# Appendix F Invasive Species in California

This section was written by Elizabeth Brusati and Doug Johnson, California Invasive Plant Council and adapted from the introduction to the state's Strategic Framework on Invasive Species (ISCC 2011).

## Impacts of Invasive Species

Invasive species are organisms that have invaded California from elsewhere and that damage our environment, agricultural production, public health, and economy. Some of these organisms were introduced inadvertently while others were introduced intentionally, without consideration of the harm they might cause. Although most of the thousands of species brought into our state cause little or no apparent harm, a small percentage are able to thrive in California to the detriment of native biological diversity, recreation, agriculture, infrastructure, and public health. Though it is difficult to compute harm from invasive species in financial terms, in *Environmental and Economic Costs Associated with Non-Indigenous Species in the United States* (1999), Pimental et al. place the cost to the United States at over $100 billion each year. (The scientific literature on invasive species and their impacts is extensive. See, for example, citations at www.invasivespeciesinfo.gov.)

Invasive species in California range from diseases, such as the insidious sudden oak death, to 200-pound feral pigs and from quagga mussels that clog infrastructure (e.g., pipes, pumps, equipment, etc.) and exert impacts on waterways to insects that damage and destroy crops and forests. Some introduced species are voracious predators, others out-compete native species for resources, and some are capable of re-engineering the environment to suit their preferences, changing hydrology, soil chemistry, and fire regimes. Collectively, invasive species are recognized as a major threat to biodiversity; they significantly impact over half of all federally listed threatened and endangered species, and are second only to habitat loss as a threat to these species (Wilcove et al. 1998). As the United Nation's Convention on Biological Diversity says, "[a]lien species that become invasive are considered to be a main direct driver of biodiversity loss across the globe. In addition, alien species have been estimated to cost our economies hundreds of billions of dollars each year (CBD 2015)."

The federal and state governments have developed and implemented plans and programs that promote interdisciplinary, interagency, and multi-stakeholder efforts to combat the threats posed by invasive species. The "Policy Background" section below provides a description of policies and plans that provide the framework and guidance for state and federal agency actions and programs described under "Agency Programs." This appendix also provides a discussion of how the agency and non-governmental organization (NGOs) efforts targeting specific taxonomic groups of species, which is organized by plants, insects and terrestrial invertebrates, aquatic and marine invertebrates, and vertebrates in the Invasive Species Leadership by Taxonomic Group" section below.

The sidebars in this section highlight only a few of the hundreds of invasive plant and animal species in California. The California Invasive Species Advisory Committee (CISAC) compiled an all-taxa list of

invasive species found in the state (as well as known invasive species with potential for being introduced into the state in the future). This list and other information can be accessed from www.iscc.ca.gov.

# Policy Background

In 1999, the federal government defined invasive species through Executive Order 13112 as "a species that is non-native to the ecosystem and whose introduction causes, or is likely to cause, economic or environmental harm, or harm to human health." Federal agencies were directed to prepare an invasive species management plan. In 2008, the National Invasive Species Council (NISC) revised the federal management plan, laying out a blueprint for action (NISC 2008). Increasingly, states have followed this lead, seeking the benefits of a coherent plan to coordinate the many agencies whose missions touch on the problem. Table F-1 shows how actions listed in the SWAP relate to the national invasive species management plan, while Table F-2 lists all objectives and tasks recommended by NISC (2008).

In California, Assembly Bill 2763 (Laird), signed by the governor in 2008, directed state agencies under the leadership of the California Department of Food and Agriculture (CDFA) to strengthen planning to anticipate the potential responses needed for future invasive species. This resulted in the formation of the Invasive Species Council of California (ISCC, comprising secretaries of six state agencies) and the CISAC (comprising 24 stakeholder representatives and expert advisors). In 2011, CISAC completed (and ISCC approved) *Stopping the Spread: A Strategic Framework for Protecting California from Invasive Species* (ISCC 2011). This plan built on two previously existing plans, the *California Noxious and Invasive Weed Action Plan* (CDFA 2005) and the *California Aquatic Invasive Species Management Plan* (CDFG 2008). The plan includes 40 recommendations for strengthening the state's response to invasive species. Table F-3 shows how actions listed by each province for SWAP fulfill recommended actions in *Stopping the Spread*. Table F-4 summarizes all recommendations from *Stopping the Spread*.

# Agency Programs

A number of agencies at the federal and state government levels, as well as NGOs, have established programs that manage invasive species as part of meeting their mission. Invasive species are a landscape-level problem, thus, solutions must also be landscape-level and not limited by jurisdictional boundaries. Interagency collaborative bodies and their efforts to tackle invasive species are also described below.

