgeons, and lampreys.

Anadromous fish conservation targets and strategies are a subset of known vital needs and actions proposed at two scales: statewide and salmonid ecoregional. Conservation targets are essential species, species guilds, habitat types, or ecological processes. Roughly three priority targets per area and three primary strategies per target are proposed to advance comprehensive conservation and management of anadromous species. Conservation targets for anadromous fishes were grouped by salmonid ecoregions.

The listed actions represent CDFW's primary proposals for collaboration and implementation with state and federal agencies, private and non-governmental partners, California Native American tribes, and the academic community. They constitute activities for both immediate implementation and long-term commitment and can be implemented at different scales and rates in each salmonid ecoregion, depending on available resources, interest, and necessity.

Three strategies are proposed for each statewide or ecoregional target. The strategies, like their targets, are only a subset of needed actions. Proposed strategies were developed to be broad in both ecological relevance and geographic scope to ensure maximum benefit to the selected targets. Another important feature of each strategy is that it is founded in collaborative implementation.

6.6.1 Statewide Conservation Targets

The three targets applicable to all of California are freshwater spawning and rearing habitat, river flow, and wetland habitats. The stresses on these habitats and ecological processes include: (1) habitat fragmentation, loss, and degraded functioning; (2) decreased water supply and quality, altered hydrology, and increased competition for water; and (3) lack of information on the distribution, use, and relative value of spawning and rearing habitat across fish species ranges.

The recommended strategies are meant to restore, connect, and expand habitat; synchronize water management with species needs; and gather information about habitat value and use it to prioritize restoration, enhancement, and protection. SWAP 2025, the California Water Action Plan, the Healthy Rivers and Landscapes Program, the California Salmon Strategy for a Hotter, Drier Future, the Department of Water Resource's California Water Plan and associated Flood and Conservation Plans, California WaterFix, and the State Water Resources Control Board and Regional Water Quality Control Board's Water Quality Control Plans will be pivotal to the CDFW's singular and collaborative efforts to integrate water management, and conservation, with anadromous fish restoration.

In-River Spawning and Rearing Habitat

- Document range and distribution of spawning and rearing habitat
- Enhance and protect key spawning and rearing habitat for each specific anadromous species
- Promote restoration actions that focus on ecological processes and climate change resilience (e.g., removing barriers to migration, expanding riparian corridors)

River Flow

- Identify annual flow regimes and habitat connectivity necessary for migration, rearing, and spawning of each anadromous species
- Develop water management and conservation plans necessary to conserve anadromous fishes
- Implement water management and conservation plans

Wetland Habitat

- Identify current condition of riparian and marsh habitat associated with anadromous species
- Restore marsh and riparian habitat to improve carrying capacity of anadromous fishes
- Protect key areas necessary to maintain viable populations

Pacific Lamprey

- Establish standing committee to implement interstate/intertribal 2022 Pacific Lamprey Conservation Agreement
- Implement habitat restoration and monitoring programs
- Secure funding specific for conserving Pacific Lamprey throughout the state

6.6.2 North Coast and North/Central Coast Ecoregions Conservation Targets

The North Coast and North/Central Coast ecoregions include every anadromous species occurring in California. This area is also represented by several 'California Salmonid Strongholds', the most functioning watersheds for particular species (e.g., Smith River for all species, Mattole River for steelhead). It also has important estuaries, from the Russian to Smith Rivers, including the Klamath River estuary, a key location for Chinook Salmon, Pacific Lamprey, and Eulachon, and Humboldt Bay, important to salmonids and longfin smelt. The last target is the Russian River, the southernmost major river that has Chinook and Coho Salmon and steelhead and a key watershed for recovery of Central California Coast Coho Salmon.

Strategies for these salmonid ecoregions are characterized by understanding how ecological function (i.e., estuaries and entire watersheds) and land use (e.g., in stronghold areas, where fish populations are faring well) are affecting fish populations, and how actions across the area of interest will be implemented to conserve species (e.g., practical support to organizations in stronghold watersheds; restoring estuary function; and maintaining the success of the conservation program at Warm Springs Hatchery).

California Anadromous Salmonid Stronghold Watersheds

- Establish collaborative working groups for each Stronghold (Smith, Mattole, and South Fork Eel rivers)
- Assess ecological and human conditions that are allowing for healthy fish populations
- Establish technical, agency, and financial support to maintain and expand ecological and human conditions supporting strong salmon and steelhead populations

Coastal Estuaries

- Evaluate current condition and estuarine needs for Coho Salmon, Eulachon, Pacific Lamprey, Green Sturgeon, and Longfin Smelt in key estuaries (i.e., Smith, Klamath, and Eel rivers and Humboldt Bay)
- Restore and enhance estuary habitat, connectivity, and ecological processes essential for anadromous species
- Establish estuary function and structure that will allow anadromous migration and be responsive to climate change

Russian River Watershed Conditions

- Restore and enhance estuary and river habitat necessary to support viable populations of all listed anadromous fishes (i.e., Chinook Salmon, Coho Salmon, steelhead, Pacific Lamprey, Western River Lamprey)
- Develop and implement water management plan to ensure Russian River fisheries and land use are compatible
- Expand Warm Springs Hatchery complex to function as a potential regional conservation facility for Coho Salmon and other listed species in the North-Central Domain

6.6.3 Klamath River Ecoregion Conservation Targets

The Klamath-Trinity Rivers Basin represents one of the largest watershed complexes in California, and the Klamath River is one of the longest rivers entering the Pacific Ocean in the lower 48 states. The system is home to populations of salmon important to commercial, recreational, and tribal fisheries, the largest populations of Pacific Lamprey and eulachon in California, and northern DPS green sturgeon. Lamprey, Eulachon, and sturgeon also are important fisheries for California Native American tribes in the region.

Targets for this ecoregion include Pacific Lamprey and Western River Lamprey, because of their ecological and tribal significance, and all anadromous salmonids, because of the multitude of their significance, and ecological processes. These factors are the basis for the health and biodiversity of the entire ecoregion. For both anadromous salmonids and lampreys, strategies are targeted on ecoregion-specific groups focused on the conservation of the species. Recovery planning, restoration programs, water settlements, and tribal rights and values demonstrate the worth and strategic value of developing a comprehensive effort to preserve these species. The value of lampreys is only now being fully appreciated along the entire Pacific Coast of North America, and successful conservation of these species will build off the success in this ecoregion.

Dams used for water diversion and power generation block anadromous migrations to traditional spawning and juvenile rearing grounds on Trinity River. Mitigation salmon hatcheries were built and are operated to compensate for lost salmonid production due to the disruption of fish access to salmonid spawning and rearing habitat above the dams; however, the altered hydrologic regime and dams blocking downstream gravel and wood transport also alter downstream habitat, further stressing anadromous fish populations. The significance of improving release flow regimes and wood, gravel, and nutrient cycling is recognized by Klamath and Trinity rivers restoration groups. Actions to improve functional processes related to flow, gravel transport, and riparian function in the affected reaches can benefit all anadromous species in the rivers, tributaries, and Klamath River estuary.

Ecological Processes

- Evaluate wood debris, gravel, and water cycling and transport mechanisms across the basins
- Establish agreements and practices to ensure adequate ecological processes, habitat quality, and connectivity are maintained to support sustainable anadromous populations across the basins
- Establish monitoring and evaluation programs to track ecological processes and functioning

Listed and At-Risk Salmonids

- Establish standing inter-organizational teams to implement federal and state recovery plans, and continue to support the Trinity River Restoration Plan, and Klamath River Settlement
- Integrate recovery actions with strategic hatchery management (e.g., Fall Creek Iron Gate and Trinity River facilities)
- Integrate sustainable river and tribal fisheries with by establishing sustainable, natural populations of salmon and steelhead
- Steelhead Trout Populations
- Establish a robust monitoring program to evaluate steelhead populations, habitat, and ecological processes

- Secure additional funding necessary to pursue essential habitat recovery
- Determine role of resident populations for recovery and sustainability of anadromous populations

Klamath River Dam Removal Project

The Klamath River Dam Renewal Project is the largest dam removal project to be implemented in the history of California, if not the world. By the fall of 2024 volitional fish passage was achieved, allowing access to potentially 400 river miles of habitat for anadromous salmonids. The removal of the mainstem dams also aims to significantly improve water quality conditions that will benefit the ecosystem and people that depend on a functioning healthy river ecosystem. The removal and restoration of the Klamath Basin Dams has been championed for multiple decades by the tribal nations of the basin.

In November 2024, threatened Coho salmon returned to the Upper Klamath River Basin for first time in more than 60 years. Coho salmon entered CDFW's new Fall Creek Fish Hatchery in Siskiyou County, which is located on Fall Creek, a formerly inaccessible Klamath River tributary about 7.5 miles upstream of the former Iron Gate Dam location. CDFW's post-dam removal management strategy, as detailed in the recently released Klamath River Anadromous Fishery Reintroduction and Monitoring Plan, is to mostly allow these ocean-going fish species to naturally repopulate the 420 miles of newly accessible habitat as they are now doing.

6.6.4 South Coast and Southern California Ecoregions Conservation Targets

The South Coast and Southern California ecoregions constitute the southern range of steelhead, represented by two DPSs. Human population size and development, arid mediterranean climate, unique geologies, and sporadic rain events currently make these ecoregions a difficult landscape for the species. For these ecoregions, steelhead itself is a conservation target. More information is needed to better conserve the species, including more robust abundance estimates across the species' range and a better understanding of the factors that affect anadromy. The other two targets represent needs that stem from large urban populations. Water management needs stem from the intense competition for water, alteration of rivers, creeks, lagoons, and estuaries, and the unpredictable nature of hydrology annually and perennially. Targeted water strategies and plans across the region will benefit steelhead, especially migration corridors, over-summering pools, estuaries, and lagoons. Restoration of estuarine ecosystems and fish barriers will also be key actions that will benefit Pacific Lamprey. Because of human communities and infrastructure corridors, many barriers to migration exist close to the ocean entry of most key rivers and creeks. Addressing key barriers and suites of barriers (e.g., the Santa Ynez River watershed) will be needed to conserve South Coast and Southern California Ecoregion steelhead.

Migration Barriers

- Remediate most downstream barriers to steelhead entering rivers and streams
- Accelerate planning and remediation of rim dam barriers to key steelhead populations
- Modify land use practices (e.g., water use, agriculture, recreation, urban and road development) to minimize effects on steelhead habitat

Water Management

- In addition to the statewide strategy, identify key streams and locations essential for over-summering juvenile and adult steelhead
- Investigate ability and options to reconnect floodplains, creating wetland habitat
- Update CDFW management and conservation plan to integrate modern water management, including drought and climate change parameters

Steelhead

- Establish a robust monitoring program to evaluate steelhead populations habitat, and ecological processes
- Secure additional funding necessary to pursue essential habitat recovery

6.6.5 Sacramento- San Joaquin River Ecoregion Conservation Targets

The Central Valley is the largest catchment basin in California. It is composed of two large river systems, the Sacramento River flowing south and the San Joaquin River flowing north, that converge in the Delta. The Central Valley once supported the largest runs of naturally spawning Chinook salmon in the state and the Valley holds the only spawning habitat of White Sturgeon and southern DPS green sturgeon in the state. The three targets of this huge ecoregion are all species-based, for lampreys, sturgeon, and salmonids. For lamprey, the key needs are to both better understand the species in the ecoregion and develop specific conservation actions for the species. To date, the species has not been a focus of investigations or actions. The success of DPS green sturgeon recovery along the Pacific Coast will hinge on conservation in the Sacramento River. Specific actions for restoration and protection of White Sturgeon will need to occur to ensure a viable population persists in the Central Valley and Delta.

Recovery strategies for Chinook salmon and steelhead need to be comprehensive. Steelhead occur year-round in the ecoregion's rivers and tributaries and experience various pressures. The Central Valley also has the greatest diversity of life histories for

Chinook salmon; each of these species experience varying pressures. Both species will benefit from improved hatchery management centered on employing the highest scientific standards and minimizing the influence on naturally spawning populations. For salmonids, water management decisions are a critical and unique conservation concern. In 2014, Shasta Dam operations caused the loss of over 95% of endangered winter-run Chinook salmon, perhaps the entire population of spring-run Chinook salmon below Shasta, and an unknown but likely sizable portion of the commercially valuable fall-run Chinook salmon below the dam. For this reason, a statewide water management plan should be prepared.

Since major dams exist on most rivers feeding water into the valley floor, this ecoregion should be the primary site for determining the feasibility and efficacy of re-introducing salmon and steelhead above rim dams. Presently, the Yuba and Sacramento rivers are intended sites for such long-term projects. Hatchery and re-introduction efforts will require the collaboration of a large, diverse group of organizations. This same strategy of broad partnerships will be necessary to implement the federal and state recovery and conservation plans completed or in development that will encompass the entire Central Valley within a decade.

Sturgeon

- Establish biological production goals for each species, coupled with SMART ecological objectives, prioritized restoration actions, focused biotic and abiotic monitoring, and adaptive management planning frameworks developed and overseen by established inter-organizational teams to establish sustainable salmon and steelhead populations and fisheries
- Establish biological production goals for each species, coupled with SMART ecological objectives, prioritized restoration actions, focused biotic and abiotic monitoring, and adaptive management planning framework that are developed and overseen by an established standing inter-organizational team to integrate activities of NMFS and CDFW recovery programs, Central Valley Program Improvement Act program, Bay Delta Conservation Plan, San Joaquin River Restoration program, and CDFW fisheries programs to establish sustained salmon and steelhead populations and fisheries
- Revise and integrate hatchery practices of the six facilities in the Central Valley to maximize scientific standards, minimize effects of programs on natural spawning populations and river habitat, and promote healthy fisheries populations
- Conduct rim dam re-introduction pilot projects on Yuba, Feather, and Sacramento rivers and evaluate efficacy of expanding rearing and spawning habitats for recovery. Establish fisheries management and conservation plans for white and green sturgeon
- Implement habitat restoration and monitoring programs

- Secure funding specific for conserving sturgeon populations and fisheries in the Central Valley

Chinook Salmon and Steelhead

- Establish biological production goals for each species, coupled with SMART ecological objectives, prioritized restoration actions, focused biotic and abiotic monitoring, and adaptive management planning frameworks developed and overseen by established inter-organizational teams to establish sustainable salmon and steelhead populations and fisheries
- Establish biological production goals for each species, coupled with SMART ecological objectives, prioritized restoration actions, focused biotic and abiotic monitoring, and adaptive management planning framework that are developed and overseen by an established standing inter-organizational team to integrate activities of NMFS and CDFW recovery programs, Central Valley Program Improvement Act program, Bay Delta Conservation Plan, San Joaquin River Restoration program, and CDFW fisheries programs to establish sustained salmon and steelhead populations and fisheries
- Revise and integrate hatchery practices of the six facilities in the Central Valley to maximize scientific standards, minimize effects of programs on natural spawning populations and river habitat, and promote healthy fisheries populations
- Conduct rim dam re-introduction pilot projects on Yuba, Feather, and Sacramento rivers and evaluate efficacy of expanding rearing and spawning habitats for recovery

6.7 Other Essential Actions

Conservation of California's anadromous species, their habitats, and their required natural ecological processes will demand a concerted, committed, long-term collaboration, more and better information, and constant educational outreach to the public and leadership in California. CDFW is dedicated to expanding and improving its efforts, maintaining and enhancing its partnerships, and exerting its leadership responsibilities to manage and conserve the state's diverse anadromous species. This section presents other essential actions to effectively conserve these species.

6.7.1 Unifying Vision

CDFW will develop a comprehensive vision for anadromous fish species that consists of biological goals for each species, and is coupled with the following planning elements:

- Ecological objectives that are specific, measurable, achievable, realistic, and time bound (i.e., SMART objectives)

- Prioritized restoration actions to guide short-term and long-term restoration efforts
- Focused monitoring to update the existing knowledge base
- Adaptive management framework to track progress towards achieving overarching biological goals

6.7.2 Partnerships, Education, and Outreach

CDFW's partnership and outreach efforts and collaborations will include:

- An improved internet presence, with more information and more frequent updating of species status, conservation efforts, grant fund opportunities, and public involvement opportunities
- Continued engagement and collaboration with California Native American tribes consistent with the CDFW Tribal Communication and Consultation Policy
- Inter-agency outreach and information sharing, such as:
- Usage of internet portals for data, reports, and contacts on anadromous fishes in compliance with the California Open Data Policy
- Updated web-based range and distribution information on California's native fishes, such as BIOS
- Continued partnerships with external organizations to maintain internet sites for status and recovery progress of California salmon and steelhead
- Partnerships and collaboration with stakeholder groups to promote watershed partnerships, community support, address monitoring, assessment, habitat restoration, and public outreach for anadromous species

6.7.3 Research, Monitoring, and Resource Assessment

Information on fish population status, habitat and water conditions, land use, and outcomes of restoration and resource management actions are essential to conserving anadromous fishes. In addition, continued academic and applied research are vital to understanding lesser-known species (e.g., smelt species along the north coast, lampreys statewide, and sturgeon statewide), ecological processes (e.g., sea level rise, changes in precipitation patterns, restoration effectiveness), and new conservation priorities (e.g., strategic hatchery management, re-introduction of fish above rim dams). Section 6.4 Companion Conservation and Recovery Plans lists programs central to conserving California's anadromous fishes.

CDFW and its partners will need to expand and improve their collaborations to meet future fish population evaluation and research needs. CDFW has partnered with federal and state agencies, California Native American tribes, academic researchers, and private research programs to continue important projects, and develop and implement key additional monitoring and assessment programs for population status and trends, restoration efficacy, and ecological functioning. Each existing program will need to be supported and likely expanded in the future, and new programs will need to be developed for some species and some ecoregions.

7 Integration and Implementation

Integrating SWAP 2025 into California's ecologically, socio-economically, and politically intricate landscape is a complex task, but is necessary for successfully implementing the SWAP 2025 strategies. The state's ecology is influenced by natural conditions, including physical, chemical, hydrologic, and biological factors, and by human demands. Any effort to successfully influence this dynamic requires an understanding of the complexities inherent in balancing the needs of wildlife with the demands of modern society. This range of concerns can be addressed and leveraged by intentionally integrating SWAP conservation strategies with the work of partner agencies, California Native American tribes, and regional interests. These collaborations are the foundation of SWAP implementation success. This chapter describes important integration, and implementation approaches for SWAP 2025. Chapter 8 describes how SWAP integration and implementation can be monitored for effectiveness.

