Glossary

abiotic — physical rather than biological; not derived from living organisms.

adaptive management — process that improves the management of biological resources by using new information gathered through monitoring, evaluation, and other credible sources as they become available, and that adjusts management strategies and practices to assist in meeting conservation and management goals (CDFG 2012).

alluvial fan — a wide, cone-shaped deposit of rocks, sand, gravel, and finer materials that has been deposited by a stream as it flows out of a mountainous area onto a plain.

alluvium — sediment deposited by a river or other flowing stream.

anadromous — fish species that spend most of their adult lives in the ocean but migrate to freshwater rivers and streams to spawn.

aquatic — growing in, living in, or frequenting water, usually open water; compare with **wetland**.

arachnids — a class of **arthropods** generally having eight legs and mainly living on land. This class includes spiders, scorpions, ticks, mites, and harvestmen.

arthropods — a group of invertebrate animals having an exoskeleton, segmented body, and paired, jointed appendages.

basin — a large-scale depression in the land surface which is wider than it is deep, with steep or gently dipping sides.

benthic — related to the bottom layer of a body of water.

biodiversity hotspot — a geographic area that is both high in biological diversity and at risk of destruction, often from human causes.

biogeography — the branch of biology that deals with the geographic distribution of plants, animals, and ecosystems.

biota — the plant and animal life of a particular habitat.

bioturbators (bioturbation) — animals or plants that rework soil and sediment through a variety of activities including digging, burrowing, ingestion, and defecation. Bioturbation is an extremely important ecosystem function and is considered a major driver of biodiversity.

branchiopods — a class of **crustaceans** including fairy shrimp, clam shrimp, and tadpole shrimp; mainly small, freshwater animals that feed on plankton and detritus.

California Natural Diversity Database (CNDDB) — a statewide inventory of the locations and conditions of the state's rarest plant and animal taxa and vegetation types. The CNDDB is a natural heritage program and is part of NatureServe's National Heritage Network, a nationwide network of similar programs.

chaparral — an ecological community composed mainly of shrubby plants with hard, evergreen leaves, adapted to the dry summers and moist winters of California's Mediterranean climate.

conservation easement — a purchased claim to some rights, generally development rights, on private property as a way of conserving both natural resources and private ownership.

continental shelf — the area of seabed around a large landmass where the sea is relatively shallow compared with the open ocean.

crustaceans — a large, diverse **taxon** of mostly aquatic **arthropods**. This subphylum includes crabs, crayfish, and shrimp.

deciduous — referring to a tree or shrub that sheds its leaves seasonally, usually in the autumn.

easement — see also **conservation easement**; a voluntary, legal agreement that permanently limits uses of the land in order to protect its conservation values.

ecoregions — as used here, defined as "sections" in the Bailey (1976) nomenclature, which are subdivisions of ecological provinces based on major terrain features such as a desert, plateau, valley, mountain range, or a combination thereof. Sections are large land areas of relatively homogeneous physical and biological components that interact to form environments of similar productive capabilities, response to disturbances, and potentials for resource management (McNab et al. 2007)

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** and **vegetation type**.

ecosystem services — positive benefits that people obtain from wildlife or **ecosystems**, such as food and fresh water, pollination of crops and orchards, soil formation, and recreational opportunities.

endangered — one of several **special status** listing designations of plant and animal **taxa**. Under the California and federal Endangered Species Acts, endangered refers to a **taxon** that is in danger of becoming **extinct** throughout all or a significant portion of its range. The word endangered is also commonly applied to non-listed taxa in danger of extinction.

endemic — found only in a specified geographic region.

endemism — used here as a measure of distribution of 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.

evergreen — referring to a tree or shrub that retains green leaves throughout the year.

exotic — a plant or animal that has been introduced to an area from outside its native range, either purposely or accidentally.

extant — still existing.

extinct — refers to a plant, animal, or v**egetation type** that no longer exists anywhere.

extirpated — refers to a plant, animal, or **vegetation type** that had been locally eliminated, but is not **extinct**.

fauna — all of the animal **taxa** in a given area.

flora — all of the plant **taxa** in a given area.

forb — a broad-leaved herb, such as clover, as distinguished from a grass or a woody plant.

gastropods — a large class of **mollusks** comprising aquatic and terrestrial snails and slugs.

geology — the earth's physical structure and substance, its history, and the processes that act on it.

georeferencing — the process of providing geographic coordinates that correspond to a location.

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 **vegetation type**.

habitat connectivity — a measure of how easily wildlife, plants, and ecological process can move through the landscape.

harvestmen — the common name for members of the **arachnids**, distinguishable from spiders by their fused body regions and single pair of eyes.

hotspot — a location where a particular condition is concentrated. In this context, the condition may be species richness, risk of extinction, or some combination of these or other factors. Hotspots are relative to the area under consideration: ecoregion, state, world, etc.

HUC — Hydrologic Unit Code. The Watershed Boundary Dataset (USGS 2013) provides Hydrologic Units that define drainage areas for surface water. Hydrologic units are subdivided into progressively smaller units with each unit nested within the previous level. Each hydrologic unit is identified by a unique hydrologic unit code (HUC) consisting of two to twelve digits; HUC12 used in this atlas is the sub-watershed level.

igneous — referring to rocks formed by the solidification of magma due to volcanic processes at or below the Earth's surface (Harden 2004).

introduced — refers to any **species** intentionally or accidentally transported and released into an environment outside its native range.

invasive — a species which spreads rapidly once established and has the potential to cause environmental or economic harm. Most, but not all, invasive species are **introduced**; not all introduced species are invasive.

invertebrate — an animal without an internal skeleton. Examples are insects, clams, shrimp, and snails.

kelp forest — an underwater forest created by dense groupings of brown algae called kelp. Kelp forests occur in nearshore, nutrient-rich environments worldwide. They create a unique habitat that provides food, shelter, **substrate**, and nursing grounds for a diverse array of marine species (CDFG 2001).

latitude — an imaginary horizontal line representing degrees north or south of the Equator. The Equator is 0 degrees while the North Pole is 90 degrees north.

longitude — an imaginary vertical line representing degrees east or west of the Prime Meridian at Greenwich, London. Greenwich is 0 degrees while the line directly

opposite it (in the Pacific Ocean) is 180 degrees west or east of the Prime Meridian.

magma — molten or semi-molten natural material beneath the earth's crust from which **igneous** rocks are formed.

Marine Protected Area — a named, discrete geographic area that has been designated by law to protect or conserve marine life and habitat (CDFW 2016b). This can be a marine or estuarine area below the mean high tide line or the mouth of a coastal river.

Mediterranean climate — climate characterized by dry summers and cool, wet winters, named for the Mediterranean basin, the largest area with this climate regime. Other areas include California and portions of Oregon and Baja California Norte, central Chile, southwestern South Africa, and southwestern Australia.

metamorphic — referring to **igneous** or **sedimentary** rocks that have been subjected to heat and pressure that alters the mineralogy, texture, or grains of the rock (Harden 2004).

migratory — refers to animals that travel seasonally. Migrations may be local or over long distances.

mima mounds — regular, low, dome-shaped mounds of soil and gravel clustered in areas that are relatively flat and poorly drained. These unexplained mound features, typically associated with prairies throughout the United States, are often an integral part of the local **vernal pool** landscape.

mitigation credit — a unit of important **habitat** created to compensate for impacts caused by projects to aquatic functions or to threatened, endangered, or other rare species and their habitats.

mollusks — a phylum of **invertebrate** animals with soft, unsegmented bodies, often enclosed in a calcium carbonate shell. This phylum includes snails, slugs, mussels, and octopuses.

montane — of mountainous country.

narrow endemic species — native species with restricted geographic distributions, often due to specific habitat requirements.

native — naturally occurring in a specified geographic region.

old growth forest — a forest that has not undergone any major unnatural changes (such as logging) for more than 100 to 150 years and thereby exhibits unique ecological features.