## State Agencies

Numerous California state agencies and departments have developed programs to address particular aspects of the invasive species challenge relevant to their mission. In some states, a single agency has been created to coordinate the state's overall response to invasive species, but that does not exist in California at this time. For more detailed information on invasive species programs in California, refer to

the state's *Aquatic Invasive Species Management Plan* (CDFG 2008) and the *Invasive and Noxious Weed Action Plan* (CDFA 2005).

### California Department of Fish and Wildlife

The California Department of Fish and Wildlife (CDFW) is the trustee agency for wildlife and habitat protection.

The CDFW Invasive Species Program (ISP) executes the state's extensive quagga mussel (*Dreissena bugensis*) and zebra mussel (*Dreissena polymorpha*) prevention and control activities. The program's overall mission is to reduce the negative effects of invasive animals and plants, both terrestrial and aquatic, on the wildlands and waterways of California. The program puts an emphasis on identifying and addressing the ways by which species are introduced and moved, typically inadvertently, by human activities. In 2014, CDFW held the first Invasive Species Action Week, seeking to engage the many volunteers across the state who help control invasive species. The ISP continues to grow, but does not yet have full capacity to take a comprehensive approach to addressing the impact of invasive species on wildlife statewide (CDFW 2015a).

Marine Invasive Species Program (MISP) within CDFW's Office of Spill Prevention and Response (OSPR) coordinates with the California State Lands Commission (SLC) to control the introduction of Non-Indigenous Species (NIS) from the ballast of ocean-going vessels. MISP is responsible for conducting biological surveys to assess the amount and types of marine invasive species present in state coastal and estuarine waters, and the degree of success of ballast water management activities. OSPR manages the California Aquatic Non-Native Organism Database (CANOD) and is working to establish consistency among the various major databases being used to analyze similar types of aquatic invasive species (AIS)-related information (CDFW 2015b).

CDFW is also responsible for preventing the introduction and spread of invasive animals in the state, controlling invasive species on land DFW owns or manages, and reducing invasive species populations that impact game or special status species. DFW maintains a regulatory list of live restricted animals (Title 14, sec. 671), through which several invasive animals, among other species, are prohibited from importation, possession, and transportation unless under a permit issued by DFW. Fish and Game Code also prohibits the sale, possession, import, transport, transfer, or live release of *Caulerpa* spp. and live or dead mussels of the family Dreissenidae (e.g., quagga, zebra, dark false), unless under DFW permit. DFW also regulates the aquaculture industry, including the import, sale, and placement of aquatic plants and animals into state waters.

### California Department of Parks and Recreation

California Department of Parks and Recreation's (State Parks) resource management policies call for preservation and restoration of native plants and animals and systematic removal of invasive species in wildland settings. Of all State Parks' expenditures on natural resource management, control of invasive species is the single largest expense. State Parks has taken aggressive action to control or eliminate the most serious invasive plants, with the Early Detection and Rapid Response (EDRR) program initiated to

detect new invasive plant introductions when populations are small. State Parks partners with the non-profit California Invasive Plant Council (Cal-IPC) and other agencies and organizations in planning and implementing strategic regional invasive plant management projects. State Parks also implements quagga/zebra mussel prevention programs in water bodies the department manages that are deemed vulnerable to mussel infestation (California Department of Parks and Recreation 2015).

State Parks Division of Boating and Waterways (DBW) manages the state's largest and oldest aquatic weed control program, working with other public agencies to control water hyacinth (*Eichhornia crassipes*), and more recently Brazilian elodea (*Egeria densa*) and South American spongeplant (*Limnobium laevigatum*), in the Sacramento-San Joaquin Delta, its tributaries, and the Suisun Marsh. DBW also leads the California Clean Boating Network, a collaboration of government, business, boating, and academic organizations working to increase and improve clean boating education efforts, including invasive species education, across the state. DBW will also manage the new boater registration "Mussel Fee" that provides grant funding to eligible agencies for quagga and zebra mussel prevention programs at uninfested reservoirs that allow boating and fishing recreation (DBW 2015).