Preparation and implementation of SWAP 2025 makes CDFW and conservation partners eligible for federal funding through State Wildlife Grants (SWG) Programs and administered in California by CDFW's SWG Program. SWG funds help to restore and actively manage biodiversity in California.

The SWAP 2025 integration approach includes:

- a revised list of Marine Pressures
- coordinating with CDFW partners to pursue funding resources needed to implement SWAP conservation strategies
- adaptively responding to emerging issues
- engaging with the public during review and revision of the Plan

7.1 Integration with Other CDFW and Resource Agency Programs

Effective implementation of SWAP 2025 will rely on integrating conservation strategies presented in Chapter 5, Chapter 6, and Appendix G into CDFW's conservation programs and into relevant efforts of other state and federal resource agencies. Efforts to integrate SWAP 2025 align with CDFW's Seven Strategic Initiatives, specifically 'Initiative 4. Develop and enhance partnerships (CDFW 2006).' CDFW and the Fish and Game Commission seek to create, foster, and actively participate in effective partnerships and collaborations with other agencies, California Native American tribes, and stakeholders to achieve shared goals and to better integrate fish and wildlife resource conservation and management with the natural resource management responsibilities of other agencies. Interagency coordination includes, but is not limited to, improved sharing of data, information, tools, and science to better align planning, policies, and regulations across agencies.

7.1.1 Integration with Other CDFW Programs and Tools

CDFW conducts habitat management and conservation activities in a wide variety of programs (see Chapter 3 and Appendix I). As examples, CDFW programs include managing CDFW lands and associated water resources, conservation planning for special-status species and their habitats, mapping and database administration, invasive species control programs, fish hatchery operations, habitat restoration projects, Delta programs, marine protection programs, toxic spill prevention and response, environmental review and permitting, and administration of grants. Integrating SWAP 2025's conservation strategies with CDFW's existing programs will help achieve successful conservation and management of wildlife.

CDFW's role as a regulatory authority provides it with up-to-date information on the pressures and stresses placed on conservation targets. CDFW's regulatory role necessitates that SWAP conservation strategies are integrated, when appropriate, into comments on environmental documents and permit terms and conditions. Examples include:

Issuance of California Endangered Species Act (CESA) incidental take permits, pursuant to Fish and Game Code (FGC) section 2081, requires that the impacts of the taking of state-listed candidate, threatened, or endangered species be fully mitigated. By default, these permit conditions and mitigation requirements will parallel, if not include, SWAP goals and strategies because they share the goal of conserving listed and proposed threatened or endangered species, referred in SWAP as Species of Greatest Conservation Need (SGCN).

Lake and Streambed Alteration (LSA) agreements, pursuant to FGC section 1600 et seq., include measures to protect existing fish and wildlife resources when the activities described in the notification may substantially affect these resources. SWAP strategies for relevant resource-related conservation targets will help guide the development of fish and wildlife protective measures in the LSA agreement process.

CDFW serves as a trustee agency under the California Environmental Quality Act (CEQA) with jurisdiction over the fish and wildlife of the state and, in this role, comments and makes recommendations regarding fish and wildlife conservation to CEQA lead agencies and project proponents during CEQA review. SWAP conservation strategies, particularly for CEQA projects involving SGCN, are considered during the comment period of CEQA reviews for project proposed by other lead agencies; SWAP 2025 can also be considered during CEQA review of CDFW's own projects.

CDFW manages numerous grant programs for the benefit of species and habitats (see Ch 3.4.1 and Appendix J). SWAP conservation strategies plus benefits to Species of Greatest Conservation Need (SGCN) and conservation targets could be better integrated into more CDFW grant program requirements and tracked towards SWAP implementation.

7.1.2 Integration with Conservation Programs of Other Agencies

Effective fish and wildlife conservation relies on collaborative efforts among partners, including other state agencies, federal agencies, California Native American tribes, nongovernmental organizations, local government, universities, landowners, and the private sector. Many conservation programs in California are managed by other state and federal agencies. By working together, and integrating SWAP 2025 strategies with programs of other agencies with conservation responsibilities, agencies create an opportunity to coordinate activities and achieve conservation outcomes more efficiently and effectively. The complete array of state agency conservation programs is too extensive to list; this section notes some of the federal and state agencies, programs, and plans that could be directly integrated with SWAP 2025.

SWAP 2025 strategies also align with state conservation priorities. In October 2020, Governor Newsom issued Executive Order N-82-20 which establishes a state goal of conserving 30% of California's lands and coastal waters by 2030 – known as 30x30. The 30x30 goal is intended to help accelerate conservation of our lands and coastal waters through voluntary, collaborative action with partners across the state to meet three objectives: conserve and restore biodiversity, expand access to nature, and mitigate and build resilience to climate change. California's 30x30 commitment is part of a global effort to increase biodiversity conservation, including in the United

States. The approach and actions for meeting 30x30 targets are outlined in the 2022 Pathways to 30x30 California. Statewide progress toward meeting the 30x30 objective of conserving and restoring biodiversity will, by definition, augment efforts toward meeting SWAP's goals of protecting and increasing biodiversity.

Key California Agencies and Programs Related to Natural Resources

California Environmental Protection Agency

The mission of the California Environmental Protection Agency (CalEPA) is to restore, protect, and enhance the environment and to ensure public health, environmental quality, and economic vitality. CalEPA fulfills its mission by developing, implementing, and enforcing environmental laws that regulate air, water, and soil quality, pesticide use, and waste recycling and reduction. Two SWAP- relevant CalEPA boards include:

- Air Resources Board
- State Water Resources Control Board

California Natural Resources Agency

The California Natural Resources Agency (CNRA) oversees and supports more than 26 distinct departments, conservancies, and commissions in its mission "to restore, protect and manage the state's natural, historical and cultural resources for current and future generations using creative approaches and solutions based on science, collaboration, and respect for all the communities and interests involved." Some SWAP-relevant CNRA departments, programs, and plans include:

- California's 30x30 Initiative
- California's Climate Adaptation Strategy
- California Coastal Commission
- California Energy Commission
- California Fish and Game Commission
- California Land Conservancies
- Caltrans
- California Transportation Plan
- California Water Action Plan
- California Water Plan
- Central Valley Flood System Conservation Strategy
- Department of Conservation
- Department of Forestry and Fire Protection (CalFire)
- Department of Parks and Recreation
- Department of Water Resources
- Desert Renewable Energy Conservation Plan

- Fire and Resource Assessment Program
- Nature-Based Solutions
- Natural and Working Lands Climate Smart Strategy
- Ocean Protection Council
- Salton Sea Management Program
- San Franscisco Bay Conservation and Development Commission
- Strategic Plan to Protect California's Coast and Ocean
- Tribal Nature-Based Solutions
- Wildlife Conservation Board

Departments external to Cal EPA and CNRA

- Department of Cannabis Cultivation
- Department of Food and Agriculture

Key Federal Agencies and Programs Related to Natural Resources

- US Army Corps of Engineers
- US Bureau of Land Management
- US Bureau of Ocean Energy Management
- US Bureau of Reclamation
- US Environmental Protection Agency
- US Fish and Wildlife Service
- US Forest Service
- US Geologic Survey
- US Landscape Conservation Cooperative
- US National Marine Fisheries Service
- US Natural Resources Conservation Service
- US National Park Service
- Central Valley Project Improvement Act
- Landscape Conservation Cooperatives
- Migratory Bird Joint Ventures
- Fish Habitat Partnerships
- National Forest Planning Rule
- Natural Resource Conservation Service

7.2 Companion Plans

The SWAP 'companion plans' are a framework for sector-specific conservation activities (see Section 1.6); SWAP 2025 includes updates to two of the existing companion plans (Water Management and Tribal Lands). Companion plans focus on conservation strategies that require collaboration with other state or federal agencies, California Native American tribes, organizations, private landowners, or other partners during implementation. The companion plans complement SWAP 2025 by extending the implementation of the conservation strategies beyond CDFW. The companion plans allow for better leveraging of the limited conservation resources through increased coordination, improved resource and data sharing, and alignment of planning and policy outcomes.

7.3 Integration with Tribal Governments

7.3.1 CDFW Tribal Coordination and Engagement

The importance of engaging with California Native American tribes throughout the development, implementation, and monitoring is imperative for the conservation and protection of California's natural resources.

As mentioned in Chapter 3, there are many policies and Executive Orders that encourage, and sometimes require, the engagement with California Native American tribes. CDFW, through the coordination of the Office of Tribal Affairs, the Department Tribal Liaison and the Regional and Statewide Program Tribal Coordinators, support tribal engagement to ensure the inclusion of tribal input, perspectives, Traditional Ecological Knowledge (TEK), and practices throughout SWAP 2025. Understanding that conservation activities and projects may potentially impact cultural resources and/or culturally significant species, the notification, coordination and engagement with California Native American tribes starting early in the development process through continued management will need to occur.

7.3.2 Integrating SWAP 2025 with Tribal Conservation Programs/Projects

As important as engaging California Native American tribes in CDFWs activities to integrate SWAP 2025, California Native American tribes may also have their own conservation programs and projects that could reinforce the goals and actions within the document. The integration of California Native American tribes in the development and implementation of SWAP 2025 provides opportunities between California Native American tribes and other entities to work together, collaborate on projects and coordinate efforts regarding conservation.

CDFW enlists the help of California Native American tribes as 'community scientists' in a few monitoring and management programs. This work is described in Chapter 8 however continued efforts for more integration of tribal engagement will expand the ways in which conservation work being done by California Native American tribes will be captured within SWAP 2025.

Reaching out to California Native American tribes, to see where opportunities may align with other efforts to integrate SWAP 2025. Creating relationships with the California Native American tribes and establishing open communication to discuss and collaborate will further strengthen the conservation of California's natural resources.

7.3.3 SWAP 2025 Tribal Engagement

CDFW SWAP Team, along with indigenous knowledge consultants, invited all California Native American tribes to participate in the review and update of SWAP, beginning in early 2024. Two inter-tribal listening sessions were held in March 2025, along with one-on-one meetings, when requested. Comments were submitted via an online form, email, and mail. XXX number of tribes participated in the listening sessions, one-on-one meetings, and/or submitted comments during the revision of SWAP 2025.

7.3.4 Tribal Wildlife Grants

Tribal Wildlife Grants are federal funds that are used to provide technical and financial assistance to federally-recognized tribes for the development and implementation of programs that benefit fish and wildlife resources and their habitat. Tribal Wildlife Grant projects can, but are not required to, implement SWAP. Activities may include, but are not limited to:

- Planning, direct action, and laboratory or field research for wildlife and habitat conservation
- Natural history studies
- Habitat mapping, field surveys, and population monitoring
- Habitat preservation
- Public education that is relevant to the project

7.4 Regional Coordination and SWAP Integration

Conservation of SGCN requires working beyond state and national borders on a regular basis. Watersheds and flyways often encompass parts of multiple states and require coordination among many partners and jurisdictions to provided needed habitat. Toward this end, the Western Association of Fish and Wildlife Agencies (WAFWA) represents agencies with primary responsibility for conservation, management, and protection of fish and wildlife resources in 24 states and Canadian provinces. Several states participate in the Southwestern AFWA Collaboration to discuss joint efforts on conservation measures for migratory species that depend on resources from multiple states during their life cycle. For example, migratory ungulates often traverse across state borders requiring multi-agency collaboration to protect these movement corridors. To meet the challenges of conserving long-distance seasonal ungulate migrations, the USGS-led Corridor Mapping Team leverages expertise from state wildlife agencies and California Native American tribes throughout the west.

Full Annual Cycle (FAC) conservation includes efforts to protect and maintain species habitat throughout their annual cycles. CDFW is a signatory on multiple Interagency Conservation Agreements and participates at various levels on Management Oversight Groups and Recovery Implementation Teams for the projects listed below.

7.4.1 Birds

- The bi-national California-Mexico light-footed Ridgeway's rail conservation effort brings together expertise from partners in California, Mexico, and Idaho to monitor and protect the Light-footed Ridgeway's Rail in Baja California, Mexico which is threatened by habitat degradation and loss, predation, and sea-level rise. These efforts were identified in the 1985 Federal Recovery Plan for the species and is the first SWG project in a Latin American country.
- Migratory Bird Joint Ventures coordinates and implements bird habitat conservation that benefits a wide range of wildlife and people.
- The Pacific Flyway Council, which is comprised of the 11 western states, is a migratory bird policy and regulation setting body that works with the U.S. Fish and Wildlife Service, Canada and Mexico. The goal is to coordinate with both state and federal agencies to give migratory birds a shared resource, for developing management plans.
- Pacific Flyway American White Pelican surveys

Pacific Flyway Double-crested Cormorant surveys is a collaboration between federal, state, tribal, and private entities to coordinate monitoring across the four North American flyways (Pacific, Central, Mississippi, and Atlantic) for subpopulations of cormorants.

- Pacific Flyway Shorebird Survey and the Migratory Shorebird Project monitor populations of migratory shorebirds across all 13 countries of the Pacific coast of the Americas.
- Project WAfLS (Western Asio flammeus Landscape Study) is studying the reasons for the sharp decline in Short-eared Owl populations. WAfLS is a citizen-science project being conducted across eight western states, including Idaho, Montana, Nevada, Oregon, Utah, Washington, and Wyoming.
- Range-wide White-faced Ibis tracking and habitat modeling
- Range-wide (western DPS) Yellow-billed Cuckoo survey

- The AFWA Southern Wings project facilitates state fish and wildlife agency participation in the conservation of priority migratory birds across their annual lifecycle.

7.4.2 Reptiles and Amphibians

- The Flat-tailed Horned Lizard (FTHL) Interagency Coordinating Committee implements the FTHL Rangewide Management Strategy.
- The Northern Leopard Frog Conservation Action Plan is being developed by Partners in Amphibian and Reptile Conservation (PARC). CDFW is not actively involved due to capacity and the species' range in CA is limited to sporadic relict populations in the Great Basin.
- The Partners in Amphibian and Reptile Conservation (PARC) meets the AFWA annual meeting as the PARC/AFWA Amphibian and Reptile Conservation Committee (ARCC). CDFW participates in multi-agency efforts through the PARC/AFWA but is not active in the annual meetings. For example, CDFW did contribute to updates to the 2011 State of the Union: Legal Authority Over the Use of Native Amphibians and Reptiles in the United States (AFWA 2011).
- The Western Mojave & Colorado Desert Recovery Implementation Team for the Mojave Desert Tortoise and Desert Tortoise Recovery Partnership, which carries out the work in the 2011 Revised Recovery Plan.
- The Western Pond Turtle (WPT) Range-wide Conservation Coalition, which implements the WPT Range-wide Management Strategy.

7.4.3 Mammals

- USGS Corridor Mapping Team (CMT) releases annual Ungulate Migrations of the Western United States reports, with contributions from states and California Native American tribes throughout the west. Transboundary herds with corridors moving between California and neighboring states are included because of multi-agency efforts.
- California Wolf Project (CAWP)

7.4.4 Invertebrates

- The Western Monarch and Native Pollinator Working Group (WMNIP) developed and works to implement the 50-year western monarch conservation plan. They are also developing a west-wide native bumble bee conservation strategy and have identified priority SGCNs pollinating invertebrates in the west to begin to focus on.

- WAFWA and non-profit partner American Bird Conservancy have a competitive State Wildlife Grant (c-SWG) to expand the Motus Wildlife Tracking System in the west. The project involves tagging monarchs, hoary and silver-haired bats, and purple martins to learn more about their migratory patterns to better target on-the-ground conservation.
- The Native Bee Risk Assessment c-SWG is evaluating the risk of bee species in partner states. The assessed species will be assigned a NatureServe rank; any species that fit the criteria for inclusion as an invertebrate SGCN in the SWAP will be added in the next revision.
- CDFW is part of a c-SWG with the Washington Department of Fish and Wildlife to restore habitat for grassland adapted butterflies including the Quino checkerspot. The project also has a genomic component to assess the taxonomy of the mardon skipper in WA, OR and CA.
- Monitoring of quino checkerspot, Hermes copper butterfly, and Laguna mountains skipper in Mexico, as these species are in decline and threated by extirpation in the United States.

7.5 International Coordination

State wildlife managers face a persistent structural challenge to the effective conservation of wide-ranging and migratory SGCN (USGS 2024): State and international coordination. The threats these wide-ranging SGCN face in their full annual cycle (FAC) accumulate across migrations and seasons are not often fully addressed by state or national jurisdictions. Research shows that effective conservation actions must be coordinated across these species FAC (Marra et al. 2015) , meeting their needs when and where they occur. The FAC encompasses a species full range of habitat associations and biological activities throughout a year including breeding, non-breeding, and migration/dispersal periods (Marra et al. 2015; Schuster et al. 2019) . Thus, conservation actions that focus on migratory birds need to span political boundaries and emphasize approaches with the greatest return on investment. California Department of Fish and Wildlife works with programs that facilitate cross-border collaboration, including the Association of Fish and Wildlife Agencies Southern Wings program (AFWA 2024), which allows U.S. state agencies to support projects in Latin America that benefit shared species, and the Sonoran Joint Venture Awards Program (Sonoran Joint Venture 2024), which funds projects addressing shared habitat and bird conservation priorities between the southwestern U.S. and northwestern Mexico, both have made significant contributions to the stewardship of Neotropical migratory birds.

Threats to landscapes and ecosystems used by birds, such as the LBVI, during the migratory and non-breeding season vary by country and region but include deforestation, commodity agriculture, illegal logging, contaminants, and insufficient enforcement in protected areas. Economic hardships in other countries add to the dire need for support from international partners that have a common interest in the protection and conservation of shared fauna. Projects also need to consider the needs and interests of local communities to be successful. International conservation actions intended to curb these threats include the acquisition and protection of lands used as migratory pathways and non-breeding sites; education of landowners on Beneficial Management Practices, including ecological friendly agriculture; the creation and maintenance of native plant nurseries; and reforestation efforts.

FAC is not only important for Neotropical migratory birds but also for other invertebrate and vertebrate species whose respective ranges cross international borders. Because California is a border state with Mexico, it has many such species, including Peninsular big horn sheep (*Ovis canadensis nelsoni*), quino checkerspot butterfly (*Euphydryas editha quino*), steelhead trout (*Oncorhynchus mykiss irideus*), and hoary bat (*Lasiurus cinereus*). Given the large diversity of species in California's SWAP that can cross political boundaries, it is important to implement FAC conservation measures when appropriate to ultimately promote cost-effective conservation and recovery of our SGCN.