plant association — a vegetation classification unit defined by a diagnostic species, a characteristic range of species composition, physiognomy, and distinctive habitat conditions (Jennings et al. 2006). Associations reflect local topography, climate, substrates, hydrology, and disturbance regimes.

playa — a flat, dry area of an undrained desert **basin**, where shallow lakes may form during rainy periods.

pyroclastic — relating to rock fragments erupted by a volcano.

recruitment — the process of adding new individuals to a population through reproduction or immigration.

refugia — areas that will remain relatively buffered from climate change over time, enabling the persistence of ecological resources.

resilience — the capacity of any entity—an individual, a community, an organization, or a natural system—to prepare for disruptions, to recover from shocks and stresses, and to adapt and grow from a disruptive experience (Rodin 2014).

riparian — of or relating to the areas bordering rivers or streams.

rocky intertidal — the area of rocky shore that lies between the extreme high and low tidemarks. In California, it can be divided into three zones: the high intertidal zone that is only submerged for a short period during high tides; the middle intertidal zone that is regularly exposed and submerged during every tidal cycle; and the lower intertidal zone that is only exposed for a short period during very low tides.

run — a group of fish that migrates to fresh water to spawn during a specific time of the year.

salmonid — collective term for a family of fish that includes salmon and trout.

sedimentary — referring to rocks formed at or near the Earth's surface by accumulation of minerals, rock, and/or plant and animal fragments (Harden 2004).

soil horizon — a distinct soil layer whose properties differ from the layers above and below it (Harden 2004).

special status — collective term for all categories of plant or animal **taxa** whose populations are rare and at risk. The **CNDDB** tracks special status taxa, which meet one or more of the following criteria:

- Is listed, is a candidate for listing, or is proposed for listing under the California or federal Endangered Species Acts or California Native Plant Protection Act as Endangered, Threatened, or (for plants only) Rare;
- Is a federal "Species of Concern," an unofficial designation sometimes seen on U.S. Fish and Wildlife Service species lists;
- Meets the criteria for listing, even if not currently included on any list, as described in Section 15380 of the California Environmental Quality Act (CEQA) Guidelines;
- Has been designated as a special status, sensitive, or declining taxon by other state or federal agencies or non-governmental organizations, including Bureau of Land Management and U.S. Forest Service;
- If an animal, is considered by CDFW to be a Species of Special Concern;
- If a plant, is listed in the California Native Plant Society's Inventory of Rare and Endangered Plants of California (CNPS 2020b);
- Is biologically rare, very restricted in distribution, declining throughout its range, or has a critical, vulnerable stage in its life cycle that warrants monitoring;
- Has population(s) in California that may be peripheral to the major portion of its range but is threatened with extirpation in California; or
- Is closely associated with a habitat that is declining in California at a significant rate (e.g., wetlands, riparian habitats, old growth forests, desert aquatic systems, native grasslands).

speciation — the process by which new **taxa** evolve.

species — the highest level of biological classification from which organisms can breed and produce fertile offspring under natural conditions.

stressor — a change in environmental conditions that places stress on the health and functioning of an organism, population and/or **ecosystem**.

subspecies — the level of classification below **species**; a genetically distinct group.

substrate — the surface on which an organism lives.

taxa — a term used to refer collectively to organisms at different levels of biological classification. For example, **species**, **subspecies**, varieties, and evolutionarily significant units (ESUs) together may be referred to as taxa. Singular is **taxon**.

taxon — the name that is applied to a group in biological classification, for example, **species**, **subspecies**, variety, or evolutionarily significant unit (ESU). Plural is **taxa**.

tectonic plate — one of many large plates (slabs of solid rock) which make up the crust of the earth and move slowly around it, sometimes colliding with or pulling apart from other plates.

terrestrial — growing on, living on, or frequenting land.

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.

tidepool — a shallow pool of seawater along a rocky shore that is exposed during low tides. Tidepools harbor many different types of seaweeds, **invertebrates**, and fishes (NOAA 2019).

topography — the shape of the surface of the earth, including mountains and valleys.

ultramafic — **igneous** rocks with very high iron and magnesium content and low (about 40 percent) silica (Harden 2004).

upland — a general term referring to **species**, **habitats**, or **vegetation types** in non-flooded or non-saturated areas.

upwelling — the process by which warm ocean surface waters are replaced by cooler subsurface waters. For regions such as California, with eastern boundary currents and winds that generally flow in a direction favorable for upwelling, surface waters are moved away from the coast and are replaced by cold, nutrient-rich subsurface waters. These nutrients support high productivity of fish, marine mammals, and sea birds.

urbanization — the degree to which natural landscapes have been altered by human development.

vagrant — an animal, usually migratory, straying outside of the normal range for its species. Many vagrants occur in California because of the state's large size; diverse **habitats** and **topography**; proximity to the ocean, where storms originate; long coastline and large marine area; and nearness to Canada, Asia, and Mexico.

vegetation type — a natural unit similar in definition to **ecosystem** but defined primarily by the composition of plant species; compare also with **habitat**.

vernal pool — seasonal **wetland** that forms in a depression on the soil surface above a water-impermeable layer of soil or rock. Plant and animal **taxa endemic** to vernal pools are those which can adapt to an annual cycle of flooding, temporary ponding, and drying.

vertebrate — an animal with an internal skeleton. Examples are birds, mammals, reptiles, amphibians, and fishes.

vulnerability — the susceptibility to harm from exposure to stresses associated with environmental and social change and from the absence of capacity to adapt (Adger 2006).

watershed — defined here as a stream or river basin and the adjacent hills and peaks which "shed," or drain, water into it.

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.

wildlands — collective term for public or private lands that are largely undeveloped and in their natural state.

References

Abbott I.A. and G.J. Hollenberg. 1976. *Marine algae of California*. Stanford University Press. Stanford, CA. 827 p.

Adger, W.N. (Ed.). 2006. *Fairness in adaptation to climate change*. Cambridge, Mass: MIT Press.

Bailey, R.G. 1976. *Ecoregions of the United States (map)*. USDA Forest Service Intermountain Region, Ogden, UT. Scale 1:7,500,000.

Baldwin, B.G, S. Boyd, B Ertter, R. Patterson, T.J. Rosatti, D. Wilken, (eds.). 2002. *The Jepson Desert Manual*. UC Press, Berkeley, California.

Baldwin, B.G., D. Goldman, D.J. Keil, R. Patterson, T.J. Rosatti, D. Wilken (eds.). 2012. *The Jepson Manual, Vascular Plants of California, 2nd ed*. University of California Press.

Baldwin, B.G., A.H. Thornhill, W.A. Freyman, D.D. Ackerly, M.M. Kling, N. Morueta-Holme, and B.D. Mishler. 2017. "Species richness and endemism in the native flora of California." *American Journal of Botany*, Volume 104: 487-501.

Beck, H.E., N.E. Zimmermann, T.R. McVicar, N. Vergopolan, A. Berg, E.F. Wood. 2018. *Present Koppen-Geiger Climate Classification Map - 1-km resolution*. GIS Dataset. Nature Scientific Data. https://www.nature.com/articles/sdata2018214.

Beck, M.W., R.D. Mazor, S. Johnson, K. Wisenbaker, J. Westfall, P.R. Ode, R. Hill, C. Loflen, M. Sutula, and E.D. Stein. 2019. "Prioritizing management goals for stream biological integrity within the developed landscape context." *Freshwater Science* 38(4): 883-898.

Bedsworth, L., D. Cayan, G. Franco, L. Fisher, S. Ziaja. 2018. *Statewide Summary Report*. California's Fourth Climate Change Assessment. Publication number: SUMCCCA4-2018-013.

Behnke, R.J. 1992. "Native Trout of Western North America." American Fisheries Society monograph number 6.

Birkeland, P.W. 1999. *Soils and Geomorphology*. Third Edition. Oxford University Press. 430 p.

Bradley, R.D., L.K. Ammerman, R.J. Baker, L.C. Bradley, J.A. Cook, R.C. Dowler, C. Jones, D.J. Schimdly, F.B. Stangl Jr., R.A. Van Den Bussche, and B. Wursig. 2014. *Revised checklist of North American mammals north of Mexico, 2014*. Museum of Texas Tech University Occasional Papers. 327:1-28. https://www.depts.ttu.edu/nsrl/publications/downloads/OP327.pdf.

Brown, L. and P. Moyle. (2005). "Native fishes of the Sacramento–San Joaquin drainage, California: A history of decline." American Fisheries Society Symposium. 2005. 75-98.

Cal-Adapt. 2020a. *April Average Snow Water Equivalent*. GIS Dataset. Derived from LOCA Downscaled CMIP5 Climate Projections. University of California, Berkeley; Geospatial Innovation Facility. http://cal-adapt.org.

Cal-Adapt. 2020b. *Projected Change in Average April Snow Water Equivalent for 2035-2064, RCP 8.5, 10 GCMs (Inches)*. GIS Dataset. Derived from LOCA Downscaled CMIP5 Climate Projections. University of California, Berkeley; Geospatial Innovation Facility. http://cal-adapt.org.

California Bird Records Committee (CBRC). 2020. *Official California Checklist*, available at https://californiabirds.org/checklist.asp (last updated January 21, 2020).

California Department of Finance (CDOF). 2020. *E-1 Population Estimates for Cities, Counties, and the State with Annual Percent Change — January 1, 2019 and 2020*. Sacramento, California, May 2020.

California Department of Fish and Game (CDFG). 2001. "California's Living Marine Resources: A Status Report." https://wildlife.ca.gov/Conservation/Marine/Status/2001.

California Department of Fish and Game (CDFG), National Oceanic and Atmospheric Administration - National Ocean Service, and U.S. Geological Survey. 2002. *Bathymetric DEM, 200 Meter Resolution*. GIS Dataset.

California Department of Fish and Game (CDFG). 2005. *Vegetation - Central Mojave Desert [ds166]*. GIS Dataset. Vegetation Classification and Mapping Program. https://apps.wildlife.ca.gov/bios.

California Department of Fish and Game (CDFG). 2010. *Ecosystem Restoration Program [ds209]*. GIS Dataset. Ecosystem Restoration Program. https://apps.wildlife.ca.gov/bios.

California Department of Fish and Game (CDFG). 2012. "Section 3.5, 2012: General Definitions." Fish and Game Code. Added by Assembly Bill 2402, Statutes of 2012.

California Department of Fish and Wildlife (CDFW). 2014. California Interagency Wildlife Task Group. CWHR version 9.0 personal computer program. Sacramento, CA. https://wildlife.ca.gov/data/cwhr.

California Department of Fish and Wildlife (CDFW). 2015. "State Wildlife Action Plan." https://wildlife.ca.gov/SWAP.

California Department of Fish and Wildlife, and Southern California Coastal Water Research Project. 2016. *California Stream Condition Index*. GIS Database. Aquatic Bioassessment Lab.

California Department of Fish and Wildlife (CDFW). 2016a. *California Non-native Estuarine and Marine Organisms Database (Cal-NEMO) [ds503]*. GIS Dataset. Office of Spill Prevention and Response. https://wildlife.ca.gov/OSPR/Science/Marine-Invasive-Species-Program.

California Department of Fish and Wildlife (CDFW). 2016b. "The Master Plan for Marine Protected Areas." https://wildlife.ca.gov/Conservation/Marine/MPAs/Master-Plan.

California Department of Fish and Wildlife (CDFW). 2017a. *CDFW Aerial Kelp Canopy Surveys 2002–2006, 2008–2016.* GIS Dataset. Marine Region. ftp://ftp.dfg.ca.gov/R7_MR/BIOLOGICAL/Kelp.

California Department of Fish and Wildlife (CDFW). 2017b. *Cannabis Restoration Grant Program.* GIS Dataset. Watershed Restoration Grants Branch.

California Department of Fish and Wildlife (CDFW). 2018a. *Vegetation - Sonoma County [ds2691].* GIS Dataset. Vegetation Classification and Mapping Program. https://apps.wildlife.ca.gov/bios.

California Department of Fish and Wildlife (CDFW). 2018b. *Vegetation - Great Valley Ecoregion [ds2632].* GIS Dataset. Vegetation Classification and Mapping Program. https://apps.wildlife.ca.gov/bios.

California Department of Fish and Wildlife (CDFW). 2018c. *Quagga and Zebra Mussel Infested Waters [ds2801].* GIS Dataset. Habitat Conservation Planning Branch. https://apps.wildlife.ca.gov/bios.

California Department of Fish and Wildlife (CDFW). 2018d. *Species Biodiversity - ACE [ds2769].* GIS Dataset. Conservation Analysis Unit. https://apps.wildlife.ca.gov/ace.

California Department of Fish and Wildlife (CDFW). 2018e. *Fisheries Restoration Grant Program (FRGP) Projects [ds168].* GIS Dataset. Fisheries Restoration Grant Program. https://apps.wildlife.ca.gov/bios.

California Department of Fish and Wildlife (CDFW). 2019a. *Rare Plant Richness - ACE [ds2710]*. GIS Dataset. Conservation Analysis Unit. https://apps.wildlife.ca.gov/ace.

California Department of Fish and Wildlife (CDFW). 2019b. "California Natural Community List." November 8, 2019. https://wildlife.ca.gov/Data/VegCAMP/Natural-Communities#natural%20communities%20lists.

California Department of Fish and Wildlife (CDFW). 2019c. *Plant Irreplaceability - ACE [ds2716].* GIS Dataset. Conservation Analysis Unit. https://apps.wildlife.ca.gov/ace.

California Department of Fish and Wildlife (CDFW). 2019d. *Native Amphibian Richness - ACE [ds2707].* GIS Dataset. Conservation Analysis Unit. https://apps.wildlife.ca.gov/ace.

California Department of Fish and Wildlife (CDFW). 2019e. *Rare Amphibian Richness - ACE [ds2713].* GIS Dataset. Conservation Analysis Unit. https://apps.wildlife.ca.gov/ace.

California Department of Fish and Wildlife (CDFW). 2019f. *Native Reptile Richness - ACE [ds2708].* GIS Dataset. Conservation Analysis Unit. https://apps.wildlife.ca.gov/ace.

California Department of Fish and Wildlife (CDFW). 2019g. *Rare Reptile Richness - ACE [ds2714].* GIS Dataset. Conservation Analysis Unit. https://apps.wildlife.ca.gov/ace.

California Department of Fish and Wildlife (CDFW). 2019h. *Native Bird Richness - ACE [ds2705].* GIS Dataset. Conservation Analysis Unit. https://apps.wildlife.ca.gov/ace.

California Department of Fish and Wildlife (CDFW). 2019i. *Rare Bird Richness - ACE [ds2711].* GIS Dataset. Conservation Analysis Unit. https://apps.wildlife.ca.gov/ace.

California Department of Fish and Wildlife (CDFW). 2019j. *Native Mammal Richness - ACE [ds2706].* GIS Dataset. Conservation Analysis Unit. https://apps.wildlife.ca.gov/ace.

California Department of Fish and Wildlife (CDFW). 2019k. *Rare Mammal Richness - ACE [ds2712].* GIS Dataset. Conservation Analysis Unit. https://apps.wildlife.ca.gov/ace.

California Department of Fish and Wildlife (CDFW). 2019m. *Native Fish Richness - ACE [ds2744].* GIS Dataset. Conservation Analysis Unit. https://apps.wildlife.ca.gov/ace.

California Department of Fish and Wildlife (CDFW). 2019n. *Rare Fish Richness - ACE [ds2749].* GIS Dataset. Conservation Analysis Unit. https://apps.wildlife.ca.gov/ace.