Full Annual Life Cycle: Least Bell's Vireo (*Vireo bellii pusillus*) Case Study

States' ecoregions extend beyond state borders; State conservation area boundaries and Species of Greatest Conservation Need (SGCN) ranges are larger than states. States must work regionally, nationally, and internationally to accomplish conservation objectives for many habitats and species. To prevent migratory species from becoming endangered, and recover those already endangered, we must understand and address the totality of threats facing the species throughout their full annual cycle (FAC) and California's role in supporting their populations. This is particularly important for neotropical migratory birds and other vertebrate and invertebrate species with ranges (e.g., breeding, wintering, migratory stopover.) that transect political boundaries.

Least Bell's vireo (LBVI) is a good example of a riparian associated Neotropical migratory bird that nests as far north as the Sacramento Valley in California south to Baja California, Mexico and winters only in Baja California Sur, Mexico (Figures 7-1 and 7-2). LBVI favors diversely structured riparian woodlands, nesting in thick understory vegetation including various willow species and mule fat (USFWS 1998). They are threatened by habitat loss and brood parasitism by brown-headed cowbirds (*Molothrus ater*), experiencing precipitous declines throughout the 20th century until only a few hundred pair remained in the 1970s. As such, LBVI became listed as Endangered by the California Endangered Species Act in 1980 and the federal Endangered Species Act in 1986.

California Department of Fish and Wildlife, U.S. Fish and Wildlife Service, U.S. Geological Survey, and American Bird Conservancy have been working cooperatively for the recovery of LBVI. This group recognizes that LBVI will benefit from incorporating FAC conservation into recovery actions and strategies that mitigate threats and stressors that confront LBVI across their full range and distribution. The urgent need for additional work in the LBVI range in Mexico presents new collaborative opportunities for California to advance FAC conservation of the species. Currently there are LBVI proposals to understand the species more comprehensively in their breeding and winter ranges in Mexico by working with such groups as the Sonoran Joint Venture and Centro de Investigación Científica y de Educación Superior de Ensenada, Baja California (CICESE). Furthermore, efforts to conserve LBVI habitat can have ancillary positive effects on other species that utilize these riparian habitats as well such as southwestern pond turtle (*Actinemys pallida)* and California red-legged frog (*Rana draytonii*).

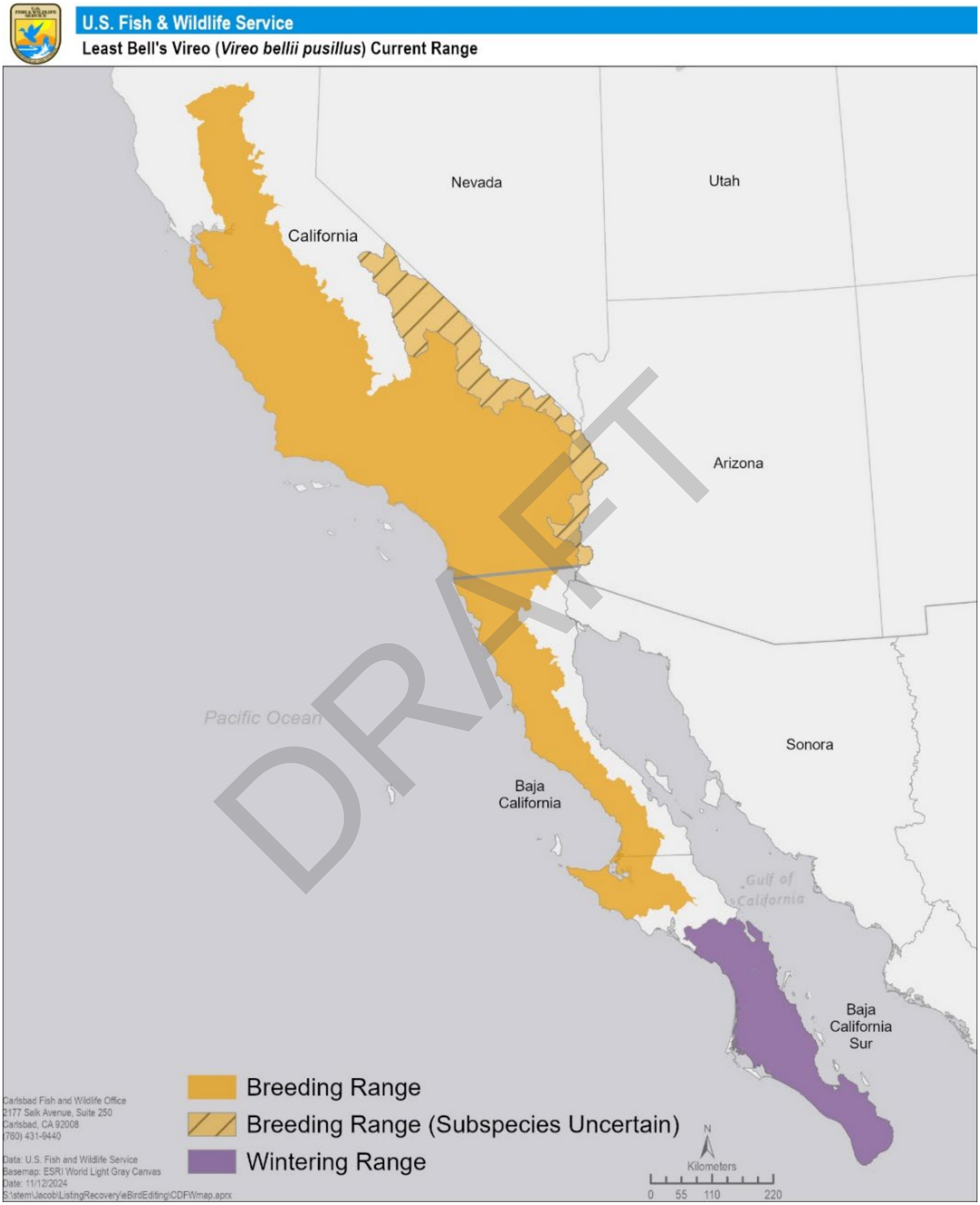


Figure 7-1 Map of breeding and wintering ranges for the least Bell's vireo (Vireo bellii pusillus) in the United States and Mexico

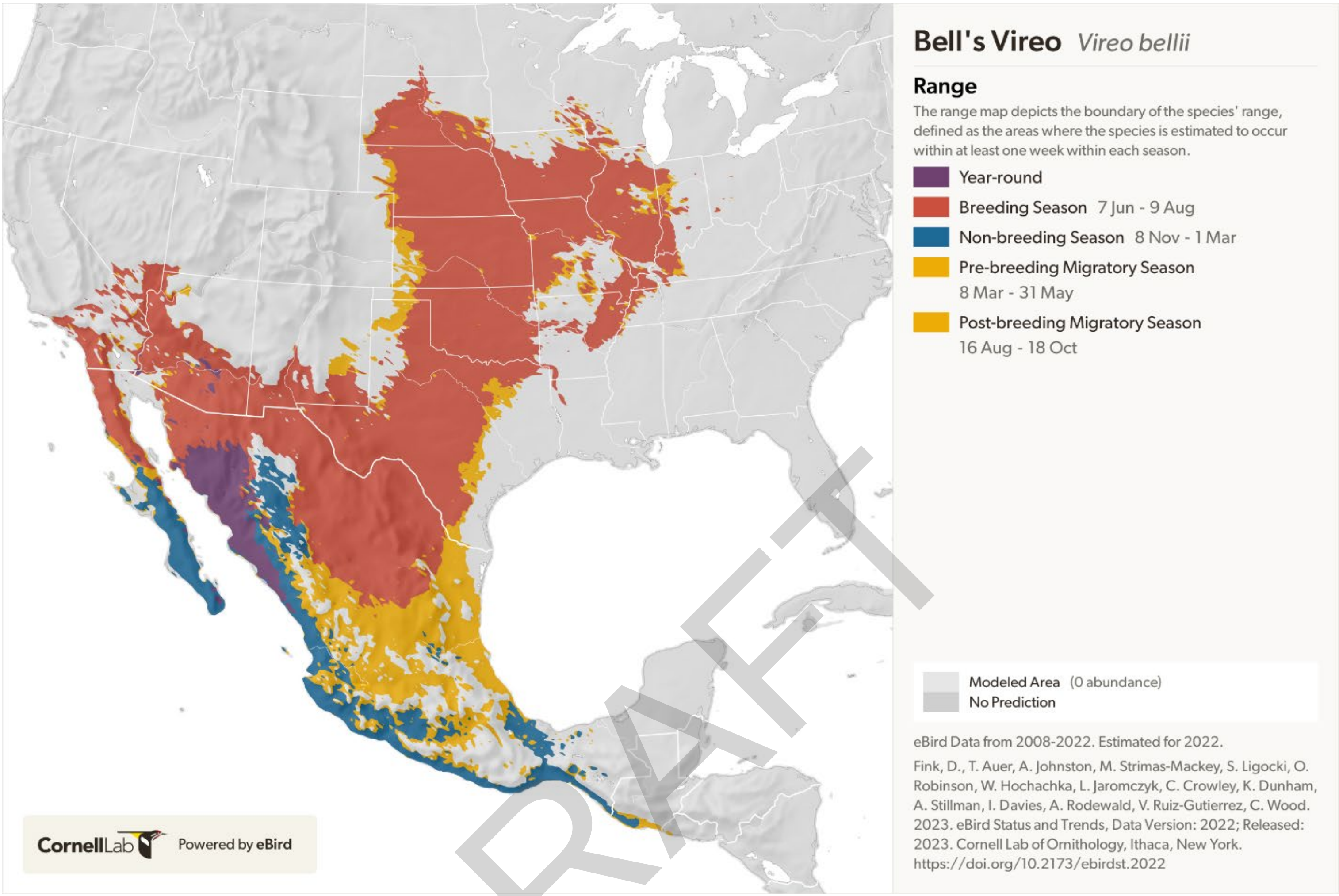


Figure 7-2 Bell's vireo (Vireo bellii) abundance map across is full life cycle; includes the least Bell's vireo sub-species (Fink et al. 2022)

7.6 Public Engagement

Across this great state CDFW interpreters and educators alongside field biologists are engaging with audiences as diverse as the states wildlife and wild places. CDFW recognizes the value of engaging with these diverse audiences through education programs, outreach events, visitor centers, community science, digital communications, and through hosting workshops and trainings. By connecting with all Californians CDFW shares its conservation goals to educate Californians about SWAP and inspire caring, stewardship, and action. Public engagement is called out in the 2025 SWAP as a conservation strategy across all provinces and within most conservation targets.

Implementing programs to engage the public in natural resource conservation involves creating accessible and engaging initiatives that raise awareness about the importance of conserving ecosystems, wildlife, and natural habitats. These programs can include workshops, community outreach events, school-based curricula, and online resources that highlight the impact of human activity on the environment and offer practical solutions for conservation. By fostering a deeper understanding of sustainability and environmental stewardship, these initiatives encourage individuals and communities to adopt responsible behaviors, participate in conservation efforts, and advocate for policies that protect natural resources. Effective engagement programs build a sense of shared responsibility, empowering people to make informed choices that contribute to the long-term health of the planet.

For the purposes of this section "education" refers to activities involving adults attending workshops and/or K-college students attending formal field trip programs, "interpretation" refers to activities involving interpretive staff interacting with the public, and "outreach" refers to events held on CDFW managed properties or at external partner sites that engage the public in CDFW messaging. Refer to Chapter 4 for the steps and considerations taken when developing each of these types of programing.

More information can be found on CDFW's [Office of Communications, Education, and Outreach website]() and Appendix I.

7.6.1 Existing CDFW Interpretation, Education, and Outreach Programs

CDFW outreach across the state includes participation at large events such as the International Sportsman's Expo, regional events with partner organizations, and local events targeted to specific audiences, such as Fishing in the City workshops.

CDFW also has a robust hunting education program, California Hunter Education, complete with in-person and virtual trainings, and workshops. Videos recordings from past workshops are available online. Additionally, it has Recruit. Retain. Reactivate. (R3) Program, which is a nationwide movement focused on reversing the decline in hunting, fishing and shooting sports participation. Furthermore, CDFW maintains a video library of recordings of "Harvest Huddle Hour", which are intended to increase knowledge and confidence around skillsets required to harvest wild food in California in a fun and approachable way.

CDFW interpretation, education, and outreach (IEO) staff engage with diverse audiences at numerous sites across California, like Yolo Basin Wildlife Area, and at many statewide events, including education fairs, school events, and clinics. CDFW works to instill conservation education in California's youth through strong outdoor and classroom education programs, including but not limited to:

- Fishing in the City Program
- Nature Bowl
- National Archery in the Schools Program (NASP)
- Classroom Aquarium Education Program
- Other virtual learning resources

Additionally, CDFW enlists the help of the public as 'community scientists' in select monitoring and management programs. This work is described in Chapter 8.

Youth Aquatic and Marine Education Programs

CDFW leads Aquatic Education Programs on CDFW managed properties throughout California, such as those that occur at the Back Bay Science Center, Nimbus Fish Hatchery and Elkhorn Slough National Estuarine Research Reserve, San Joaquin Hatchery, and in many Marine Protected Areas (MPAs).

Back Bay Science Center: Education programs on the island are led by CDFW staff with the help of volunteers from the Newport Bay Conservancy. Programs involve several learning stations including an investigation of plankton, animals living in the mud, the watershed, birds and water quality.

Nimbus Fish Hatchery: The most visited hatchery in the state, Nimbus offers a staffed Visitor Center, educational public programming, interpretive panels, and guided and self-guided field trips for approximately 8,000 students annually. Students learn about the natural history of salmon and steelhead and their role in ecosystems, water management and conservation, impacts of climate change, and fisheries management practices.

Elkhorn Slough National Estuarine Research Reserve: Each year, approximately 5,000 students experience the diverse habitats of this CDFW Ecological Reserve as part of a school field trip. They can choose to do a variety of field activities from plankton sampling to carbon calculation in an oak forest. Another 20,000 visitors come to walk the trails and enjoy the Visitor Center.

7.6.2 SWAP 2025 Outreach Opportunities

Successful implementation of SWAP will involve the integration of SWAP priorities and conservation strategies into existing CDFW and partner interpretation, education, and outreach efforts and citizen science monitoring programs (described in Chapter 8). CDFW will also conduct targeted SWAP outreach to the public, which would include conservation partners, tribal governments, and other agencies, via webinars, social media and news releases, and presentations at events and conferences.

CDFW intends to improve the usability and integration of SWAP with other publicly available tools, like BIOS (described in Chapter 4), through the development of a new SWAP implementation tracker. This will also enable CDFW to document and share its conservation "wins" with the public. Furthermore, CDFW intends to post annual SWAP updates to ensure the most current information is available for reference and implementation. CDFW will release a new SWAP and SWG user guidance after every SWAP update.

7.7 Resources Needed for Conservation Actions

Conservation actions described in SWAP 2025 are carried out by many CDFW programs. While historically these activities were not specifically implementing the SWAP, the activities can now be considered part of this greater and more comprehensive SWAP effort. Additionally, CDFW receives and uses California's annual allocation of State Wildlife Grant funds to accomplish resource assessment and direct management actions for SGCN and their habitats.

7.7.1 Wildlife Conservation Funding Needs

Existing conservation programs and many of the conservation actions recommended in this plan require additional funding. Preventing biodiversity loss will require new research, expanded conservation planning and management, greatly increased species assessment and monitoring, and major habitat restoration projects. Success or failure of conserving California's wildlife depends on the level of funding dedicated to wildlife conservation and restoration programs over the next few decades.

Increased Demands on Conservation Agencies by Growth and Development

The workloads of wildlife managers and conservation managers have greatly increased to meet the challenge of conserving wildlife in a time of rapid growth and development, increased water diversions from creeks and rivers, continued invasions of non-native species, expanded off-road vehicle recreation, and numerous other modern demands. California's unique habitats are shrinking due to this continued development and pressure to develop wildlands that now provide key wildlife habitat. These challenges compound workloads of state wildlife managers. Maintaining healthy populations of species on fragmented and smaller areas of habitat requires more intensive management, environmental review, conservation planning, monitoring, mitigation project design, and habitat restoration. Accompanying this expanded development is an increased public demand for recreational access to public land, waterways, and ocean resources.

Expanding Responsibilities and Demands for Wildlife Conservation

CDFW is the state agency charged with conserving and restoring wildlife and ecosystems, responsibilities that have expanded and become more complex over the last several decades. State policy-makers have enacted new wildlife conservation and environmental protection mandates in response to the increasing problems affecting species and habitats. Resource assessment, conservation planning, and dozens of tasks necessary to conserve wildlife species at risk are severely underfunded. Without a broad-based stable funding mechanism, CDFW is hard-pressed to implement many of these conservation programs, even at modest levels.

CDFW has evolved from primarily managing fishing and hunting programs to also serving as the public trust steward for all wildlife, habitat, and ecosystems. With the enactment of more than 20 conservation programs since 1968, CDFW's wildlife and wildlands stewardship role has expanded dramatically beyond its statutory and regulatory responsibilities. Many of these measures have mandated major new workloads for CDFW without providing new or sufficient funding and staffing.

Since 2015, new legislative mandates and programs, along with emerging and expanding threats (i.e., pressures) like wildfires and drought have increased demands on CDFW, leading to the establishment of new programs, including:

- Beaver Restoration Program
- Cannabis Program
- Cutting the Green Tape
- Nutria Eradication Program
- Office of Justice Equity Diversity and Inclusion (JEDI)
- Office of Tribal Affairs
- Pollinator Conservation
- Regional Conservation Investment Strategies Program (RCIS)
- Western Joshua Tree Conservation
- Wildlife Connectivity
- Wildlife Diversity Program (formerly the Nongame Wildlife Program)
- Wildfire Resiliency
- Wildlife-Human Conflicts

Examples of Interagency Programs

CDFW develops and operationalizes many of it its objectives through collaborations with these long-standing interagency programs:

- CDFW Ecosystem Restoration Program (ERP), in coordination with USFWS and National Marine Fisheries Service (NMFS), has finalized a Conservation Strategy for restoration of the Sacramento-San Joaquin Delta, Sacramento Valley and San Joaquin Valley regions.