California Department of Fish and Wildlife (CDFW). 2019o. *Vernal Pools - ACE [ds2732].* GIS Dataset. Conservation Analysis Unit. https://apps.wildlife.ca.gov/bios.

California Department of Fish and Wildlife (CDFW). 2019p. *Freshwater Fish Range Maps.* GIS Dataset. Fisheries Branch.

California Department of Fish and Wildlife (CDFW). 2019q. *California Marine Protected Areas [ds582].* GIS Dataset. Marine Region GIS. https://apps.wildlife.ca.gov/bios.

California Department of Fish and Wildlife (CDFW). 2019r. *Terrestrial Connectivity - ACE [ds2734].* GIS Dataset. Conservation Analysis Unit. https://apps.wildlife.ca.gov/bios.

California Department of Fish and Wildlife (CDFW). 2019s. *Conservation Plan Boundaries, HCP and NCCP [ds760].* GIS Dataset. Habitat Conservation Planning Branch. https://apps.wildlife.ca.gov/bios.

California Department of Fish and Wildlife (CDFW). 2019t. *Mitigation Bank Locations.* GIS Dataset. Habitat Conservation Planning Branch.

California Department of Fish and Wildlife (CDFW). 2019u. *Regional Conservation Investment Strategy (RCIS) Areas.* GIS Dataset. Habitat Conservation Planning Branch.

California Department of Fish and Wildlife (CDFW). 2020a. *California Natural Diversity Database: Special Plants and Animals Lists*. https://wildlife.ca.gov/Data/CNDDB/Plants-and-Animals. (accessed July 2020).

California Department of Fish and Wildlife (CDFW). 2020b. *California Natural Diversity Database*. Biogeographic Data Branch. Sacramento, CA.

California Department of Fish and Wildlife (CDFW). 2020c. *Count of Alliances by USDA Ecoregion Subsection*. GIS Dataset. Vegetation Classification and Mapping Program (VegCAMP). Sacramento, CA.

California Department of Fish and Wildlife (CDFW). 2020d. *California Natural Diversity Database (CNDDB) [ds45].* GIS Dataset. Biogeographic Data Branch. Sacramento, CA.

California Department of Fish and Wildlife (CDFW). 2020e. *Anadromous Fish Richness*. GIS Dataset. Fisheries Branch. Sacramento, CA.

California Department of Fish and Wildlife (CDFW). 2020f. *Oaks, Various Regional Projects*. GIS Dataset. Vegetation Classification and Mapping Program (VegCAMP). Sacramento, CA.

California Department of Fish and Wildlife (CDFW). 2020g. "Living with Wildlife." https://wildlife.ca.gov/Living-with-Wildlife.

California Department of Fish and Wildlife (CDFW). 2020i. *Wildlife Incident Reporting System*. GIS Dataset. Sacramento, CA.

California Department of Fish and Wildlife (CDFW). 2020j. *California Fish Passage Assessment Database [ds69]*. GIS Dataset. Sacramento, CA.

California Department of Fish and Wildlife (CDFW). 2020k. *Aquatic Climate Vulnerable Species - ACE*. GIS Dataset. Conservation Analysis Unit. Sacramento, CA.

California Department of Fish and Wildlife (CDFW). 2020m. *Terrestrial Climate Vulnerable Species - ACE*. GIS Dataset. Conservation Analysis Unit. Sacramento, CA.

California Department of Fish and Wildlife (CDFW). 2020n. "California Marine Protected Areas." https://www.wildlife.ca.gov/Conservation/Marine/MPAs.

California Department of Fish and Wildlife (CDFW). 2020o. *Greenhouse Gas Reduction Projects*. GIS Dataset. Wetlands Branch.

California Department of Fish and Wildlife (CDFW). 2020p. *Proposition 1 & Proposition 68 Grants*. GIS Dataset. Watershed Restoration Grants Branch.

California Department of Fish and Wildlife (CDFW). 2020q. *Atlas 2nd Edition Notes*. http://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=184756.

California Department of Parks and Recreation. 2020. *California State Park Boundaries*. GIS Dataset. https://www.parks.ca.gov/?page_id=29682.

California Department of Water Resources (CDFW). 2018a. *Natural Communities Commonly Associated with Groundwater - Vegetation [ds2788]*. GIS Dataset. https://apps.wildlife.ca.gov/bios.

California Department of Water Resources (CDFW). 2018b. *Natural Communities Commonly Associated with Groundwater - Wetlands [ds2789]*. GIS Dataset. https://apps.wildlife.ca.gov/bios.

California Environmental Protection Agency (CEPA). 2018. *Indicators of Climate Change in California*. Office of Environmental Health Hazard Assessment.

California Geological Survey (CGS). 2002. "California Geomorphic Provinces: California Department of Conservation, Note 36." https://www.conservation.ca.gov/cgs/Documents/Publications/CGS-Notes/CGS-Note-36.pdf.

California Geological Survey (CGS). 2015a. *Geological Gems of California State Parks*. California Department of Conservation, CGS Special Report 230. https://www.parks.ca.gov/pages/734/files/CGS_SR230_GeoGems.pdf.

California Geological Society (CGS). 2015b. "Wilder Ranch State Park." *Geological Gems of California State Parks*. California Department of Conservation, CGS Special Report 230, GeoGem Note 18. https://www.conservation.ca.gov/cgs/Documents/Publications/Special-Reports/SR_230-GeoGems-Notes-LR/CGS_SR230_WilderRanch_SP_lr.pdf.

California Geological Survey (CGS). 2018a. *Geology of California*. Department of Conservation. Map Sheet 57. Educator's Edition, Scale 1:2,500,000. https://www.conservation.ca.gov/cgs/Documents/Publications/Map-Sheets/MS_057-Geology-of-California-18x24.pdf.

California Geological Survey (CGS). 2018b. *Faulting in California*. Department of Conservation. Map Sheet 54. Educator's Edition, Scale 1:2,500,000. https://www.conservation.ca.gov/cgs/Documents/Publications/Map-Sheets/MS_054-Faulting-in-California-18x24.pdf.

California Geological Survey (CGS). 2020. "Geology, Soil, and Ecology: How Geology Influences Soil Development and Ecosystems," California Department of Conservation. CGS Note 56.

California Invasive Plant Council. 2020. *Level of Terrestrial Plant Invasion by Quad [ds2810].* GIS Dataset. https://apps.wildlife.ca.gov/bios.

California Native Plant Society (CNPS). 2020a. *A Manual of California Vegetation,* Online Edition. http://www.cnps.org/cnps/vegetation/. California Native Plant Society, Sacramento, CA.

California Native Plant Society (CNPS), Rare Plant Program. 2020b. *Inventory of Rare and Endangered Plants of California* (online edition, v8-03 0.39). Website http://www.rareplants.cnps.org.

California Ocean Science Trust (CalOST). 2018. *Impacts of Ocean Acidification on California Marine Living Resources*. https://www.oceansciencetrust.org/wp-content/uploads/2019/01/OST-OA-Impacts-Infographic-Final.pdf

California State University. 2006. *Marine habitat mapping survey of Cordell Bank, California*. GIS Dataset. Seafloor Mapping Lab, Monterey Bay, California.

Cavole, L. M., A. M. Demko, R. E. Diner, A. Giddings, I. Koester, C. Pagniello, M. L. Paulsen, A. Ramirez-Valdez, S. M. Schwenck, N. K. Yen, M. E. Zill, P. J. S. Franks. 2016. *Biological impacts of the 2013–2015 warm-water anomaly in the Northeast Pacific: Winners, losers, and the future.* Oceanography 29(2): 273-285. https://doi.org/10.5670/oceanog.2016.32.

Centers for Water and Wildland Resources (CWWR). 1996. "Status of the Sierra Nevada, Summary of the Sierra Nevada Ecosystem Project Report: Wildland Resources Center Report No. 39, University of California, Davis." https://pubs.usgs.gov/dds/dds-43/SUMMARY/SUMMARY.PDF.