- CDFW is engaged in habitat restoration in the Delta in coordination with Department of Water Resources (DWR) through the Fish Restoration Program Agreement (FRPA).
- As a primary participant in the Interagency Ecological Program (IEP) for the San Francisco Estuary, in partnership with the Delta Science Program, CDFW continues to conduct extensive research and monitoring to inform real-time decisions on water exports to maintain compliance with ESA and water quality requirements, to identify status, and trends and inform long-range export planning.
- CDFW is participating in several phases of the State Water Resources Control Board's (SWRCB) review and update of its Bay-Delta Water Quality Control Plan (Bay-Delta Plan) including making recommendations to (1) revise San Joaquin River flow standards entering the south Delta; (2) revise water quality, flow and Delta operations objectives in the Delta itself; and (3) providing instream flow recommendations for Delta tributary streams.
- CDFW is responsible for managing California's redesigned MPA network, which includes 124 MPAs and 15 special closures, covering approximately 16 percent of the state waters (over nine percent of which is in no-take MPAs).
- Natural Community Conservation Planning is a comprehensive, multi-jurisdictional plan that provides for regional habitat and species conservation at an ecosystem level while allowing local land use authorities to better manage growth and development. Upon issuing a NCCP Permit, CDFW can authorize take of certain state listed species and other species of concern, subject to the terms of coverage under the NCCP.
- CDFW coordinates with California State Parks, Division of Boating and Waterways on the development and implementation of the Enhanced Quagga Mussel Prevention Program.
- The San Joaquin River Restoration Program (SJRRP) was implemented in 2006 with CDFW supporting spring-run Chinook salmon reintroduction, as outlined in the NMFS 10(a)1(A), permit application for the Reintroduction of Central Valley spring-run Chinook salmon into the San Joaquin River.
- CDFW facilitates the California Multi-Agency Monarch and Pollinator Collaborative, a working group comprised of thirteen state and federal agencies working together with the goal of increasing the pace and scale of monarch and pollinator conservation in the state through shared objectives and actions.

Resources Needed for Regional Planning

Ongoing differences between development project interests and protection of endangered species led conservation scientists, California Native American tribes, stakeholders, and CDFW to partner on regional planning for habitat conservation and protecting biodiversity. This broad, proactive approach to conservation aims to identify and protect key wildlife habitats and designate areas for development that avoid those habitats, prior to planning for individual projects in a region. CDFW serves numerous important functions in these broad conservation efforts, providing:

- Biological data on individual species, which is then used to develop multispecies conservation plans, recovery programs, and restoration projects
- Habitat quality and resource assessments, used to identify the most important lands for supporting multiple species
- Planning and design expertise for conservation planning projects
- Design of appropriate mitigation measures for effects of development on natural resources
- Facilitation in bringing diverse stakeholders and California Native American tribes to the table and assisting them in developing conservation strategies at the local government level
- Monitoring implementation of conservation plans and mitigation projects to assess the effect and effectiveness of the implementation

These responsibilities are not in lieu of work at the species level. On the contrary, species-level research and management, and particularly implementation of CESA, trigger efforts that evolve into the broader conservation planning efforts.

Wildlife Conservation Funding Crisis: Recognized but Not Solved

The fiscal difficulties of administering all programs and mandates required of CDFW have been repeatedly acknowledged by the Legislature. The Legislature described the problem in statute in 1978, 1990, and 1992, as noted in the FGC sections below. In addition, FGC sections 711, subdivision (a) and section 711.4 describe funding for nongame fish and wildlife programs, managing lands, and defraying the costs of managing and protecting fish and wildlife trust resources. Finally, in FGC section 1019 the caveat “subject to an appropriation of funds” was included, acknowledging the lack of ability to implement without funding.

FGC Section 710

The Legislature finds and declares that CDFW has in the past not been properly funded to meet its mandates. Fixed revenues from fees and licenses relative to rising inflation and other costs has led CDFW to restrict warden enforcement and defer management of state lands or facilities (e.g. essential repairs to fish hatcheries). The lack of secure funding for fish and wildlife activities other than sport and commercial fishing and hunting activities has resulted in inadequate non-game fish and wildlife protection programs (statute last amended in 2007).

FGC Section 710.5

While revenues have been declining, CDFW's responsibilities continue to expand into new areas. The existing limitations on the expenditure of CDFW revenues have resulted in its inability to effectively provide all the programs and activities required under FGC and to manage the wildlife resources held in trust by CDFW for the public. Many CDFW programs are supported by user fees, and the Legislature supports continued funding by users of the state's resources, including hunting, fishing, commercial fees, and other entitlements; however, CDFW must secure a more reliable source of funding (added to statutes in 1990, last amended 2017).

FGC Section 710.7

CDFW continues to face serious funding instability due to revenue declines from user fees and taxes and the addition of new program responsibilities. Wildlife and marine conservation programs, which are the primary beneficiaries of the limited General Fund dollars, have suffered dramatic budget cuts since 2015 with fiscal needs from the overall state budget. Unfunded mandates have increased over this same period without concomitant budget augmentations. As California's population and land development activities grow, CDFW resources are re-directed to conservation efforts. The Legislature encourages CDFW to partner with other organizations to extend the current user-based funding system by allocating a portion of the marine resource protection costs to those who use and benefit from recreational and commercial use of the marine resources (added to statutes in 1992, last amended 2007).

FGC Section 711(a)

The Legislature finds and declares under subdivision (a)(1) that the Budget Act will provide funding through nongame user fees for nongame fish and wildlife programs separate from the General Fund. Under subdivision (a)(2), commercial fishing fees, other revenues, and other appropriated funds will offset the costs of commercial fishing programs or from reimbursements and federal funds received for commercial fishing programs. Under subdivision (a)(3), hunting and sportfishing revenues and reimbursements and federal funds will be separate from those for commercial fishing programs, free hunting and fishing license programs, and nongame programs, and with other appropriated funds will offset the costs of hunting and sportfishing programs. Under subdivision (a)(4), revenues in the Native Species Conservation and Enhancement Account in the Fish and Game Preservation Fund will supplement the costs of wildlife and land management programs. Under subdivision (a)(5), hunting and sport fishing license fees are adjusted annually pursuant to FGC Section 713 based on inflationary index. However, a substantial increase in the aggregate of hunting and sportfishing programs shall be reflected by appropriate amendments FGC that establish base sport license fee levels. Under subdivision (a)(6), the costs of a conservation and mitigation banking program, including, but not limited to, costs incurred by CDFW during its adoption of guidelines for, and the review, approval, establishment, monitoring, and oversight of, banks, shall be reimbursed from revenues of conservation and mitigation bank application fees imposed pursuant to FGC Sections 1798.5, 1798.6, and 1799.

FGC Section 711.4

CDFW collects fees in the amount prescribed in subdivision (d) to defray the costs of managing and protecting fish and wildlife resources, including, but not limited to, consulting with other public agencies, reviewing environmental documents, recommending mitigation measures, developing monitoring requirements for purposes of CEQA, consulting pursuant to Section 21104.2 of the Public Resources Code, and other activities protecting those resources.

FGC Section 712.1

Senate Bill 854 (2018) required CDFW to embark on service-based budget review of its core goals and programs through contracting with a provider who could guide CDFW through defining service standards and essential activities required for CDFW to meet its mandates, including detailed staff and administrative costs. Ongoing analysis is required of current service levels for comparison to service standards, as well as analysis of existing CDFW revenue streams and program funds to support the services and essential activities. The service-based budget tracking system shall be developed as a tool to inform ongoing and future fiscal decision-making processes.

FGC Section 1019

The legislature requires the preparation of a draft management plan for public review within 18 months of acquiring new parcels, subject to an appropriation of funds. These funds have not been appropriated and there is a significant backlog of plans to be completed. Further, FCG section1019 does not include a provision for funding the completion of the identified plans. Plans are most commonly funded by grants awarded from WCB or PR Funds.

7.7.2 Wildlife Conservation Program Needs

Fishing and hunting programs and related conservation efforts have specific dedicated funding derived from licenses, fees, and taxes on outdoor equipment. The public-trust duties of CDFW and its conservation programs that broadly benefit species, habitats, and ecosystems warrant funding from all Californians. Conservation-related activities that should be supported by broad-based funding may be described within the following four categories:

Science and Planning

- Managing and conducting resource assessments including baseline studies and long-term time-series data
- Implementing ecological research that supports conservation and management
- Developing regional conservation plans
- Developing Land Management Plans for Wildlife Areas and Ecological Reserves
- Include engagement with California Native American tribes in development of plans and the implementation, management and assessment of research and studies
- Support for long-term monitoring to track of the state's biodiversity and climate shifts in order to respond quickly and adapt management

Wildlife Conservation and Habitat Restoration

- Implementing conservation and recovery plans and projects
- Designing, implementing, and monitoring habitat restoration projects
- Developing conservation and recovery strategies and plans
- Include engagement with California Native American tribes on the design/development and implementation of plans, projects and strategies

Enforcement for Wildlife, Wildlands, and Marine Resources

- Expanding wildlife and marine enforcement staff, salaries, and resources
- Developing an investigator class of wildlife enforcement staff

Wildlife Conservation Education and Service

- Educating the public on wildlife conservation issues
- Providing interpretive information and public services related to outdoor activities
- Include engagement with California Native American tribes in the development of educational and informational public services

7.7.3 Wildlife Lands Management Needs

State and federal wildlife and land management agencies and some state policymakers have expressed great concern for the lack of resources for wildlife conservation, restoration, and enforcement on public lands. The needs for operation and maintenance of lands managed by CDFW are discussed below. The USFWS, BLM, USFS, National Park Service, and California State Parks face similar challenges as CDFW to fund the restoration, ongoing maintenance, and other management of public lands.

The acreage of wildlife areas, ecological reserves, and wildlands that CDFW manages has quadrupled in the last 45 years, from 250,000 acres in 1980 to over 1.1 million acres today. Funding to manage these lands has not kept pace. The bond acts and appropriations that fund acquisition of new lands for wildlife often come without funding for planning, restoration, and maintenance of these lands. Site security, managing public health and safety on the lands, managing wildlife and natural resources, maintaining infrastructure, and managing recreation are additional costs included in wildlands management.

The consequences of neglecting lands are many. Without management, wildlife values of the lands are also compromised. The habitat is degraded if invasive species are not controlled, fuels are not managed, and ecosystems functions are not maintained. An area that is not secure or regularly inspected invites trespass by individuals and livestock and encroachment by such adjoining land uses as residential development, agricultural operations, and off-road vehicles. Trespassing often involves vandalism and dumping. The result is degradation of the land, and the state is seen as a bad neighbor. Lacking restoration efforts and/or management, many acquired lands do not meet the habitat goals for which they were purchased.

Public-use and education potential on CDFW lands can also not be realized without sufficient staff resources. State wildlife lands have been acquired for specific conservation or recreation goals. Managing lands for their intended purpose requires staff and resources. Depending on the intended purposes of the land and the habitat values, CDFW’s Lands Program in the Wildlife Branch estimates annual land operating management costs for many wildlife areas to range from $80 to $500 per acre. Other public lands management entities estimate land operating and management costs to be significantly higher (Center for Natural Lands Management 2004). In 2005, maintenance, restoration, and management of CDFW’s wildlife areas and ecological reserves were supported, on average, at the level of $13 per acre ($22 in 2024 when adjusted for inflation) and one staff person per 10,000 acres. Many lands were operated at $1 per acre, with no dedicated staff. There has not been a significant increase in the budget since then. Lack of increased funding inhibits the advancement of public outreach and educational programs on these lands. This highlights the importance of considering stewardship and co-management opportunities with other organizations and California Native American Tribes.

8 Monitoring California's Species and Habitat Conservation

> "Adaptive management is about continuous learning, not with the objective of finding the perfect final solution to a problem, but to navigate complexities, while keeping a direction toward improved environmental conditions."
>
> Lisen Schultz and Ioan Fazey in Adaptive Management: A Practitioners Guide (Allan and Stankey 2009)

California's large and biodiverse landscapes are inherently complex systems that require effective strategies to monitor and adaptively manage the natural resources within them. Environmental monitoring provides scientists and land managers with evidence-based information to make management decisions and develop regulatory frameworks. According to a 2021 gap analysis of CDFW's services, monitoring is a key function that needs to be prioritized to fulfill CDFW's mission. This analysis highlighted the critical need to scale up monitoring of species and their habitats to meet CDFW's mission, as well as that of other state and federal agencies and local and regional organizations, to maintain and safeguard biodiversity.

CDFW's monitoring programs track species and conservation strategies using a range of software and database systems (see Chapter 3). This chapter discusses CDFW's monitoring efforts, which includes:

- extensive species monitoring through all CDFW branches; Although this work is not always specific to SWAP, CDFW branch objectives regularly align with SWAP goals and associated monitoring can be used to gauge SWAP conservation strategies
- State Wildlife Grant (SWG) tracking, which is specific to gauging the implementation of SWAP-based grant objectives

Species and habitat monitoring play a key role in adaptive management. As an umbrella action plan, SWAP 2025 provides a framework for California's wildlife conservation community and programmatic direction to CDFW. Specific conservation strategies that are described in the SWAP framework are adapted based on data-driven decisions, partly derived from monitoring results.

CDFW continues to build internal capacity and strengthen efforts across agencies and partnerships to use adaptive management effectively. California's agencies have teamed-up to upgrade monitoring methods and systems. CDFW plays the key role of collating and sharing wildlife and habitat data, investing in scalable tools that support effective monitoring practices, and establishing tractable measures to evaluate species and habitat conservation outcomes. These efforts strengthen projects through adaptive management and improve outcomes for SWAP goals both directly and indirectly.

Climate-Biodiversity Sentinel Site Network

The California Climate-Biodiversity Sentinel Site Network is a collection of long-term climate and biodiversity monitoring sites statewide, established to systematically monitor how ecosystems are changing at local, regional, and state-wide scales in response to climate change and other stressors.

At CDFW, the Science Institute, Lands, and Wildlife Diversity Programs have worked together to establish sentinel sites on select CDFW lands, including Wildlife Areas and Ecological Reserves across the state. These sites were chosen to reflect the wide range of climate conditions and ecosystem types in California (e.g., coastal, deserts, high-elevation mountain sites, valleys, foothills, etc.). Each CDFW sentinel site hosts at least one weather station with a variety of sensors for climate monitoring, wildlife cameras for documenting reptiles, amphibians, and small to large mammals, acoustic sensors for recording bird and bat vocalizations, and Motus telemetry stations for tracking animal movement. Standardized field method, data storage, and data processing protocols are being applied across the network to maximize utility of the data by researchers and conservation practitioners throughout the state. CDFW Cannabis Program developed the protocols as part of the California Environmental Monitoring and Assessment Framework (CEMAF).

Measuring and documenting climate impacts via long-term monitoring (spanning decades) is crucial for informing management strategies and actions aimed at conserving California's biodiversity for future generations. The Sentinel Site Network is being developed through a statewide, multi-jurisdictional partnership and community of practice for science-informed management in collaboration with the California Biodiversity Network. The Sentinel Site Network supports goals and supports data inputs for California's 30x30 Initiative, CDFW's 2025 SWAP, and CNRA's Nature-Based Solutions.

8.1 Monitoring

Monitoring is the scientific practice of taking systematic, repeated measurements of environmental conditions, using the same methods over time to make long-term comparisons. Monitoring is a critical component of managing California's rich biodiversity, particularly SGCN and the habitat on which they depend, and to evaluate project impacts, both negative and positive. Effective monitoring requires the identification of key variables and the commitment to ongoing data collection, management, and analysis (Foundations of Success 2019) . Monitoring may be short or long term, depending on factors such as the anticipated rate of change or whether influencing actions are discrete or ongoing.

8.1.1 CDFW's Role in Monitoring

CDFW engages in multiple long-term monitoring efforts across a wide variety of taxa to track the status and trend of wildlife populations. CDFW has built a large library of monitoring protocols, discussed below, for endangered, threatened, and otherwise identified critical species that have been developed internally, or in scientific literature and by USFWS, USGS, USGS, and other research partners. Monitoring efforts as undertaken by CDFW are built upon these best practices (Margoluis et al. 2009).

CDFW's research and monitoring efforts attempt to address where species and their habitat occur, the status or trend of species and their habitats, and the effectiveness of current and past conservation actions. Species and habitat monitoring is critical to expanding CDFW's understanding of species distribution and various populations across the state. CDFW staff select or develop monitoring protocols depending on the specifics of the conservation issue.

CDFW's monitoring of special status species, also identified as SGCN in SWAP 2025, directly informs CDFW work. CDFW conducts monitoring on a multitude of taxa and has long-term monitoring data from years of wildlife projects (see Table 8-1).

CDFW manages federal Section 6 grants for monitoring projects targeted for at-risk species, species that are the subject of a proposed federal listing, species undergoing status review, and recently de-listed species. Through CDFW's monitoring work, SGCN conservation work is directly integrated with CDFW's programmatic work. Monitoring data collected by CDFW and partner organizations on special status species (SGCN) directly informs CDFW's responsibilities of:

- Reviewing petitions for listing
- Developing RCIS and HCCPs
- CESA permitting and CEQA review
- LSA agreements and HREA

Internally, CDFW's Science Institute coordinates a Monitoring and Adaptive Management Science Institute Focus Team (SIFT), known as the Monitoring SIFT. The Monitoring SIFT has provided a forum to share knowledge of programs, projects, ideas, and opportunities related to monitoring. A range of CDFW staff participate in SIFTs, which allows for cross-functional collaboration within CDFW. The forums aim to improve CDFW's ability to apply best-practices during monitoring, improve monitoring data on project life-cycles within an adaptive framework, streamline access to current protocols and data, engage and inform the public, and provide educational resources to CDFW employees.

The Monitoring and Adaptive Management SIFT has provided forums on adaptive management regarding metrics and implementation, education and outreach, and community science programs.

Externally, CDFW engages with monitoring on the national and international level in collaborative species research and monitoring efforts with universities, California Native American tribes, NGOs, agency partners, and private landowners. Based on these multiple monitoring inputs, CDFW can analyze the extent and viability of some wildlife populations, including SGCN, across the south-west US region. Large scale and long-term monitoring conducted in partnership with neighboring states and jurisdictions has aligned scientific underpinnings and revealed habitat trends of migratory species. Monitoring can identify pressures to habitats that are required by migratory species, including SGCN, with critical habitat requirements in multiple states including California (see Section 7.5 Regional Coordination and SWAP Integration). Large scale monitoring and cross-jurisdictional coordination can inform and implement effective conservation strategies to counter threats and bolster populations.

8.1.2 Types of Monitoring

CDFW prioritizes monitoring efforts for species or habitats of highest conservation concern, such as species of legislative concern, species listed under CESA and ESA, and covered in signed conservation agreements or strategies, or that are the subject of reintroduction efforts. Monitoring is conducted at multiple scales, depending on the research question or management issue. As such, CDFW monitors at the genetic, species, habitat, and ecosystem levels depending on project goals and priorities.

8.1.3 Species or Species Group Monitoring

CDFW conducts species-level monitoring with a continually evolving variety of tools, from traditional tagging conducted at hatcheries to camera traps with machine learning models for terrestrial wildlife, and Passive Integrator Transponder (PIT) tags to identify and track anadromous fish. CDFW partners with agencies statewide and continually modernizes methods for genetic, wildlife, and plant species monitoring.

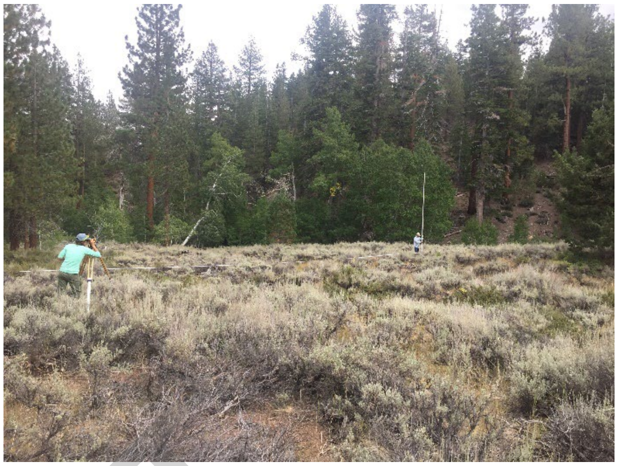
Fall Midwater Trawl

The Fall Midwater Trawl Survey (FMWT) has sampled annually since its inception in 1967, with the exceptions of 1974 and 1979, when sampling was not conducted. FMWT equipment and methods have remained consistent since the survey's inception, which allows annual abundance indices to be compared across time. The FMWT data has also been used to study upper estuary pelagic species, including delta smelt (*Hypomesus transpacificus*), longfin smelt (*Spirinchus thaleichthys*), American shad (*Alosa sapidissima*), splittail (*Pogonichthys macrolepidotus*), and threadfin shad (*Dorosoma petenense*).

The Delta Smelt is a small fish, endemic to California that only occurs in the San Francisco Estuary. Delta Smelt feed primarily on planktonic copepods, cladocerans, and amphipods. Weak swimming behavior, combined with diel shifts up and down in the water column cause Delta Smelt to stay in limited regions, where planktonic food is concentrated. Delta Smelt is called an 'indicator species'—a species representing the overall health of the Bay Delta Estuary ecosystem. Once the most abundant species in the entire estuary, the Delta smelt is now listed as "endangered" under both the federal Endangered Species Act and the California Endangered Species Act.

CDFW long-term monitoring surveys have tracked the demise of the Delta Smelt in the Bay Delta. CDFW continues to work with the Interagency Ecological Program, a group of state and federal agencies doing cooperative ecological research, to conduct the January-March midwater trawl, replaced in 2002 with the Spring Kodiak Trawl, to track movements of mature adult delta smelt. In 2023, the sixth year in a row, no Delta smelt were collected in the CDFW FMWT Survey. When no Delta smelt are found in six years of a survey that has been conducted since 1967, the estuary is in a serious ecological crisis.

CDFW monitors habitat conditions and trends, treatment effectiveness, and overall land health. CDFW's habitat monitoring efforts track biotic and abiotic factors at multiple temporal and spatial scales to understand both habitat condition and trend and the effectiveness of conservation actions. These efforts also assist with understanding the extent and influence of human disturbance on the landscape that ultimately impacts wildlife habitat.



Throughout the state, habitat monitoring is conducted by CDFW programs and other public, tribal and NGO land managers and formalized in their resource management plans. Much of the monitoring is done with CDFW partners and in concert with species-level projects.

Vegetation is often considered to be the best single surrogate for habitat and ecosystems. Vegetation science has thus played an increasing role in wildlife and natural lands conservation and management over the years; it is now among the principal tools involved in wildlands management and planning.

The State Legislature tasked CDFW with developing and maintaining a vegetation mapping standard for the state (Fish and Game Code §1940). This standard complies with the National Vegetation Classification System and is manifested in the Survey of California Vegetation and implemented by the Vegetation Classification and Mapping Program (VegCAMP). VegCAMP focuses on developing and maintaining maps and classifying all vegetation and habitats in the state to support conservation and management decisions at the local, regional, and state levels (See Chapter 3). The California Environmental Monitoring and Assessment Framework (CEMAF) was developed by CDFW staff in the Cannabis Program and Water Branch in response to growing concerns regarding the impacts of land use change, particularly cannabis cultivation, in California. The CEMAF is interdisciplinary, as it includes assessments of both land-based (terrestrial) and water-based (aquatic) species and their habitats. The framework is now being used to assess how the cumulative effects of agricultural expansion, exurban development, drought, groundwater extraction, wildfires, etc. are impacting fish, wildlife, and their habitats in the state.

California Marine Protected Area Long Term Monitoring Program (2019-2021)

The Ocean Protection Council (OPC) funded seven long-term projects through the Marine Protected Area Monitoring Program between 2019 and 2021, administered by CA Sea Grant, OPC, and CDFW. The projects built on more than a decade of MPA monitoring. The long-term projects examined marine habitats in detail; projects included:

- Establishing a statewide baseline and long-term MPA monitoring program for commercial and CPFV fisheries in the state of California
- Monitoring and evaluation of kelp forest ecosystems in the MLPA marine protected area network
- Evaluating the performance of California's MPA network through the lens of sandy beach and surf zone ecosystems
- California Collaborative Fisheries Research Program – monitoring and evaluation of California marine protected areas
- Assessment of rocky intertidal habitats for the California marine protected area monitoring program
- Integrated ocean observing systems for assessing marine protected areas across California
- Monitoring and evaluation of mid-depth rocky reef ecosystems in the MLPA marine protected area

Disease and Mortality Monitoring

CDFW also conducts disease and mortality monitoring at different scales. Examples include Snake Fungal Disease, Rabbit Hemorrhagic Disease, White-nose syndrome (see text box below), and Chronic Wasting Disease. See more information on CDFW's Wildlife Health Laboratory (WHL) and other laboratories in Appendix I.

CDFW Monitors Bat Species and Disease

California is home to 25 bat species, most of which are insectivores but two species, the lesser long-nosed bat (*Leptonycteris yerbabuenae*), and the Mexican long-tongued bat (*Choeronycteris mexicana*), primarily forage on nectar and pollen. These species are important pollinators of agaves and large cacti in southwestern North America. CDFW is engaged with partners from other states, federal agencies, and non-governmental organizations to monitor bat populations, through the North American Bat Monitoring Program (NABat). NABat uses a variety of techniques, including acoustic monitoring and roost counts, to assess distributions and other trends of bat populations in Canada, the US, and Mexico.

White-nose syndrome is a disease caused by the fungus *Pseudogymnoascus destructans*. It has killed over six million bats in the eastern US. CDFW leads the California White-Nose Syndrome Steering Committee, a multi-agency scientific research group that has been monitoring the syndrome across the US since 2009. In 2019, CDFW and US Fish and Wildlife Service announced that the fungus was likely present in California. CDFW continues to work with US Fish and Wildlife Service, as well as other partners, to monitor for the fungus and disease, in places where bats hibernate. CDFW is also working on the California Bat Conservation Plan, an in-depth assessment of the conservation threats and best management practices for all of California's bats, including pollinator species.

8.1.4 Survey and Monitoring Protocols

U.S. Fish and Wildlife Service maintains a handbook on How to Develop Survey Protocols, which ensures enough detail is captured to understand why, where, by whom, when, and how a survey is conducted. Protocols should account for costs for data collection, data management, analysis, and reporting of results.

CDFW maintains a variety of survey and monitoring protocols, based on the best available methodology for the intended purpose, including incorporating Traditional Ecological Knowledge (TEK) when appropriate. Standardized protocols are currently available for select species and taxa, including some plants, invertebrates, amphibians, reptiles, birds, and mammals. Terrestrial Field Methodology Protocols for non-invasive monitoring of small to large terrestrial mammals, bats, birds, and reptiles have been developed as well. Additional protocols for standardized processing of remote camera as well as acoustic data for birds, bats, and other vocal species are also available.

VegCAMP sampling projects utilize the CDFW-CNPS Protocol for the Combined Vegetation Rapid Assessment and Relevé Field Protocol for field data collection. The data that is collected for these projects will be included in statistical analyses to inform the state-wide vegetation classification that is available to the public through the Manual of California Vegetation online as well as through region-specific vegetation classification reports. The vegetation mapping projects will be completed following the Survey of California Vegetation Classification and Mapping Standards (SCV) set forth by VegCAMP.

Furthermore, CDFW's Instream Flow Quality Assurance Program provides publicly available tools to ensure environmental data collection, analysis, and reporting is transparent, promotes accountability, and is scientifically defensible. CDFW Restoration Grant Programs provide numerous resources, including a Monitoring and Long-Term Management Plan template. This program also maintains an internal guidance document for monitoring and site visits.

8.1.5 Methodologies and Tools

CDFW utilizes a variety of methodologies to accomplish monitoring goals, including remote sensing, qualitative and PhotoPoint data, point monitoring using a robust sample design, land health assessments, and threats-based mapping and analysis. Through these monitoring strategies, CDFW collects data that allows it to track species, habitat conditions, and trends through time as well as the effects of project implementation.

Monitoring should rely on 1) standardized field methods and indicators, 2) modern data management and stewardship, 3) appropriate sample designs, 4) integration with remote sensing, and 5) structured implementation. Broad- (remote sensing, tracking treatment metrics), mid- (drone, etc.), and fine- (intensive point-based) scale efforts are all utilized to accomplish monitoring goals of CDFW. See Chapter 3.2.2 to learn more about CDFW's conservation data, data management, and decision support tools.

Examples of monitoring tools and methodologies that CDFW employs to monitor wildlife and fish populations include, but are not limited to:

- Aquatic Invertebrate Bioassessment Surveys
- Auditory and acoustic recording surveys
- Banding and tracking via transmitter or telemetry
- Breeding Bird Surveys
- California Environmental Monitoring and Assessment Framework
- Call boxes & video cameras
- Camera trapping
- Combined vegetation rapid assessment and relevé
- Detect/non-detect environmental DNA (eDNA) surveys
- Direct counting census
- Drone imagery
- Electrofishing and snorkel survey surveys
- Harvest metrics, including hunter and angler surveys
- Helicopter/aerial/drone surveys
- Hydrology and water quality
- Local bio-blitzes
- Mark-recapture and other statistics-based subsampling methods
- Mist netting over water sources
- Motus System for Tracking Wildlife Movement
- Multispectral remote sensing PIT tag arrays and transect surveys
- Point-intercept transects
- Sampling (e.g., Chronic Wasting Disease sampling)
- Small mammal trapping grids
- Timelapse photogrammetry (phenology)
- Trail camera monitoring
- Vegetation mapping and re-mapping (e.g., post wildfire)

8.1.6 Monitoring and Management Plans

Integral to CDFW's mission is the development and maintenance of monitoring programs and plans, management plans, plus project and grant reports with monitoring components. CDFW has a co-collection of project-related monitoring plans created by grantees and project proponents. Most of these plans and reports are housed by individual CDFW programs and laboratories, such as:

- Cannabis Restoration Grant Program
- Drought Response Projects, including Stressor Monitoring
- Fisheries Program (also described in Ch 6.8)

- Game Management Program
- Office of Spill Prevention and Response
- Marine Invasive Species Monitoring
- Marine Wildlife Veterinary Care and Research Center
- Natural Resource Damage Assessment (NRDA) and Restoration Program
- OSPR Aquatic Bioassessment Lab
- Water Pollution Control Lab
- Lands Program and CDFW Land Management Plans
- Marine Protected Areas (MPAs) Monitoring Program
- Marine Pollution Studies Laboratory
- Native Plant Program
- Natural Community Conservation Plan Program
- Restoration Grant Programs (WebGrants)
- Shellfish Health Laboratory
- Wildfire Resiliency Initiative Monitoring Program
- Wildlife Diversity Program
- Wildlife Health Laboratory

Additional ongoing or recent monitoring and management plans are outlined in Table 8.1 below. These plans are utilized by CDFW and our partners to monitor single species, multiple species, and/or their habitats. Plans listed below may include or benefit the Species of Greatest Conservation Need (SGCN) and/or SWAP conservation targets and should be seen as additional SWAP implementation tools. This is not an exhaustive list of monitoring plans in California. As part of an ongoing adaptive management strategy, CDFW will continue to review and assess monitoring strategies in accordance with changing conditions and scientific and technological developments.

Table 8-1 Examples of CDFW Survey Protocols, Monitoring and Adaptive Management Plans

Project or Plan Name	Species of Greatest Conservation Need (SGCNs)	Macrogroups or SWAP Conservation Targets	Website	Monitoring Component?	Adaptive Management Component?
A conservation Strategy for the Mohave Ground Squirrel	Mohave ground squirrel	Shadscale-Saltbush Scrub	https://wildlife.ca.gov/Conservation/Mammals/Mohave-Ground-Squirrel	X	X
A conservation strategy for the sierra nevada red fox	Sierra Nevada red fox	Rocky Mountain Subalpine and High Montane Conifer Forest, Western North America Wet Meadow and Low Shrub Carr, Western North American Montane/Boreal Peatland, Western North American Montane-Subalpine Wet Shrubland and Wet Meadow Western North American Temperate Grassland and Meadow Vancouverian Alpine Scrub, Forb Meadow, and Grassland Vancouverian Flooded and Swamp Forest	https://wildlife.ca.gov/Conservation/Mammals/Sierra-Nevada-Red-Fox	X	
A strategy for conservation of Springsnails in Nevada and Utah, USA	Fish Slough springsnail, Wong's springsnail	springs and spring brooks	https://ecos.fws.gov/docs/recovery_plan/980930b.pdf	X	
A Willow Flycatcher Survey Protocol for California	willow flycatcher	Warm Southwest Riparian Forest			
Assessment of rocky intertidal habitats for the California Marine Protected Area Monitoring Program	Rocky Intertidal species and habitats	Marine ecosystems	https://caseagrant.ucsd.edu/news/california-marine-protected-area-long-term-monitoring-program-final-reports-2019-2021	X	X

Project or Plan Name	Species of Greatest Conservation Need (SGCNs)	Macrogroups or SWAP Conservation Targets	Website	Monitoring Component?	Adaptive Management Component?
Bi-state Sage Grouse Action Plan	Bi-state greater sage grouse	Cool Semi-Desert Wash and Disturbance Scrub, Inter-Mountain Dry Shrubland and Grassland, Western North America Tall Sage Shrubland and Steppe, Western North America Vernal Pool Western North America Wet Meadow and Low Shrub Carr, Western North American Montane-Subalpine Wet Shrubland and Wet Meadow Western North American Temperate Grassland and Meadow	https://www.bistatesagegrouse.com/	X	X
Boca Unit Floodplain Restoration		See website link.			X
Butte Creek House Meadow Restoration Project		See website link.			X
California Collaborative Fisheries Research Program-Monitoring and Evaluation of California Marine Protected Areas	Groundfish Species	Marine ecosystems	https://caseagrant.ucsd.edu/news/california-marine-protected-area-long-term-monitoring-program-final-reports-2019-2021	X	X
California Monitoring Plan for Anadromous Salmon and Steelhead	SONCC Chinook and Coho salmon, CCC Chinook and Coho salmon, SCC Steelhead,	Anadromous assemblage		X	
California's MPA Network Decadal Management Review	Various nearshore marine species and habitats	Marine ecosystems	https://wildlife.ca.gov/Conservation/Marine/MPAs/Management/Decadal-Review	X	X
California's Wildfire and Forest Reslilience Action Plan	Wildfire/Forest Resilience	Numerous	https://wildfiretaskforce.org/the-plan/	X	X

Project or Plan Name	Species of Greatest Conservation Need (SGCNs)	Macrogroups or SWAP Conservation Targets	Website	Monitoring Component?	Adaptive Management Component?
CDFW Coded Wire Tagging/Recovery Program	Pacific salmon	Anadromous assemblage			
CDFW Delta Investigation and Monitoring Program- smelt and sturgeon species	Delta smelt, Longfin smelt, Green sturgeon, white sturgeon	Anadromous assemblage		X	
CDFW Hatchery Operation	Pacific salmon	Anadromous assemblage			
CDFW Juvenile Sturgeon Telemetry Program	Green Sturgeon, White Sturgeon	Anadromous assemblage			
CDFW Klamath-Trinity River Program and tribal and federal agency monitoring programs- anadromous salmonids, including the Yurok, Karuk, and Hoopa Klamath River Coho Ecolo Study, the Lower Klamath River Sub-basin Restoration Plan and the Yurok's and Wiyot Pacific Lamprey monitoring programs.	Southern Oregon/ Northern California Coast (SONCC) Chinook salmon, coho salmon, steelhead	Anadromous assemblage		X	
CDFW Ocean Salmon Project	Pacific Chinook and Coho salmon	Anadromous assemblage			
CDFW San Joaquin River Restoration Program- anadromous salmonids	California Central Valley Chinook salmon	Anadromous assemblage			
CDFW White Sturgeon Population Monitoring Program	White Sturgeon	Anadromous assemblage		X	
[Central Coast MPA Monitoring Plan 2014]	Central Coast nearshore marine species and habitats	Marine ecosystems		X	X

Project or Plan Name	Species of Greatest Conservation Need (SGCNs)	Macrogroups or SWAP Conservation Targets	Website	Monitoring Component?	Adaptive Management Component?
Central Valley Anadromous Fisheries Restoration Program	California Central Valley Chinook salmon and steelhead	Anadromous assemblage			
Central Valley Chinook Salmon Monitoring Program	California Central Valley Chinook salmon and steelhead	Anadromous assemblage		X	
Central Valley Steelhead Monioring Plan	Central Valley Steelhead	Anadromous assemblage		X	
Climate Resilience and California's Marine Portected Area Network	Various nearshore marine species, habitats, human dimensions	Marine ecosystems		X	X
Coachella Valley Multiple Species Habitat Conservation Plan (MSHCP)	Desert pupfish, yuma clapper rail, CV fringe toed lizard	Numerous	https://wildlife.ca.gov/Conservation/Planning/NCCP/Plans/Coachella-Valley	X	X
Conservation and Management Plan for Bighorn Sheep in California	bighorn sheep (multiple)	Numerous	https://wildlife.ca.gov/Conservation/Mammals/Bighorn-Sheep/Sierra-Nevada/Recovery-Program	X	X
Conservation Plan for Gray Wolves in California	Gray wolf	See website link.	https://wildlife.ca.gov/Conservation/Mammals/Gray-Wolf		
Cooperative Management Agreement for the Inyo CA Towhee	Inyo California towhee	Warm Southwest Riparian Forest		X	X
Desert tortoise Montioring Handbook	Mojave desert tortoise	Shadscale-Saltbush Scrub, Mojave and Sonoran Desert Scrub, Desert Wash woodland and scrub, High Desert Wash and “Rangeland” Scrub Great Basin Upland Scrub	https://wildlife.ca.gov/Conservation/Reptiles/Desert-Tortoise	X	X