Chesser, R. T., K. J. Burns, C. Cicero, J. L. Dunn, A. W. Kratter, I. J. Lovette, P. C. Rasmussen, J. V. Remsen, Jr., D. F. Stotz, and K. Winker. 2019. *Check-list of North American Birds* (online). American Ornithological Society. http://checklist.aou.org/taxa.

Crother, B. I. (ed.). 2017. *Scientific and Standard English Names of Amphibians and Reptiles of North America North of Mexico, with Comments Regarding Confidence in Our Understanding*. pp. 1–102. SSAR Herpetological Circular 43.

Dartnell, P., A. C. Ritchie, D. P. Finlayson, R. G. Kvitek. 2015. *BathymetryB [5m]–Monterey Canyon and Vicinity, California*. GIS Dataset. U.S. Geological Survey. https://www.sciencebase.gov/catalog/file/get/556f8b8ae4b0d9246a9fd0b4.

Docker, Margaret F. 2015. *Lampreys: Biology, Conservation and Control*. Edited by Margaret F. Docker and David L. G. Noakes. Fish & Fisheries Series. Volume 37. Springer Netherlands.

Drost, C., J. Nekola, B. Roth, and T. Pearce (2018). "Land Mollusks of the California Channel Islands: An Overview of Diversity, Populations, and Conservation Status." Western North American Naturalist 78(4): 799-810. https://doi.org/10.3398/064.078.0419.

Eisenhauer, N., A. Bonn, and C. Guerra (2019). "Recognizing the quiet extinction of invertebrates." Nature Communications 10:50. https://doi.org/10.1038/s41467-018-07916-1.

Gershunov, A., T. Shulgina, R.E.S. Clemesha, K. Guirguis, D.W. Pierce, M.D. Dettinger, D.A. Lavers, D.R. Cayan, S.D. Polade, J. Kalansky, and F.M. Ralph. 2019. *Precipitation regime change in Western North America: the role of atmospheric rivers.* Scientific Reports 9:9944-9954. https://doi.org/10.1038/s41598-019-46169-w.

GreenInfo Network. 2020a. *California Protected Areas Database (CPAD)*. GIS Dataset. CPAD Manager. www.calands.org.

GreenInfo Network. 2020b. *California Conservation Easement Database (CCED)*. GIS Dataset. CCED Manager. www.calands.org.

Habeck, R. J. 1992. "*Sequoiadendron giganteum*, Botanical and Ecological Characteristics." Fire Effects Information System. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.fed.us/database/feis/plants/tree/seqgig/all.html (accessed April 2020).

Harden, D. 2004. *California Geology*. Second Edition. San Jose State University. Pearson Education Inc. Upper Saddle River, NJ.

Harrison, S. (2013). Plant and Animal Endemism in California. University of California Press. Retrieved July 9, 2020, from www.jstor.org/stable/10.1525/j.ctt2jcbf0.

Intergovernmental Panel on Climate Change (IPCC). 2014. *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. Geneva, Switzerland, 151 pp.

Jennings, M.D., D. Faber-Langendoen, R.K. Peet, O.L. Loucks, D.C. Glenn-Lewin, A. Damman, M.G. Barbour, R. Pfister, D.H. Grossman, D. Roberts, D. Tart, M. Walker, S.S. Talbot, J. Walker, G.S. Hartshorn, G. Waggoner, M.D. Abrams, A. Hill, and M. Rejmanek. 2006. *Description, documentation, and evaluation of associations and alliances within the U.S. National Vegetation Classification, Version 4.5*. Vegetation Classification Panel. The Ecological Society of America. Washington, DC.

Jepson Flora Project (eds.). 2019. *Jepson eFlora*. https://ucjeps.berkeley.edu/eflora.

Jepson Flora Project (eds.). 2020a. *Jepson eFlora*. https://ucjeps.berkeley.edu/eflora.

Jepson Flora Project (eds.). 2020b. *Jepson eFlora: Summary of taxa*. https://ucjeps.berkeley.edu/eflora/IJM_stats.html (accessed on May 18, 2020).

Keeler-Wolf, T., D. R. Elam, K. Lewis, and S. A. Flint. 1998. "California vernal pool assessment preliminary report." Sacramento: California Department of Fish and Game. 159 pages.

Kimsey, L. (1996). "Status of terrestrial insects." From Sierra Nevada Ecosystem Project: Final report to Congress, vol. II, Assessments and scientific basis for management options. Davis: University of California, Centers for Water and Wildland Resources, 1996. https://pubs.usgs.gov/dds/dds-43/VOL_II/VII_C26.PDF.

Kimsey, L. S., T. J. Zavortink, R. B. Kimsey, and S. L. Heydon. 2017. "Insect biodiversity of the Algodones Dunes of California." Biodiversity data journal, (5), e21715. https://doi.org/10.3897/BDJ.5.e21715.

King, J. L., M. A. Simovich, and R. C. Brusca. 1996. "Species richness, endemism and ecology of crustacean assemblages in northern California vernal pools." Hydrobiologia 328, 85–116. https://doi.org/10.1007/BF00018707.

Kling, M. M., B. D. Mishler, A. H. Thornhill, B. G. Baldwin, and D. D. Ackerly. 2018. "Facets of phylodiversity: evolutionary diversification, divergence and survival as conservation targets." *Philosophical Transactions of the Royal Society B*, Volume 374.

Marshall, K. Anna. 1995. "*Larrea tridentata*, Management Considerations and Botanical and Ecological Characteristics." Fire Effects Information System. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Science Laboratory. https://www.fs.fed.us/database/feis/plants/shrub/lartri/all.html (accessed April 2020).

Mazor, R. D., P. R. Ode, A. C. Rehn, M. Engeln, K. A. Schiff, E. Stein, D. Gillett, D. Herbst, and C. P. Hawkins. 2016. "Bioassessment in complex environments: Designing an index for consistent meaning in different settings." *The Society for Freshwater Science* 35(1): 249-271.

McNab, W.H., D.T. Cleland, J.A. Freeouf, J.E. Keys, Jr., G.J. Nowacki, and C.A. Carpenter, (comps.). 2007. *Description of ecological subregions: sections of the conterminous United States* [CD-ROM]. General Technical Report WO-76B. U.S. Department of Agriculture, Forest Service. Washington, DC. 80 p. https://www.fs.fed.us/research/publications/misc/73327-wo-gtr-76b-mcnab2007.pdf.

Mittermeier, R. A., P. Robles-Gil, M. Hoffmann, J. Pilgrim, T. Brooks, C. G. Mittermeier, J. Lamoreux, G. Da Fonseca. 2004. *Hotspots Revisited: Earth's Biologically Richest and Most Endangered Terrestrial Ecoregions*. CEMEX/Agrupación Sierra Madre, 391 pp.

Moyle, Peter B. 2002. *Inland Fishes of California*. Edited by Doris Kretschmer and Peter Strupp. 2nd, Revised ed. University of California Press.

Moyle, P. B., R. M. Quiñones, J. V. Katz, and J. Weaver. 2015. *Fish Species of Special Concern in California*. California Department of Fish and Wildlife. Sacramento. https://wildlife.ca.gov/Conservation/SSC/Fishes.

National Oceanic and Atmospheric Administration. 1998. *High Resolution Sea Surface Temperature Data*. GIS Dataset. Ocean and Atmospheric Research/Earth System Research Laboratories. Physical Sciences Laboratory. Boulder, Colorado. https://psl.noaa.gov.

National Oceanic and Atmospheric Administration. 2002. *Coastal Relief Model*. GIS Dataset. National Geophysical Data Center. https://www.ngdc.noaa.gov/mgg/coastal/crm.html.