Project or Plan Name	Species of Greatest Conservation Need (SGCNs)	Macrogroups or SWAP Conservation Targets	Website	Monitoring Component?	Adaptive Management Component?
Establishing a statewide baseline and long-term MPA monitoring program for commercial and CPFV fisheries in the state of California	Commericial fisheries	Marine ecosystems	https://caseagrant.ucsd.edu/news/california-marine-protected-area-long-term-monitoring-program-final-reports-2019-2021	X	X
Evaluation the performance of California's MPA Network through the lens of sandy beach and surf zone ecosystems	Sandy Beach species and ecosystems	Marine ecosystems	https://caseagrant.ucsd.edu/news/california-marine-protected-area-long-term-monitoring-program-final-reports-2019-2021	X	X
Final Coastal Multispecies Recovery Plan for California Coastal Chinook Salmon, Northern California Steelhead and Central California Coast Steelhead	California Coastal Chinook Salmon, Nor. Cal. Steelhead, Central Ca. Coast Steelhead	Anadromous assemblage	https://www.fisheries.noaa.gov/resource/document/final-coastal-multispecies-recovery-plan-california-coastal-chinook-salmon		
Final Recovery Plan for South-Central California Steelhead	South-Central California Steelhead	Anadromous assemblage	https://www.fisheries.noaa.gov/resource/document/final-recovery-plan-south-central-california-steelhead		
Five Year Species Review of Desert pupfish	Desert pupfish	See website link.			
Integrated Ocean Observing Systems for Assessing Marine Protected Areas Across California	Various nearshore marine species and habitats; oceanographic features	Marine ecosystems	https://caseagrant.ucsd.edu/news/california-marine-protected-area-long-term-monitoring-program-final-reports-2019-2021	X	X

Project or Plan Name	Species of Greatest Conservation Need (SGCNs)	Macrogroups or SWAP Conservation Targets	Website	Monitoring Component?	Adaptive Management Component?
Lahontan cutthroat trout Recovery	Lahontan cutthroat trout	Walker River Native Fish Assemblage	https://wildlife.ca.gov/Science-Institute/News/success-fueling-lahontan-cutthroat-trout-recovery-in-silver-creek	X	
Least Bell's vireo survey protocols	Least Bell's vireo	Warm Southwest Riparian Forest			
Management Plan for Fish Slough A Cooperative Management Program (1984)	Fish Slough milk-vetch	springs and spring brooks, cienegas, ponds, alkali meadow	https://wildlife.ca.gov/Lands/Places-to-Visit/Fish-Slough-ER	X	X
Marine Protected Area (MPA) Monitoring Action Plan	Various near-hore marine species and habitats	Marine ecosystems	https://wildlife.ca.gov/Conservation/Marine/MPAs/Management/Monitoring/Action-Plan	X	X
Master Plan for Marine Protected Areas		Marine ecosystems	https://wildlife.ca.gov/Conservation/Marine/MPAs/Master-Plan	X	X
Monitoring and evaluation of kelp forest ecosystems in the MLPA marine protected area network	Kelp forest species and habitats	Marine ecosystems	https://caseagrant.ucsd.edu/news/california-marine-protected-area-long-term-monitoring-program-final-reports-2019-2021	X	X

Project or Plan Name	Species of Greatest Conservation Need (SGCNs)	Macrogroups or SWAP Conservation Targets	Website	Monitoring Component?	Adaptive Management Component?
Monitoring and Evaluation of Mid-Depth Rock Ecosystems in the MLPA Marine Protected Areas	Mid-depth rocky reef species and habitats	Marine ecosystems	https://caseagrant.ucsd.edu/news/california-marine-protected-area-long-term-monitoring-program-final-reports-2019-2021	X	X
Mount Diablo State Park Vegetation Treatment Project		See website link.			X
North Central Coast MPA Monitoring Plan 2014	North Central Coast nearshore marine species and habitats	Marine ecosystems		X	X
North Coast MPA Monitoring Plan 2017	North Coast nearshore marine species and habitats	Marine ecosystems		X	X
North Coast Salmon Project		Anadromous assemblage	https://wildlife.ca.gov/Conservation/Fishes/Coho-Salmon/North-Coast-Salmon-Project		
North Coast Smelt Monitoring	Longfin smelt, Eulachon	Anadromous assemblage		X	
Owens Basin Wetland and Aquatic Species Recovery Plan for Inyo and Mono Counties, CA	Owens tui chub	springs and spring brooks, cienegas, ponds, lakes, reservoirs, aquatic refuges, anthropogenically created features	https://wildlife.ca.gov/Regions/6/Desert-Fishes/Owens-tui-chub	X	
Owens pupfish Recovery	Owens pupfish	springs and spring brooks, cienegas, ponds, lakes, reservoirs, aquatic refuges, anthropogenically created features	https://wildlife.ca.gov/Regions/6/Desert-Fishes/Owens-pupfish	X	
Owens speckled dace Recovery	Owens speckled dace	springs and spring brooks, cienegas, ponds, lakes, reservoirs, aquatic refuges, anthropogenically created features	https://wildlife.ca.gov/Regions/6/Desert-Fishes/Long-Valley-Speckled-Dace	X	

Project or Plan Name	Species of Greatest Conservation Need (SGCNs)	Macrogroups or SWAP Conservation Targets	Website	Monitoring Component?	Adaptive Management Component?
Pacific Lamprey and Western River Lamprey Monitoring Programs	Pacific Lamprey, Western River Lamprey	Klamath-Trinity and Central Valley ecoregions		X	
Priority Action Coho Team		Anadromous assemblage	https://wildlife.ca.gov/Conservation/Fishes/Coho-Salmon/PACT		
Recovery Plan for Amargosa Vole	Amargosa vole	springs and spring brooks, cienegas, ponds, alkali meadow	https://wildlife.ca.gov/Drought/Projects/Amargosa-Basin		
Recovery Plan for the Evolutionarily Significant Unit of Central California Coast Coho Salmon	Central California Coast Coho Salmon	Anadromous assemblage	https://www.fisheries.noaa.gov/resource/document/recovery-plan-evolutionarily-significant-unit-central-california-coast-coho		
Revised Recovery Plan for the Mojave Population of the Desert tortoise	Mojave desert tortoise	Shadscale-Saltbush Scrub, Mojave and Sonoran Desert Scrub, Desert Wash woodland and scrub, High Desert Wash and "Rangeland" Scrub Great Basin Upland Scrub	https://wildlife.ca.gov/Conservation/Reptiles/Desert-Tortoise	X	X
San Francisco Garter Snake Recovery Action Plan	San Francisco Garter Snaker	See website link.			X
Scientific Guidance fro Evaluating California's Marine Protected Area Network	Various nearshore marine species, habitats, human dimensions	See website link.		X	X
Snake Marsh Restoration Project	giant garter snake	Marine ecosystems			X
South Coast MPA Monitoring Plan 2011	South Coast nearshore marine species and habitats	Marine ecosystems		X	X

Project or Plan Name	Species of Greatest Conservation Need (SGCNs)	Macrogroups or SWAP Conservation Targets	Website	Monitoring Component?	Adaptive Management Component?
Species Status Assessment Report for western pond turtles	western pond turtle	springs and spring brooks, cienegas, ponds, lakes, reservoirs, aquatic refuges, anthropogenically created features, streams, rivers, Warm Southwest Riparian Forest			
State and Federal Fishery Management Plans (FMPs)	Numerous marine species	See website link.		X	X
State of the California Central Coast 2013	Central Coast nearshore marine species and habitats	Marine ecosystems		X	X
State of the California North Central Coast 2015	North Central Coast nearshore marine species and habitats	Marine ecosystems		X	X
State of the California North Coast 2017	North Coast nearshore marine species and habitats	Marine ecosystems		X	X
State of the California South Coast 2017	South Coast nearshore marine species and habitats	Marine ecosystems		X	X
Statewide Bobcat Management Plan/ California Statewide Bobcat Population Monitoring Project	Bobcat	Numerous	https://wildlife.ca.gov/Conservation/Mammals/Bobcat#conservation	X	
Status review of the San Bernardino kangaroo rat in California	San Bernardino k rat	Numerous			
Western Joshua Tree Conservation Plan	Western joshua tree	Joshua tree scrub	https://wildlife.ca.gov/Conservation/Environmental-Review/WJT	X	X
Western Riverside Multiple Species Habitat Conservation Plan (MSHCP)	Numerous	Numerous	https://wildlife.ca.gov/Conservation/Planning/NCCP/Plans/Riverside	X	X
	Tri-colored blackbird	Numerous	https://wildlife.ca.gov/Drought/Projects/Tricolored-Blackbird	X	X

8.2 Community Science

Engagement with California Native American tribes and the public through community science projects is an important way to get public participation in SWAP conservation strategy implementation. Public participation not only helps promote wildlife management issues, conservation of natural places, and the relevance of CDFWs mission, but also involves tapping into a relatively underutilized group of eager participants. While this type of engagement is important for educating California's public about the importance of wildlife conservation and fostering long-lasting connections with wildlife and nature, leveraging volunteer opportunities can also be critical to successfully implementing monitoring projects. Through engagement and collaboration with California Native American tribes, community science is often the space where ecological knowledge can be incorporated into the management and conservation of resources. Ensuring California Native American tribes are part of the conversation, and better yet - co-managing, provides additional resources, information and opportunities to broaden SWAP activities.

CDFW actively engages California Native American tribes and the public through community science (also known as citizen science) in various ways. The Invasive Species program enlists the public to help in monitoring quagga/zebra mussels and other invasive species. The Sierra Nevada Bighorn Sheep Recovery Program solicits public bighorn sheep observations. CDFW and Xerces staff developed the California Bumble Bee Atlas to compile resources for volunteers, recruit and train community scientists from around the state, and use data gathered to help identify priorities for bumble bee conservation in California.

Other ways the public can contribute to science include the use of crowdsourcing applications, participating in events, and volunteering with organizations.

Crowdsourcing applications include:

- eBird for birds
- Calflora Observer for native and invasive plants
- EDDMapS for invasive species
- HerpMapper for reptiles and amphibians
- iNaturalist for all species

California Biodiversity Day was established on September 7th 2018 as part of Jerry Brown's Biodiversity Initiative Executive Order, to safeguard the state's natural heritage in response to the growing loss of biodiversity across the state. Since then, California Biodiversity Day is celebrated annually on September 7th through nature activities encouraging actions to protect and steward California's unique and threatened biodiversity.

At the core of these activities is community science, the collection of local nature data by scientists and non-scientists that contributes to the state's collective knowledge of biodiversity. Participation in California Biodiversity Day activities has grown each year since its inception, with many thousands of individuals of all ages across California joining in self-led or hosted community science activities.

The growing participation in community science has contributed to an increase in biodiversity observed and mapped throughout the state. In 2024 nearly 4,000 California species were mapped on the app, iNaturalist, and over 300 birds were observed and submitted on eBird during the week surrounding California Biodiversity Day. Biodiversity discovery games further promote participation in community science during the week, such as the "Find 30 Species Challenge", organized by the California Natural Resource Agency as part of the California 30x30 Initiative.

The biodiversity data collected through these community science activities maps the distribution of common plants and animals, rare and endangered species, and non-native invasive species. Observations submitted on iNaturalist and eBird are shared and used locally and globally to understand biodiversity and make conservation decisions to steward and protect it.

Examples of statewide, national and international community science events and organizations include:

- Calflora Plant Observations and Weed Observations, part of the Early Detection Network
- California Biodiversity Day

- Christmas Bird Count
- City Nature Challenge
- Citizen Science Month
- Bio-blitzes
- BeachCOMBERS
- North American Bat Monitoring Program (NABat)
- World Migratory Bird Day

8.3 Adaptive Management

Natural communities, ecosystems, species population dynamics, and the effects of pressures and stresses on them are inherently complex. Wildlife and resource managers often are called upon to implement conservation strategies or actions based upon limited scientific information and considerable uncertainties. Conservation issues may emerge that were not anticipated during or following the preparation of SWAP 2025, or ecosystem and species outcomes may not materialize as expected.

Adaptive management is an essential process for meeting this challenge and implementing effective conservation programs. Adaptive management is an iterative process that includes continually monitoring and assessing the environment to inform the effect, and effectiveness, of conservation strategies. The monitoring results are then used to adjust a conservation plan or program, as needed, to achieve the desired outcomes.

Pursuant to Fish and Game Code (FGC) section 703.3, resource management decisions by CDFW should incorporate adaptive management to the extent possible. FGC section 13.5 states that adaptive management "…unless otherwise specified in this code, means management that improves the management of biological resources over time by using new information gathered through monitoring, evaluation, and other credible sources as they become available, and adjusts management strategies and practices to assist in meeting conservation and management goals. Under adaptive management, program actions are viewed as tools for learning to inform future actions." CDFW's intent is to improve the management of biological resources over time by incorporating adaptive management principles and processes, as appropriate, into conservation planning and resource management. This includes:

- Designing monitoring, research, and/or assessment studies that are integral to an adaptive management framework
- Improving CDFW's knowledge base by synthesizing new information gathered through monitoring, research, assessment, and credible scientific sources

- Engaging with California Native American tribes in activities, projects and actions further conservation efforts
- Regularly re-evaluating, based on the best available science, and adjusting, if needed, conservation and management strategies and practices to meet long-term goals

As new information becomes available on the status of conservation targets and the effectiveness of conservation strategies, SWAP approaches can be updated. Conservation actions recommended in SWAP 2025 will be assessed with monitoring to determine the outcome of implementation of the strategies. In some cases, monitoring of a few environmental variables will be sufficient. In other cases, such as a regional multispecies conservation effort, a major long-term and comprehensive monitoring program will be needed. Mitigation and Conservation Banking

8.3.1 Adaptive Management Process

CDFW outlines both the definitions and requirements of adaptive management throughout the FGC and Water Code in "Incorporation of Adaptive Management into Conservation Planning and Resources Management" (CDFW: Adaptive Management Subcommitee 2014) . Furthermore, it summarizes descriptions and evaluations of adaptive management in the technical literature.

A rich literature regarding the theory and conduct of adaptive management exists and supports the principles and processes of adaptive management. While differences among the various frameworks exist, they generally contain three broad phases: Plan, Do, and Evaluate and Respond (DSC 2013). Figure 831 provides a representative example of the adaptive management process, including the three broad phases and the individual steps within the process.

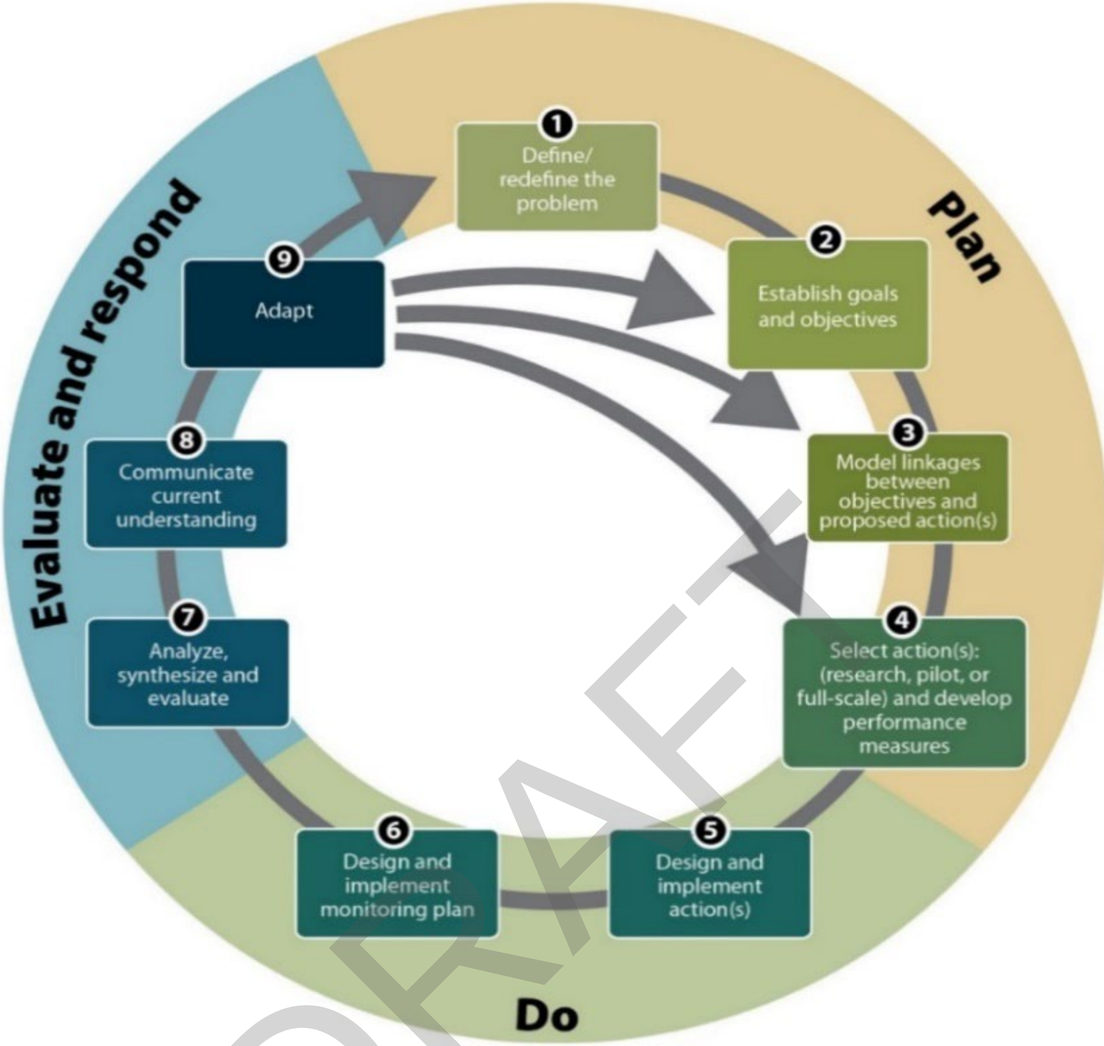


Figure 8.3 -1 A Three Phase (Nine Step) Adaptive Management Framework Source: Delta Plan (Delta Stewardship Council 2013)

8.3.2 Adaptive Management in Practice

Informal adaptive management has been used for decades by CDFW's programs. These programs typically consist of a resource management decision embedded in a management plan that includes species population objectives (e.g., harvest level recommendations in a timber harvest plan). These programs are supported by long-running population monitoring programs that are used to assess the results of previous management decisions and inform future management decisions.

An example of a well-established CDFW program that relies on adaptive management is the California Natural Community Conservation Plan (NCCP) Program. The practice of building effective adaptive management programs for large-scale, multi-species NCCPs is an endeavor that continues to evolve. NCCPs in California are making real progress in designing adaptive management programs that work. For example, implementing partners of the San Diego Multiple Species Conservation Program (MSCP), through the San Diego Management and Monitoring Program, have demonstrated leadership in scientific collaborations and ecological applications that are informing strategic approaches to reserve management, monitoring, and habitat connectivity enhancement.

8.3.3 When Adaptive Management Should Be Used

Certain CDFW activities are mandated by FGC to include an adaptive management program (e.g., FGC § § 2820 and 2856). FGC sections 33, 703.3, and 715 define and promote the use of adaptive management in resource management decisions, to the extent feasible, but do not further define those decisions or provide more specific guidance.

The adaptive management literature cautions that not all resource management decisions/actions are amenable to adaptive management (Gregory et al. 2006; Williams et al. 2009; Allen et al. 2011; Allen and Gunderson 2011; Williams 2011). For example, an Adaptive Management Technical Guide prepared for the U.S. Department of Interior (DOI) states that for adaptive management to be operationally appropriate and effective, there must be a mandate to take action in the face of uncertainty, and there must be institutional capacity and commitment to undertake and sustain an adaptive program (Williams et al. 2009). If no decision is necessary, if there is little uncertainty about what management actions to take and what outcome to expect, or if management cannot be adjusted in response to what is learned, non-adaptive management approaches may be appropriate (Williams 2011).

Increasing or continuing the use of adaptive management processes within CDFW will require a significant commitment to ensure that those charged with implementing adaptive management have the appropriate support, training, expertise, and resources (e.g., funding). Technical resources, such as the DOI technical guide, are available and can serve as a foundation upon which CDFW can build and maintain the necessary capacity and infrastructure to support implementation of adaptive management.

8.4 Monitoring SWAP Implementation

8.4.1 SWAP 2015 Implementation

Since 2015, CDFW has been implementing SWAP conservation strategies through local, statewide, and regional efforts (Chapters 3, 4 and 7), partnerships (Chapter 7), and specifically via the following grant programs (Chapter 3): State Water Bonds: Proposition 1 (Prop 1) and Proposition 68, State Wildlife Grant (SWG), Traditional Endangered Species Act (ESA) Section 6, and Non-Traditional ESA Section 6.

8.4.2 CDFW Report on Implementing SWAP 2015

In 2020, the CDFW SWAP Program produced an internal report on the progress of CDFW-issued grants towards the implementation of SWAP 2015 priorities and strategies. The report examined whether a subset of CDFW grant-funded projects were aligned with the achievement of SWAP 2015's desired outcomes.

CDFW does not currently maintain a comprehensive system of all SWAP-related projects undertaken by CDFW programs. Instead, the analysis used a subset of grants issued under CDFW granting programs: State Water Bond Proposition 1 (Prop 1; 109), State Wildlife Grant (SWG; 62), Traditional Endangered Species Act (ESA) Section 6 Grant (63), and Non Traditional ESA Section 6 Grant (51) projects, from the years 2015–2018, 2015–2020, 2015–2020, and 2015–2019, respectively. These projects were evaluated with respect to the following SWAP 2015 "metrics": Salmonid Ecoregions (for anadromous fish projects), Geographic Provinces, Terrestrial Ecoregions or Marine Conservation Units, Hydrologic Units, Conservation Targets, Key Ecological Attributes, Pressures and Conservation Strategies.

Key Findings

Since most CDFW grant programs are not yet consistently tracking the same SWAP metrics, a common language is lacking between grant programs. This, in addition to the fact that many grant agreements had been scanned from hardcopies meant the data was not available in spreadsheets, making it difficult for SWAP Program staff to pull SWAP metrics from the narratives of the grant agreements and final reports. The data generated by this report can only be used to highlight SWAP implementation.

- Prop 1 projects comprised the majority of the anadromous fish projects across grant programs and were sited across the state.
- Most of the anadromous fish projects examined across grant programs are focused on the Chinook salmon and steelhead SWAP 2015 conservation target.
- Few projects addressed the state's deserts, except for the Mojave Desert.
- All grant programs appear to highly prioritize the American southwest riparian forest and woodland SWAP 2015 conservation targets from 2015 – 2020.
- Very few of the projects analyzed addressed the native versus nonnative diversity and/or endemic diversity SWAP 2015 KEAs.
- All grant programs appear to highly prioritize the climate change SWAP 2015 pressure from 2015–2020.
- The data collection and analysis SWAP 2015 strategy is most highly prioritized by Prop 1, SWG, and Traditional Section 6 programs. Whereas Non-Traditional Section 6 program funds the acquisition of threatened and endangered species habitats, in support of approved and draft species recovery plans.

Key Recommendations

The Report made the following recommendations for improved monitoring/tracking of SWAP implementation via these subset of grant programs.

- Original, digital, grant agreement documents (not scanned from printed/hard copies) should be made readily available by grant programs, internally.
- Grant agreements and final reports should be uploaded to shared internal repositories by grant programs as soon as possible and/or on a regular basis.
- Grant programs should track SWAP measures via a software program (such that these data will be easily accessible for SWAP Program staff's periodic evaluations), down to the conservation unit level, at least, but ideally to the conservation target level.
- SWAP Program staff should work with Information Technology Branch (ITB) to develop a software utility to accompany the SWAP 2025 Update, which should help users easily navigate the document.
- Grantees, grant program managers, and/or other experts should participate in the SWAP 2025 Update process, to weigh in on the progress that has been made

(quantitatively) towards addressing the priority conservation recommendations made by SWAP 2015, as well as the work that remains (including addressing new needs). The qualitatively tracked progress of CDFW-issued grants toward the implementation of SWAP 2015 priorities (as presented here) may be used as a starting point for these quantitative analyses.

- Whenever possible, grant programs should prioritize funding pre- and post-project monitoring, to determine whether projects are successful, and engage in adaptive management. CDFW will need to develop a decision tree or policy for when and how to apply adaptive management.

8.4.3 SWAP 2025 Implementation

Taking into consideration the key recommendations from the internal report, CDFW is committed to tracking the implementation on SWAP conservation strategies and sharing those successes with external partners and the public. CDFW is currently reviewing various tools and software available to track grant program proposals, reports, and SWAP metrics. A SWAP implementation tool and process will be developed after the completion of the SWAP 2025 update, initially relying on linking State Wildlife Grant Program deliverables to SWAP metrics and conservation strategies. Eventually, SWAP implementation tracking can be expanded to include deliverables from other CDFW managed grants and programs and connect to other monitoring efforts (e.g., California 30x30).

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11 Glossary

Some terms in this section originate from the glossary in the Conservation Measures Partnership's (CMP) *Open Standards for the Practice of Conservation* (Version 4.0; Conservation Measures Partnership 2020). These definitions are based on current usage by many CMP members, other conservation organizations, and planners in other disciplines. Some terms have been added or refined to clarify how CDFW uses them.

Action: A general term used to refer to the work of conservation teams. This includes strategies, activities, and tasks.

Activity: A specific action or set of tasks undertaken by project staff and/or partners to reach one or more objectives. Sometimes called an action, response, or strategic action. (See relationship to strategies.)

Adaptive Management: The incorporation of deliberate learning into professional practice to reduce uncertainty in decision making. Specifically, it is the integration of design, management, and monitoring to enable practitioners to systematically and efficiently test key assumptions, evaluate the results, adjust management decisions, and generate learning. The Conservation Standards explicitly bring adaptive management principles into conservation practice.

Alluvium: Clay, silt, sand, gravel, or similar detrital material deposited by flowing water

Anadromous: Fish or aquatic species that spend most of their lives in the ocean but migrate to freshwater rivers and streams to spawn

Anthropogenically Created Aquatic Features: Various human-made features that incidentally support native fish and/or amphibians including agricultural drainage ditches, irrigation canals, roadside ditches, flood control basins, borrow pits, railroad berms, golf course ponds, cattle stock ponds, and duck club ponds. These features were not created with the intent of providing fish or amphibian habitat.

Animal Unit Month (AUM): The amount of forage needed by an "animal unit" (AU) grazing for one month. The animal unit in turn is defined as one mature 1,000-pound cow and calf, one horse, five sheep, or one steer.

Anthropogenic: Resulting from the influence of humans on nature

Aquatic: Growing, living in, or frequenting fresh water, usually open water; compare with wetland

Aquatic Refuge: A natural, human-modified, or constructed watercourse/waterbody that is specifically managed or created for the recovery/restoration/conservation of at-risk native aquatic species

Aquifer: An underground reservoir of water

Assumption: An explicit statement of what a team assumes is true. The logical sequences linking project strategies to one or more targets as reflected in a theory of change. Assumptions may also include a team's expression of how they anticipate external variables may influence the achievement of results (see also risk factor). Assumptions are also present in situation models linking presumed influencing factors to other factors.

Audit: An assessment of a project or program in relation to an external set of criteria, such as generally accepted accounting principles, sustainable harvest principles, or the standards outlined in this document.

Bay: A body of water connected to an ocean or lake, formed by an indentation of the shoreline

Benthic: Living on or near the bottom of a body of water

Bioaccumulation: The uptake and concentration of chemicals by living systems

Biodiversity: The full array of living things

Biodiversity Target: A synonym for conservation target

Biological Diversity: The variety of life over some spatial unit, used to describe all aspects of the broadly diverse forms into which organisms have evolved, especially including species richness, ecosystem complexity, and genetic variation

Biomes: Areas on the earth with similar climate, plants, and animals, classified according to the predominant vegetation and characterized by adaptations of organisms to that particular environment

Bioregion: An area that includes a rational ecological community with characteristic physical (climate, geology), biological (vegetation, animal), and environmental conditions

Browse: 1. Tender shoots, twigs, and leaves of trees and shrubs and grass that are available and acceptable to grazing animals (see also forage); 2. to feed on browse, graze

California Legacy Project: An initiative that involves a broad range of government agencies and citizen organizations working together to develop a suite of tools and maps to help Californians make important decisions about conserving and protecting the state's working lands and natural resources

California Wildlife Habitat Relationships System (CWHR): An information system and predictive model for California's wildlife containing range maps and habitat relationship information on all the state's regularly occurring amphibians, reptiles, birds, and mammals

Canopy: The cover provided by a layer of vegetation, such as overstory trees in a forest

Cavity Nesting: A type of bird species that nests in holes (cavities) in trees. They are divided into two groups. Primary cavity nesters excavate their own holes in trees and snags, while secondary cavity nesters are dependent upon natural cavities or abandoned sites excavated by primary cavity nesters

Cienega: Water-saturated and poorly drained wetland areas associated with perennial spring and seep systems in isolated arid basins of the southwest. Cienega habitats are unique to the desert west and are rapidly disappearing

Clearcutting: A silvicultural method in which all trees in a designated area are removed in one operation

Climate Change Adaptive Capacity: A measure of the ability of a system or species to respond to climate change with minimal disruption. Adaptive capacity is an intrinsic characteristic of a system, but even for systems with relatively high adaptive capacity, landscape context (e.g. location within the broader landscape, habitat patch size, proximity to range limit) may affect the ability of a system to realize this adaptive capacity

Climate Change Vulnerability: The degree to which an ecological system, habitat, or individual species is likely to be negatively affected as a result of changes in climate and often dependent on factors such as exposure, sensitivity, and adaptive capacity

Climate Exposure: A measure of the direction, magnitude, and variability of a change in climate and the associated effects of a system, habitat, or species is likely to experience. Examples of climate change exposure include the following:

- changes in CO_2 concentrations
- changes in temperature and precipitation (averages, extremes, or timing)
- sea level rise
- change in the frequency/intensity of disturbance events (e.g., fire, flooding events, droughts)
- changes in hydrology (e.g., groundwater tables, runoff and river flow)

Climate Sensitivity: A measure of whether and how a system or species is intrinsically tolerant to changes in climate or dependent on a particular climate regime such that changes in climate would adversely affect the condition of the target. In other words, for a sensitive target, a change in exposure generates a stress on a key ecological attribute of the target. Examples of sensitivities at the habitat-level (here defined by dominant vegetation) include the following:

- dependence on particular temperature or moisture conditions
- dependence on a particular disturbance regime (e.g., fire, flooding events, drought) or on a lack of disturbance
- sensitivity to changes in CO2 concentration
- dependence on timing of abiotic phenological events (e.g., snow melt, peak spring flows, etc.)

Commensal: Having benefit for one member of a two-species association but neither positive nor negative effect on the other

Community of Practice: A group of practitioners who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis

Competition: Occurs when two or more organisms have the potential for using the same resource. Competition may be between individuals of the same species or between two or more different species

Conceptual Model: A diagram that represents relationships between key factors that are believed to impact or lead to one or more conservation targets. A good model should link the conservation targets to pressures, opportunities, stakeholders, and intervention points (factors – pressures, opportunities, or targets – in a conceptual model where a team can develop strategies that will influence those factors). It should also indicate which factors are most important to monitor.

Conifer: Trees belonging to the order Gymnospermae, comprising a wide range of trees that are mostly evergreens. Conifers bear cones and have needle-shaped or scalelike leaves. In the wood products industry, the term "softwoods" refers to conifers.

Conservation: The use of natural resources in ways such that they may remain viable for future generations. Compare with preservation

Conservation Bank: Privately or publicly owned land that is permanently protected and managed for its natural resource values. A conservation bank operator may sell habitat credits to developers who need to satisfy legal requirements for mitigating environmental impacts of development projects. Conservation banks must be approved by such wildlife agencies as CDFW and USFWS.

Conservation Target: An element of biodiversity (species, habitat, or ecological system) at a project site on which a project has chosen to focus. All targets should collectively represent the biodiversity of concern at the site. (Synonymous with biodiversity target, conservation focus, or conservation value.)

Conservation Unit: A spatial unit in which the conservation objects called targets were selected, their conditions analyzed, and the conservation strategies developed. There are three types of conservation units: terrestrial, aquatic, and marine. Terrestrial units consist of ecoregional areas called "section" defined by USDA (Ecoregions of the United States). Aquatic units are watersheds defined by USGS as HUC4 (US Hydrologic unit Maps). Marine units are adopted from the Marine protection Area defined under the Marine Life Protection Act (MLPA) (Marine Protected Areas).

Contributing Factor: A behind the scenes socio-economic factor that contributes to produce pressures

Critical Pressure: Pressure that has been prioritized as being the most important to address

Distribution: The pattern of occurrences for a species or habitat throughout the state; generally, more precise than range

Disturbance Regime: The characteristic pattern of natural- or human-caused events that disrupt the current physical and biological conditions of an area, such as floods, fires, storms, and human-activity

Down Logs: Trees, limbs, or trunks that have fallen and are at least 10 feet long and at least 10 inches in diameter as measured on the large end

Driver: A synonym for factor

Ecological Integrity: The degree to which the components (types of species, soil, etc.), structures (arrangement of components), and processes (flows of energy and nutrients) of an ecosystem or natural community are present and functioning intact. Lands with high ecological integrity generally have not been subjected to significant human influences or disruption of natural processes, such as fire, floods, or nutrient and hydrological cycling.

Ecological Reserve: Designation given to certain lands owned or managed by CDFW as a way of regulating appropriate use. This designation is usually reserved for land with special status plants, animals, or vegetation types. Compare with Wildlife Area.

Ecosystem: A natural unit defined by both its living and non-living components; a balanced system for the exchange of nutrients and energy. Compare with habitat.

Ecosystem Function: The operational role of ecosystem components, structure, and processes

Ecosystem Health: The degree to which a biological community and its non-living environmental surroundings function within a normal range of variability; the capacity to maintain ecosystems structures, functions, and capabilities to provide for human need

Ecosystem Processes: the flow or cycling of energy, materials, and nutrients through space and time

Ecosystem Services: Services that intact, functioning ecosystems, species, and habitats provide and that can benefit people

Ecosystem Structure: Spatial distribution or pattern of ecosystem components

Enabling Condition: A broad or high-level opportunity within a situation analysis; For example, the legal or policy framework within a country

Endangered Species: Any species, including subspecies or qualifying distinct population segment, which is in danger of extinction throughout all or a significant portion of its range

Endemic: Found only in a specified geographic region

Endemism: A measure of distribution for those taxa that are found only in one specific area, such as one region or the state itself. A region of high endemism has many taxa restricted to it

Estuary: An area in which salt water from the ocean mixes with flowing fresh water, usually at the wide mouth of a river

Evaluation: An assessment of a project or program in relation to its own previously stated goals and objectives. See monitoring and compare to audit

Evolutionarily Significant Unit (ESU): A genetically distinct population segment of a species. An ESU is protected under the federal Endangered Species Act, which defines species to include "any subspecies of fish or wildlife or plants, and any distinct population segment of any species of vertebrate fish or wildlife, which interbreeds when mature"

Excessive Livestock Grazing: Livestock grazing at a frequency or intensity that causes degradation of native plant communities, reduces habitat values for native wildlife species, degrades aquatic or other ecosystems, or impairs ecosystem functions (The term "overgrazing" has a different meaning; it is usually used in referring to the productivity of the forage crop and range condition).

Exotic Species: A species of plant or animal introduced from another country or geographic region outside its natural range; non-native

Extinct: A plant or animal or vegetation type that no longer exists anywhere

Extirpated: A plant or animal or vegetation type that has been locally eliminated but is not extinct

Factor: A generic term for an element of a conceptual model including pressures, opportunities, and associated stakeholders. It is often advantageous to use this generic term since many factors – for example tourism – could be both a threat and an opportunity.