National Oceanic and Atmospheric Administration. 2004 and 2008. *Office of National Marine Sanctuaries Digital Boundary Files*. GIS Dataset. Office of National Marine Sanctuaries. https://sanctuaries.noaa.gov/library/imast_gis.html.

National Oceanic and Atmospheric Administration (NOAA). 2019. "What is a tide pool?" https://oceanservice.noaa.gov/facts/tide-pool.html.

National Oceanic and Atmospheric Administration (NOAA). 2020. *The California Current Marine Heatwave Tracker – An experimental tool for tracking marine heatwaves*. California Current Project. https://www.integratedecosystemassessment.noaa.gov/regions/california-current/cc-projects-blobtracker, accessed September 18, 2020.

National Park Service. 2019. *NPS - Land Resources Division Boundary and Tract Data Service.* GIS Dataset. Land Resources Division. https://www.arcgis.com/home/item.html?id=c8d60ffcbf5c4030a17762fe10e81c6a#.

NatureServe. 2019. *Map of Biodiversity Importance*. GIS Dataset. https://www.natureserve.org/conservation-tools/projects/map-biodiversity-importance.

NatureServe. 2020a. NatureServe Central Databases. NatureServe, Arlington, Virginia. https://explorer.natureserve.org/. (accessed June 19, 2020).

NatureServe. 2020b. Personal communication with Gwen Davis. Arlington, Virginia.

Nelson, J.S., E.J. Crossman, H. Espinosa-Perez, L.T. Findley, C.R. Gilbert, R.N. Lea, and J. D. Williams. 2004. *Common and scientific names of fishes from the United States, Canada, and Mexico*. American Fisheries Society. Special Publication 29. Bethesda, Maryland. 386 pp.

Ocean Ecology Laboratory. 2014. *Moderate-resolution Imaging Spectroradiometer (MODIS) Aqua 11µm Day/Night Sea Surface Temperature Data.* Ocean Biology Processing Group. NASA Goddard Space Flight Center, Greenbelt, MD.

Ocean Ecology Laboratory. 2019. *September Sea Surface Temperature Anomalies (2011 - 2019).* Ocean Biology Processing Group. NASA Goddard Space Flight Center, Greenbelt, MD.

Oliver, E.C.J., M.G. Donat, M.T. Burrows, P.J. Moore, D.A. Smale, L.V. Alexander, J.A. Benthuysen, M. Feng, A. Sen Gupta, A.J. Hobday, N.J. Holbrook, S.E. Perkins-Kirkpatrick, H.A. Scannell, S.C. Straub, and T. Wernberg. 2018. *Longer and more frequent marine heatwaves over the past century.* Nature Communications. 9:1324-1335. https://doi.org/10.1038/s41467-018-03732-9.

Paddison, J. 1999. *A World Transformed: Firsthand Accounts of California Before the Gold Rush*. Heyday Book. Berkeley, CA.

Pierce, D. W., J. F. Kalansky, and D. R. Cayan, (Scripps Institution of Oceanography). 2018. *Climate, Drought, and Sea Level Rise Scenarios for the Fourth California Climate Assessment*. GIS Dataset. California's Fourth Climate Change Assessment, California Energy Commission. Publication Number: CNRA-CEC-2018-006. Retrieved from: https://cal-adapt.org/tools/maps-of-projected-change.

Radke, J. D., G. S. Biging, M. Schmidt-Poolman, H. Foster, E. Roe, Y. Ju, O. Hoes, T. Beach, A. Alruheil, L. Meier, W. Hsu, R. Neuhausler, W. Fourt (University of California, Berkeley). 2017. *Assessment of Bay Area Natural Gas Pipeline Vulnerability to Climate Change*. California Energy Commission. Publication number: CEC-500-2017-008. https://cal-adapt.org/tools/slr-calflod-3d and https://apps.wildlife.ca.gov/bios.

Raven, P. H. and D. I. Axelrod. 1978. *Origin and Relationships of the California Flora*. University of California Publications in Botany, Volume 72. University of California Press.

Rodin, J. 2014The Resilience Dividend: Being Strong in a World Where Things Go Wrong. Public Affairs.

Rogers-Bennett, L. and C. A. Catton. 2019. "Marine heat wave and multiple stressors tip bull kelp forest to sea urchin barrens." *Scientific Reports* 9 (15050), https://doi.org/10.1038/s41598-019-51114-y.

Rykaczewski, R. R., J. P. Dunne, W. J. Sydeman, M. García-Reyes, B. A. Black, and S. J. Bograd. 2015. *Poleward displacement of coastal upwelling-favorable winds in the ocean's eastern boundary currents through the 21st century*. Geophysical Research Letters, 42: 6424–6431. https://doi.org/10.1002/2015GL064694.

Sawyer, J. O., T. Keeler-Wolf, and J. M. Evens. 2009. *A Manual of California Vegetation*. Second Edition. California Native Plant Society Press, Sacramento, CA.

Schoenherr, A.A. 2017. *A Natural History of California*. Second Edition. University of California Press. Oakland, California.

Schulz, M., C. Lawrence, D. Muhs, C. Prentice, and S. Flanagan. 2018. "Landscape from the waves – Marine terraces of California: U.S. Geological Survey, Fact Sheet 2018-3002." 4 p., doi: https://doi.org/10.3133/fs20183002.

Shapiro, A. M. and T. D. Manolis. 2007. Field Guide to Butterflies of the San Francisco Bay and Sacramento Valley Regions. University of California Press. Retrieved July 9, 2020, from www.jstor.org/stable/10.1525/j.ctt1ppk17.

Sievanen, L. and J. Phillips, C. Colgan, G. Griggs, J. Finzi Hart, E. Hartge, T. Hill, R. Kudela, N. Mantua, K. Nielsen, L. Whiteman. 2018. *California's Coast and Ocean Summary Report*. California's Fourth Climate Change Assessment. Publication number: SUMCCC4A-2018-011.

Simons, E. 2019. *California's Early June Heat Wave Cooked Coastal Mussels in Place*. https://baynature.org/2019/06/26/californias-early-june-heat-wave-cooked-coastal-mussels-in-place.

Sleeter, B. M., T. S. Wilson, E. Sharygin, and J. Sherba. 2017. "Future Scenarios of Land Change Based on Empirical Dataand Demographic Trends." *Earth's Future*, 5, 1068–1083. https://doi.org/10.1002/2017EF000560.

Southern California Coastal Water Research Project. 2018. *Biological Integrity of Constrained Streams by Watershed [ds2808].* GIS Dataset. https://apps.wildlife.ca.gov/bios.

Stein, Bruce A. 2002. *States of the Union: Ranking America's Biodiversity*. Arlington, Virginia: NatureServe.

Stewart, Joseph A. E., D. H. Wright, K. A. Heckman, R. Guralnick. 2017. *Apparent climate-mediated loss and fragmentation of core habitat of the American pika in the Northern Sierra Nevada, California, USA*. PLOS ONE. 12(8): e0181834-. https://doi.org/10.1371/journal.pone.0181834.

Tilley, D., L. St. John, and D. Ogle. 2011. "Plant guide for whitebark pine (*Pinus albicaulis*)." Aberdeen, Idaho. USDA Natural Resources Conservation Service.

U.S. Census Bureau. 2010. *Census 2010*. GIS Dataset. https://www.census.gov/programs-surveys/decennial-census/decade.html.

U.S. Census Bureau. 2020. *Annual Estimates of the Resident Population for Counties in California: April 1, 2010 to July 1, 2019*. GIS Dataset. Population Division. https://www.census.gov/data/datasets/time-series/demo/popest/2010s-counties-total.html.

U.S. Fish & Wildlife Service (USFWS). 2019. *National Wetlands Inventory – California – USFWS [ds2630]*. GIS Dataset. National Standards and Support Team. https://apps.wildlife.ca.gov/bios.

U.S. Fish & Wildlife Service (USFWS). 2020. *Waterfowl Flyways*. GIS Dataset. Division of Migratory Bird Management. https://www.fws.gov/birds/management/flyways.php.