Fauna: All of the animal taxa in a given area

Fen: Low land covered wholly or partly with water

Fire Frequency: A broad measure of the rate of fire occurrence in a particular area

Fire Regime: A measure of the general pattern of fire frequency and severity typical to a particular area or type of landscape

Flagship Species: Popular species that appeal to the general public and have interesting or notable features that make them suitable for communicating conservation concerns

Flora: All of the plant taxa in a given area

Fluvial: Pertaining to rivers

Forage: Browse and herbage that is available and acceptable to grazing animals (see also browse)

Forb: A broad-leaved herb, such as clover, as distinguished from a grass or a woody plant.

Forest Health: Capacity of a forest for renewal, for recovery from a wide range of disturbances, and for retention of ecological function, while meeting the current and future needs of people for desired levels of values, uses, products, and services

Forest Structure: The horizontal and vertical distribution of components of a forest stand, including height, diameter, crown layers, and stems of trees, shrubs, herbaceous understory, and down woods' debris

Fragmentation: The process by which a contiguous land cover, vegetative community, or habitat is broken into smaller patches within a mosaic of other forms of land use/land cover; e.g., islands of an older forest age class immersed within areas of younger-aged forest, or patches of oak woodlands surrounded by housing development

Fyke: A long bag fishing net kept open by hoops

Gap Analysis Program (GAP): Identifies gaps between land areas that are rich in biodiversity and areas that are managed for conservation

Genus: The level of biological classification above species. Closely related species belong to the same genus

Geographic Information System (GIS): An organized assembly of people, data, techniques, computers, and programs for acquiring, analyzing, storing, retrieving, and displaying spatial information about the real world

Goal: A formal statement detailing a desired outcome of a conservation project, such as a desired future status of a target. The scope of a goal is to improve or maintain key ecological attributes. A good goal meets the criteria of being linked to targets, impact oriented, measurable, time limited, and specific.

Grazing Permit: Land lease offering written permission to graze a specific number, kind, and class of livestock for a specified defined allotment

Habitat: Where a given plant or animal species meets its requirements for food, cover, and water in both space and time. May or may not coincide with a single macrogroup, i.e., vegetated condition or aquatic condition. Compare with ecosystem.

Habitat Quality: The capacity of a habitat to support a species

Herbaceous: Having characteristics of an herb, i.e., a nonwoody stem such as forbs, grasses, and ferns, or the nonwoody tissues of a branch or stem

Hybridization: The crossbreeding of two animals or plants of different species or subspecies

Impact: The desired future state of a conservation target. A goal is a formal statement of the desired impact.

Impaired: Condition of the quality of an ecosystem or habitat that has been adversely affected for a specific use by contamination or pollution

Indicator: A measurable entity related to a specific information need such as the status of a target/factor, change in a threat, or progress toward an objective. A good indicator meets the criteria of being measurable, precise, consistent, and sensitive

Information Need: Something that a project team and/or other people must know about a project. The basis for designing a monitoring plan

Inland Empire: Riverside and San Bernardino Counties in Southern California

Intermediate Result: A specific benchmark or milestone that a project is working to achieve en route to accomplishing a final goal or objective (in this case, “intermediate” typically refers to a temporal dimension)

Introduced: Any species intentionally or accidentally transported and released into an environment outside its native range

Invasive: An introduced species which spreads rapidly once established and has the potential to cause environmental or economic harm. Not all introduced species are invasive.

Invertebrate: An animal without an internal skeleton. Examples are insects, spiders, clams, shrimp, and snails.

Key Ecological Attribute (KEA): Aspects of a target's biology or ecology that, if present, define a healthy target and, if missing or altered, would lead to the outright loss or extreme degradation of the target over time

Key Intervention Point: Priority factors (threats, opportunities, or targets) within a situation model on which a team should take action

Keystone Species: A species whose loss from an ecosystem would cause a greater than average change in other species populations or ecosystem processes and whose continued well-being is vital for the functioning of a whole community

Lagoon: A shallow body of water separated from a larger body of water by barrier islands or reefs

Land Cover: Predominant vegetation life forms, natural features, or land uses of an area

Landscape: The traits, patterns, and structure of a specific geographic area, including its biological composition, its physical environment, and its anthropogenic or social patterns. An area where interacting ecosystems are grouped and repeated in similar form.

Late Succession Forest: Stands of dominant and predominant trees with open, moderate, or dense canopy, often with multiple canopies, and at least 20 acres in size. Characteristics include large decadent trees, snags, and large down logs.

Late Successional: The latter developmental stages of a plant community where vegetation structures are in a stable state and slow to change, reflective of increased age.

Learning Questions: Questions that define what you want to learn based on the implementation of your project. Learning questions drive the identification of information needs, and thus, your monitoring plan.

Listed: General term used for a taxon protected under the federal Endangered Species Act, the California Endangered Species Act, or the California Native Plant Protection Act

Logical Framework: Often abbreviated as logframe. A matrix that results from a logical framework analysis that is used to display a project's goals, objectives, and indicators in tabular form, showing the logic of the project

Macrogroup: The fifth level in the National Vegetation Classification natural vegetation hierarchy, in which each vegetation unit is defined by a group of plant communities with a common set of growth forms and many diagnostic plant taxa, including many character taxa of the dominant growth forms, preferentially sharing a broadly similar geographic region and regional climate, and disturbance

Mesic: Neither wet (hydric) nor dry (xeric); intermediate in moisture, without extremes

Metapopulation: A group of populations, usually of the same species, that exist at the same time but in different places

Method: A specific technique used to collect data to measure an indicator. A good method should meet the criteria of accurate, reliable, cost-effective, feasible, and appropriate.

Migrate; Migratory: Referring to animals that travel seasonally. Migrations may be local or over long distances.

Monitoring: The periodic collection and evaluation of data relative to stated project goals and objectives. Many people often also refer to this process as monitoring and evaluation (abbreviated M&E).

Monitoring Plan: The plan for monitoring a project. It includes information needs, indicators, and methods, spatial scale and locations, timeframe, and roles and responsibilities for collecting data

Morphology: The form and structure of organisms

Native: Naturally occurring in a specified geographic region

Natural Community: General term often used synonymously with habitat or vegetation type

NatureServe: A non-profit conservation organization that hosts a network of natural heritage programs providing information about rare and endangered species and threatened ecosystems

Non-native species: See exotic species

Nonpoint: Pollution whose source cannot be ascertained, including runoff from storm water and agricultural, range, and forestry operations, as well as dust and air pollution that contaminate waterbodies

Objective: A formal statement detailing a desired outcome of a project, such as reducing a critical threat. A good objective meets the criteria of being specific, measurable, achievable, results-oriented, and time limited (SMART). If the project is well-conceptualized and -designed, the realization of a project’s objectives should lead to the fulfillment of the project’s goals and ultimately its vision. Compare to vision and goal.

Old Growth Forest: A stand or stands of forest trees that exhibit large tree sizes, relatively old age, and decay characteristics common with over-mature trees

Operational Plan: A plan that includes analyses of: funding required; human capacity and skills and other non-financial resources required; risk assessment and mitigation; and estimate of project lifespan and exit strategy

Opportunity: A factor identified in an analysis of the project situation that potentially has a positive effect on one or more targets, either directly or indirectly. Often an entry point for conservation actions – for example, demand for sustainably harvested timber. (In some senses, the opposite of a threat.)

Outcome: The desired future state of a threat or opportunity factor. An objective is a formal statement of the desired outcome (Synonym for result.)

Overdraft: The pumping of water from a groundwater basin or aquifer in excess of the supply flowing into the basin; results in a depletion or "mining" of the groundwater in the basin

Overstory: The uppermost canopy (treetops) in a stand of trees

Pacific Flyway: The westernmost migratory bird flyway in North America, which begins in Alaska and runs south through California. It consists of several parallel routes linked together by several branches and follows the coast of North America and the valleys of the major mountain ranges.

Pelagic: Living on the open ocean rather than coastal or inland bodies of water

Piscivore: An animal whose primary food source is fish

Plant Alliance: A level of classification for vegetation types generally based upon the dominant plant species in the uppermost or dominant layer of vegetation

Plant Association: A level of classification for vegetation types below plant alliance and defined by the most characteristic species associated with a plant alliance. Many plant associations may be nested within a single plant alliance, just like many species may be nested within a single genus.

Population: The number of individuals of a particular taxon in a defined area

Practitioner: People involved in designing, managing, and monitoring conservation projects and programs

Predation: The act of killing and eating other animals

Prescribed Fire: A deliberate burn of wildland fuels in either their natural or modified setting and under specific environmental conditions that allow the fire to be confined to a predetermined area and intensity to attain a planned resource management objective

Preservation: Generally, the nonuse of natural resources. Compare with conservation.

Pressure: An anthropogenic (human-induced) or natural driver that could result in changing the ecological conditions of the target. Pressures can be positive or negative depending on intensity, timing, and duration. Negative or positive, the influence of a pressure to the target is likely to be significant.

Private Land: Lands not publicly owned, including private conservancy lands

Program: A group of projects which together aim to achieve a common broad vision. In the interest of simplicity, this document uses the term "project" to represent both projects and programs since these standards of practice are designed to apply equally well to both.

Project: A set of actions undertaken by a defined group of practitioners – including managers, researchers, community members, or other stakeholders – to achieve defined goals and objectives. The basic unit of conservation work. (Compare with program.)

Project Area: The place where the biodiversity of interest to the project is located. It can include one or more conservation areas or areas of biodiversity significance, as identified through ecoregional assessments. Note that in some cases, project actions may take place outside of the defined project area.

Project Scope: Individual ecoregion or watershed will serve as the basis for developing strategies and actions within the project area

Project Team: A specific core group of practitioners who are responsible for designing, implementing, and monitoring a project. This group can include managers, stakeholders, researchers, operations staff, and other key implementers.

Province: A regional unit defined under SWAP 2015 that is made of several nearby conservation units

Public: Lands owned by local, state, or federal government or special districts

Ramsar Convention: An international treaty providing the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources

Range: The maximum geographic extent of a taxon or habitat; does not imply that suitable conditions exist throughout the defined limits. Compare with distribution.

Rangelands: Any expanse of land not fertilized, cultivated, or irrigated that is suitable and predominately used for grazing domestic livestock and wildlife

Rare: One of several special status listing designations in state law; it applies only to plants. Under California law, a plant is rare when, although it is not in immediate danger of extinction, it occurs in such low numbers that it may become endangered if its environment worsens. The word rare is also commonly applied to non-listed plants and animals whose populations are low in number and therefore at risk.

Rarity: A measure of sensitivity for those taxa that have special status due to very limited distribution, low population levels, or immediate threat. An area high in rarity has many taxa that meet this definition.

Recruitment: The influx of new members into a population by reproduction or immigration

Redd: Nesting site for salmonids and other fish

Refugia: Areas where species can take refuge during times of climatic upheaval or biological stress. Places of past refugium are sometimes areas that still harbor high biological diversity

Regime: A regular pattern of occurrence or action

Resident: Refers to animal taxa that remain in a given location throughout the year

Result: The desired future state of a target or factor. Results include impacts, which are linked to targets and outcomes, which are linked to threats and opportunities.

Results Chain: A visual diagram of a project's theory of change. A results chain includes core assumptions and the logical sequence linking project interventions to one or more targets. In scientific terms, it lays out hypothesized relationships or theories of change.

Richness: A measure of diversity; the total number of plant taxa, animal species, or vegetation types in a given area

Riparian: Relating to rivers or streams

Riprap: Gabions, stones, blocks of concrete, or other protective covering material of like nature deposited upon river and stream beds and banks, lake, tidal, or other shores to prevent erosion and scour by water flow, wave, or other movement

Risk Factor: A condition under which the project is expected to function, but which can cause problems for the project. Often, a condition over which the project has no direct control. Killer risks are those that when not overcome, will completely stop the project from achieving its goals and objectives.

Salmonids: Collective term for a family of fish that includes salmon and trout

Scope: The broad geographic or thematic focus of a project

Sensitive Species: Plant and animal species for which population viability is a concern

Seral: A series of stages in community transformation during ecological succession

Silviculture: Generally, the science and art of cultivating forest crops

Snags: Standing dead trees with a minimum diameter of 10 inches and a height of 10 feet

Spawn: The release or deposit of egg and sperm, usually into water, by aquatic animals. As a verb, spawn refers to the process of releasing eggs and sperm, also called spawning. Most aquatic animals, apart from aquatic mammals, reproduce through the process of spawning.

Special Animals List: A list compiled by CDFW containing threatened, endangered, and unlisted, but sensitive or declining, vertebrate and invertebrate taxa; taxa on this list are included in the California Natural Diversity Database.

Species at Risk: Candidate, threatened, or endangered species pursuant to state and federal Endangered Species Acts, and species of special concern

Species of Greatest Conservation Need (SGCN): All state and federally listed and candidate species; species for which there is a conservation concern (i.e., Species of Special Concern and Fully Protected Species); species identified as being highly vulnerable to climate change, experiencing population declines, or highly vulnerable to stressors; and species whose take is expressly prohibited by NOAA-NMFS or CDFW, a federal rebuilding plan, or considered overfished. Invertebrates with NatureServe ranks of S1 and S1S2 are also included in the SGCN list.

Species of Special Concern (SSC): An administrative designation given to animals that were not listed under the federal Endangered Species Act or the California Endangered Species Act at the time of designation but are declining at a rate that could, and sometimes does, result in listing

Stakeholder: Any individual, group, or institution that has a vested interest in the natural resources of the project area and/or that potentially will be affected by project activities and have something to gain or lose if conditions change or stay the same. Stakeholders are all those who need to be considered in achieving project goals and whose participation and support are crucial to their success.

Strategic Plan: The overall plan for a project. A complete strategic plan includes descriptions of a project's scope, vision, and targets, an analysis of project situation, an action plan, a monitoring plan, and an operational plan.

Strategy: A set of activities with a common focus that work together to achieve specific goals and objectives by targeting key intervention points, optimizing opportunities, and limiting constraints. A good strategy meets the criteria of being linked, focused, feasible, and appropriate.

Stress: A degraded ecological condition of a target that resulted directly or indirectly from negative impacts of pressures (defined above [e.g., habitat fragmentation])

Substrate: The base or material on which an organism lives; subsoil

Succession: The gradual transformation of one ecological community to another, either in response to an environmental change or induced by the organisms themselves

Successional Stage: A particular state of ecological development

Tailwater: Irrigation runoff water from agriculture

Take: To hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill

Target: See conservation target.

Task: A specific action in a work plan required to implement activities, a monitoring plan, or other components of a strategic plan

Taxa: Plural of taxon

Taxon: A group in biological classification, for example, species, subspecies, variety, or evolutionary significant unit (ESU). The plural is taxa.

Threat: A human activity that directly or indirectly degrades one or more targets. Typically tied to one or more stakeholders. (See also direct threat and indirect threat.) See pressure.

Threatened Species: Any species that is likely to become endangered within the foreseeable future throughout all or a significant portion of its range

Threatened: One of several special status listing designations of plant and animal taxa. Under the California and federal Endangered Species Acts, threatened refers to a taxon that is likely to become endangered in the foreseeable future. The word threatened is also commonly applied to non-listed taxa in danger of extinction.

Total Maximum Daily Load (TMDL): A calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards, as well as an estimation of the percentage originating from each pollution source. A TMDL is the sum of the allowable loads of a single pollutant from all contributing point and nonpoint sources. The calculation must include a margin of safety to ensure that the waterbody can be used for state-designated purposes. The calculation must also account for seasonal variation in water quality.

Turbidity: Reduced water clarity resulting from the presence of suspended matter

Umbrella Species: A species whose conservation protects a wide range of co-existing species in the same habitat, which may be lesser-known and difficult to protect otherwise

Understory: The trees and other woody species growing under a relatively continuous cover of branches and foliage formed by the overstory trees

Uneven-aged: A silvicultural system in which individual trees originate at different times and result in a forest with trees of many ages and sizes

Upland: Referring to species, habitats, or vegetation types in non-flooded or non-saturated areas

Vegetation Type: A named category of plant community or vegetation defined on the basis of shared floristic and/or physiognomic characteristics that distinguish it from other kinds of plant communities or vegetation. This term can refer to units in any level of the National Vegetation Classification hierarchy.

Vernal Pools: Seasonal wetlands that form in depressions on the soil surface above a water-restricting layer of soil or rock. Plant and animal taxa endemic to vernal pools are those which can adapt to a unique cycle of flooding, temporary ponding, and drying.

Vertebrate: An animal with an internal skeleton. Examples are birds, mammals, reptiles, amphibians, and fish

Viable: Able to persist over time; self-sustaining

Vision: A description of the desired state or ultimate condition that a project is working to achieve. A complete vision can include a description of the biodiversity of the site and/or a map of the project area as well as a summary vision statement.

Vision Statement: A brief summary of the project's vision. A good vision statement meets the criteria of being relatively general, visionary, and brief.

Watershed: The area of land that catches rain and snow and drains or seeps into a marsh, stream, river, lake, or groundwater

Wetland: A general term referring to the transitional zone between aquatic and upland areas. Some wetlands are flooded or saturated only during certain seasons of the year. Vernal pools are one example of a seasonal wetland.

Wildfire: Any fire occurring on undeveloped land; the term specifies a fire occurring on a wildland area that does not meet management objectives and thus requires a suppression response. Wildland fire protection agencies use this term generally to indicate a vegetation fire. Wildfire often replaces such terms as forest fire, brush fire, range fire, and grass fire.

Wildlands: Collective term for public or private lands largely undeveloped and in their natural state

Wildlife: All species of free-ranging animals, including but not limited to mammals, birds, fishes, reptiles, amphibians, and invertebrates

Wildlife Area: Designation given to certain lands owned or managed CDFW as a way of regulating appropriate use. This designation is usually given to land with potential for multiple wildlife-dependent public uses such as waterfowl hunting, fishing, or wildlife viewing. Compare with Ecological Reserve.

Woody Debris: Fallen dead wood or large branches. Woody debris is an important source of nutrients and habitat as well as a source of fuel for fire.

Work Plan: A short-term schedule for implementing an action or monitoring plan. Work plans typically list activities and/or tasks required, responsible individuals, and timing of the activity or task. They often link to budgets showing the money and resources required to implement the work plan.

Xeric: Dry or desert-like

Zooplankton: Minute, often microscopic, animal life that drift or swim in water bodies such as the ocean