U.S. Forest Service (USFS). 2010. *Ecological Subregions for the State of California (07_3)*. GIS Dataset. Pacific Southwest Region.

U.S. Forest Service (USFS). 2019. *Classification and Assessment with Landsat of Visible Ecological Groupings (CALVEG)*. GIS Dataset. Pacific Southwest Region. https://www.fs.usda.gov/detail/r5/landmanagement/gis/?cid=STELPRDB5327836.

U.S. Forest Service (USFS). 2020. "Klamath-Siskiyou Serpentines." https://www.fs.fed.us/wildflowers/beauty/serpentines. (accessed April 2020).

U.S. Geological Survey (USGS). 1999. *National Elevation Dataset.* GIS Dataset. https://catalog.data.gov/dataset/usgs-national-elevation-dataset-ned.

U.S. Geological Survey (USGS) and U.S. Department of Agriculture, Natural Resources Conservation Service. 2013. *Federal Standards and Procedures for the National Watershed Boundary Dataset (WBD) (4 ed.): U.S. Geological Survey Techniques and Methods 11–A3*. 63 p. http://pubs.usgs.gov/tm/tm11a3.

U.S. Geological Survey (USGS). 2016. *National Land Cover Database (NLCD).* GIS Dataset. Western Geographic Science Center. https://www.usgs.gov/centers/eros/science/national-land-cover-database?qt-science_center_objects=0#qt-science_center_objects.

U.S. Geological Survey (USGS). 2018. *Land Use Change Probability – 2100 – USGS [ds2669].* GIS Dataset. Western Geographic Science Center. https://apps.wildlife.ca.gov/bios.

U.S. Geological Survey (USGS). 2020. *Nonindigenous Aquatic Species (NAS), USGS [ds731].* GIS Dataset. Nonindigenous Aquatic Species Database Program. https://nas.er.usgs.gov.

United States National Vegetation Classification (USNVC). 2018. *United States National Vegetation Classification Database, V2.02*. Federal Geographic Data Committee, Vegetation Subcommittee, Washington DC.

Vose, R. S., D. R. Easterling, K. E. Kunkel, A. N. LeGrande, and M. F. Wehner. 2017. "Temperature changes in the United States. Climate Science Special Report." *Fourth National Climate Assessment, Volume I.* 185–206. NOAA National Centers for Environmental Information. https://www.energy.ca.gov/sites/default/files/2019-11/Statewide_Reports-SUM-CCCA4-2018-013_Statewide_Summary_Report_ADA.pdf.

Weatherspoon, P. C. 1990. "*Sequoiadendron giganteum* (Lindl.) Buchholz Giant Sequoia." In *Silvics of North America, Conifers, Agriculture Handbook 654*. v.1. 552-562. Washington, D.C.: U.S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station.

Westerling, A.L. 2018. *Wildfire Simulations for California's Fourth Climate Change Assessment: Projecting Changes in Extreme Wildfire Events with a Warming Climate*. California's Fourth Climate Change Assessment, California Energy Commission. Publication Number: CCCA4-CEC-2018-014. https://www.energy.ca.gov/sites/default/files/2019-11/Projections_CCCA4-CEC-2018-014_ADA.pdf.

Wildlife Conservation Board. 2020. *Wildlife Conservation Board (WCB) Approved Projects [ds672].* GIS Dataset. https://apps.wildlife.ca.gov/bios.

Zachos, F.E. and J. C. Habel (eds). 2010. *Biodiversity hotspots: distribution and protection of conservation priority areas*. Springer, Heidelberg.

About the Authors

Authors are with the California Department of Fish and Wildlife unless otherwise noted.

Whitney Albright is a senior scientist and climate change specialist in the Science Institute, and was co-lead of the Biodiversity and Habitat chapter in Safeguarding California Plan: California's Climate Adaptation Strategy. (Climate Change)

Debbie Aseltine-Neilson is a senior scientist with over 27 years of experience in the Marine Region, currently focused on implementing the Marine Life Management Act Master Plan for Fisheries. (Sea Currents and Temperatures; Climate Change)

Farhat Bajjaliya is the Statewide Inland Trout Coordinator and supervising scientist in the Fisheries Branch's Inland Fish Program, with over 13 years of fisheries experience. (Trout)

Jeb Bjerke is a senior botanist in the Habitat Conservation Planning Branch's Native Plant Program, working to protect and recover California's rare, threatened, and endangered plants. (Special Status Plants)

Esther Burkett is a senior wildlife biologist with the Threatened and Endangered Species Program in the Wildlife Branch, and has worked for over 35 years on threatened and endangered animal conservation. (Coast Redwoods)

Neil Clipperton is the Statewide Coordinator for Bird Conservation with the Nongame Wildlife Program in the Wildlife Branch, and works to secure the state's most vulnerable birds. (Birds)

Katie Ferguson is a rare plant botanist and data technician with the California Natural Diversity Database Program in the Biogeographic Data Branch, tracking status trends and locations of the state's special status plants. (Plants)

Rebecca Flores Miller is a marine fisheries scientist with the Marine Region working out of the Monterey Office on the Aquaculture and Bay Management Project. She co-authored *Beneath Pacific Tides: Subtidal Invertebrates of the West Coast*. (Kelp Forests)

Rachel Freund works for Chico State Enterprises in association with Chico State University's Geographic Information Center and has been a zoologist with the California Natural Diversity Database Program in the Biogeographic Data Branch for eight years. (Invertebrates)

Rebecca Fris is currently the Assistant Executive Director of the Wildlife Conservation Board. Previously, she was Chief of the Watershed Restoration Grants Branch. (Habitat Restoration)

Barrett Garrison was an environmental scientist in the Sacramento Valley-Central Sierra Region specializing in habitat relationships and community ecology of birds and other wildlife in California's oak woodlands and forests. (Oak Woodlands)

Melanie Gogol-Prokurat is a senior spatial ecologist and coordinator for the Conservation Analysis Unit in the Biogeographic Data Branch. She is currently focused on habitat connectivity modeling statewide. (Habitat Connectivity)

Diana Hickson is the supervising ecologist of the Vegetation Classification and Mapping Program and the Conservation Analysis Unit in the Biogeographic Data Branch, and has over 25 years of experience in geography and vegetation. (Various Vegetation Chapters)

Ryan Hill is a research data specialist with the Conservation Analysis Unit in the Biogeographic Data Branch. He currently manages the Areas of Conservation Emphasis, including data aggregation models from which many of the maps in the atlas were created. (Lands Conservation)

Kevin Hunting is currently a wildlife biologist for the California Natural Diversity Database Program in the Biogeographic Data Branch, having returned after retiring as the Department's Chief Deputy Director. (Central Valley Grasslands)

Eric Kauffman was the cartographer and project manager for the original Atlas of the Biodiversity of California. He was a Research Program Specialist at that time and is now an Information Technology Specialist III with the California Department of Technology. (Climate & Topography)

Todd Keeler-Wolf was the lead vegetation ecologist for the Vegetation Classification and Mapping Program and a co-author of the Manual of California Vegetation. Though retired, he continues to advance program goals. (Various Vegetation Chapters)

Vicki Lake is the manager of the Ecosystem Restoration Grant Programs (Propositions 1 & 68) in the Watershed Restoration Grants Branch. Her specialty is wetland ecology and she has experience in oil spill recovery. (Habitat Restoration)

Jeremy Lancaster is the manager of the Regional Geologic and Landslides Mapping Program with the California Geological Survey, Department of Conservation. (Geology and Soils)

Raffica La Rosa is a botanist with the Native Plant Program in the Habitat Conservation Planning Branch, preparing five-year status reviews for the state's rare, threatened, and endangered plants. Her expertise is in plant evolution and conservation. (Special Status Plants)

Caroline Larsen-Bircher is currently serving as a Fish and Wildlife Scientific Aid with the California Natural Diversity Database Program while conducting geospatial research as a graduate student at the University of California, Davis. (Invertebrates)

Kristi Lazar is a rare plant botanist and data manager with the California Natural Diversity Database Program in the Biogeographic Data Branch, maintaining location and status information for over 2,300 special status plants. (Plants)

Shannon Lucas is the supervising scientist of Regional Conservation Planning for the Landscape Conservation Planning Program in the Habitat Conservation Planning Branch. (Regional Conservation Planning)

Winn McEnery is a research data specialist working on the Data Management Project from the Marine Region's Monterey Office. (Bathymetry)

Karen Miner has over 30 years of experience as a conservation ecologist for California and is currently the Chief of the Biogeographic Data Branch. She served as project manager for this second edition of the atlas. (Various)

Victoria Monroe is the Statewide Wildlife Conflict Coordinator and supervising scientist in the Wildlife Branch's Wildlife Investigations Program. Her specialty is animal behavior. (Human-Wildlife Conflict)

Peter Ode is the supervising scientist of the Chemical and Biological Assessment Laboratory Program in the Office of Spill Prevention and Response. He specializes in macroinvertebrates as indicators of water quality. (Watershed Health)

Scott Osborn is a senior wildlife biologist with the Nongame Wildlife Program in the Wildlife Branch and is the Statewide Coordinator for Small Mammal Conservation. He specializes in the physiological ecology of desert mammals. (Mammals)

Monica Parisi was the editor of the original Atlas of the Biodiversity of California and served as manager of the California Wildlife Habitat Relationship System and supervisor in the Landscape Conservation Planning Program before retirement. (Definition of Biodiversity)

Christina Parker is an environmental scientist with the Anadromous Fish Program in the Fisheries Branch and an Executive Committee Member of California/Nevada Chapter of American Fisheries Society. (Anadromous Fishes)

Laura Patterson is the Statewide Amphibian and Reptile Conservation Coordinator and senior wildlife biologist with the Threatened and Endangered Species Program in the Wildlife Branch. She specializes in imperiled aquatic reptiles and amphibians. (Amphibians, Reptiles)

Daydre Roser is currently an environmental scientist in the Invasive Species Program formerly located in the Habitat Conservation Planning Branch, now Fisheries Branch. She previously worked for the Lands Program in the Wildlife Branch. (Aquatic/Terrestrial Invasive Species)

Janine Salwasser was a project sponsor for the original Atlas of the Biodiversity of California and previously served as Chief of the Wildlife and Habitat Data Analysis Branch. She is currently the program leader for the Oregon Explorer, a natural resources digital library at Oregon State University. (Definition of Biodiversity)

Tom Schroyer is the Statewide Fish Passage Coordinator and senior scientist with the Anadromous Fish Program in the Fisheries Branch. (Stream Barriers)

Paulo Serpa is an environmental scientist specializing in Geographic Information Systems analyses for the Data Management Project out of the Marine Region's Monterey Office. (Bathymetry)

Francesca Valencia currently works as an engineering geologist for the Geologic and Landslide Mapping Program as part of the California Geological Survey in Los Angeles, Department of Conservation. (Geology and Soils)

Martha Volkoff is the manager of the Invasive Species Program, previously located in the Habitat Conservation Planning Branch, now Fisheries Branch. (Aquatic/Terrestrial Invasive Species)

Sara Worden is an environmental scientist with the Marine Region's Marine Protected Areas Project, the largest scientifically designed network of marine protected areas in North America, working out of the Belmont Office. (Marine Managed Areas)

Index

By Subject

Pages with photos or graphics are indicated by italicized numbers. Bold numbers indicate a page where a term is defined.

Index

By Species Name

Pages with photos are indicated by italicized numbers. We have adopted the scientific convention for capitalization of the official common names according to the current standard for each taxon group. For example, for plants and mammals only proper names are capitalized, while all names of fish, amphibians, reptiles, and birds are capitalized.

D

E

F

G

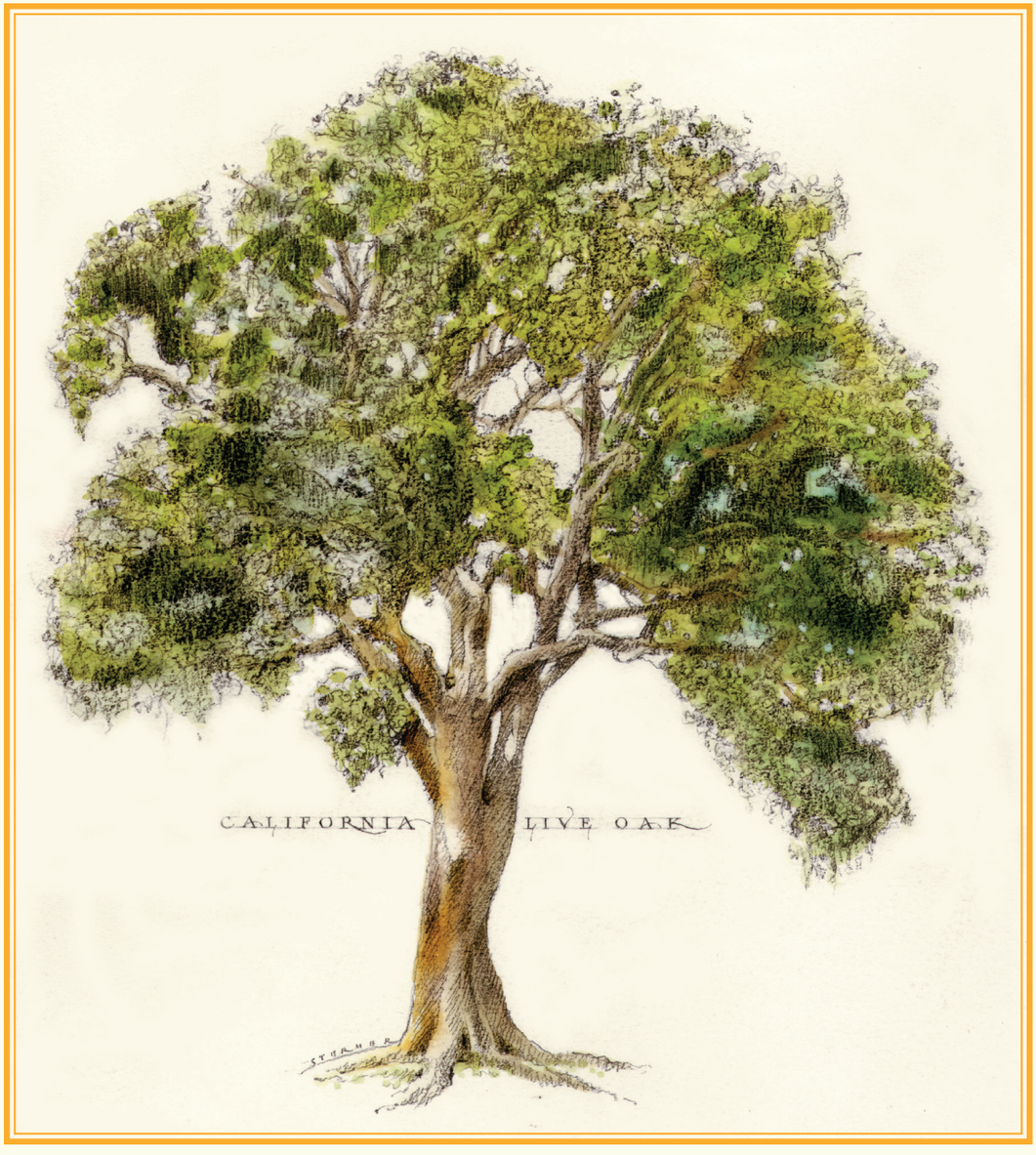
H

I

J

K

L



ISBN 978-1-7923-5570-7