### California Department of Water Resources

The California Department of Water Resources (DWR) addresses invasive species that impact water supply, water delivery and flood control. Activities related to invasive species are diverse. DWR conducts monthly monitoring of benthic (bottom-dwelling) invertebrates, zooplankton and phytoplankton throughout the upper San Francisco Estuary and reports trends in invertebrate abundance and community composition, including newly introduced species, to the State Water Resources Control Board (SWRCB). DWR contributes to programs aimed at controlling invasive plants along eroding Sacramento River banks, within flood control and water conveyance structures and along urban streams. DWR also conducts research on invasive species with the potential to impact the State's water resources including the invasive algal species *Microcystis* spp. in the upper San Francisco Estuary, the impacts of the Chinese mitten crab (*Eriocher sinensis*) on the benthic invertebrate community in the Sacramento-San Joaquin Delta, quagga and zebra mussel impacts on State Water Project infrastructure, and northern pike (*Esox lucius*) control at Lake Davis and downstream protection, including the installation of a structure to prevent pike escape over the dam (DWR 2015).

### California Coastal Conservancy

For over 20 years, the California Coastal Conservancy (Coastal Conservancy) has been involved in the control and eradication of aquatic invasive species, pursuant to Division 21 of the Public Resources Code. The Coastal Conservancy developed, funded and operates the Invasive Spartina Project in San Francisco Bay that shows great promise in eradicating invasive *Spartina* cordgrass species and their associated hybrids. The Coastal Conservancy is also involved in efforts to control giant reed (*Arundo donax*) in many coastal watersheds. The Coastal Conservancy directly develops projects and provides grant funds related to resources enhancement and restoration, including control and elimination of invasive species (California Coastal Conservancy 2015).

### State Water Resources Control Board

The SWRCB and regional boards have been working in support of, and in an advisory capacity to, other state agencies on various aquatic invasive species activities, such as hull fouling and ballast water management. Invasive species come under SWRCB purview as part of the state's efforts to implement and enforce the Clean Water Act since a 2005 federal court ruling defined non-indigenous species as "pollutants" present in discharges and found that such discharges are not exempt from permitting. The SWRCB supported extensive mapping of invasive giant reed in coastal watersheds from the Bay Area to Mexico.

### California State Lands Commission

SLC manages the mandatory, statewide, multi-agency MISP. This program works to implement regulations governing ballast water management for vessels operating on the west coast of North America. In addition to its regulatory activities, SLC facilitates scientific research and technology development to enhance management efforts of the program and to inform policymakers. Limited funding is provided for research that targets priority information gaps and to technologies that show exceptional promise for the treatment of ballast water. In recent years, the SLC has prepared a number of reports for the state legislature documenting commercial vessel fouling in California, proposing performance standards for ballast water discharges, and summarizing vessel ballast water activities and compliance. SLC also coordinates interagency efforts to manage invasive aquatic plants such as Eurasian watermilfoil (*Myriophyllum spicatum*) in Lake Tahoe (SLC 2015).
http://www.slc.ca.gov/spec_pub/mfd/ballast_water/Ballast_Water_Default.html

### San Francisco Bay Conservation and Development Commission

The San Francisco Bay Conservation and Development Commission (BCDC) recognizes the threat of non-native invasive species to the Bay's ecosystem, and the *San Francisco Bay Plan* contains policies regarding the monitoring, control, and eradication of aquatic invasive species in the Bay.

### California Department of Food and Agriculture

As prescribed by its mission statement, one of the primary mandates of CDFA is to "[p]rotect against invasion of exotic pests and diseases." This mandate focuses primarily on protecting agriculture. However, some of CDFA's activities overlap with efforts to protect wildlife, especially their invasive plant programs, but these have been virtually eliminated in recent years due to budget cuts. CDFA's regulatory authority includes quarantine, exterior pest exclusion (border protection stations and inspections), interior pest exclusion (survey of pet/aquaria stores, aquatic plant dealers, and nurseries), and detection and control/eradication programs. The CDFA Plant Pest Diagnostic Center identifies plant species, assigns plant pest ratings, and supports the listing of noxious weed species. CDFA has a long-standing partnership with County Agricultural Commissioners (CACs) to address invasive plants across the state. CDFA oversaw the operation of the state's Weed Management Area (WMA) network from their creation in 2000 until funding was lost in 2010. WMAs eradicated several thousand high-priority invasive plant populations across the state. CDFA's weed biocontrol lab, which also lost funding in 2010, distributed biocontrol agents developed by the U.S. Department of Agriculture (USDA) Agricultural Research Service to the CACs. With funding from the U.S. Forest Service (USFS), CDFA supported the development of CalWeedMapper, the statewide mapping and decision-support tool, by the nonprofit

California Invasive Plant Council (Cal-IPC), and the development of the Weed Heuristics: Invasive Population Prioritization for Eradication Tool (WHIPPET), another decision-support prioritization tool, at UC Davis. The one wildland program remaining at CDFA is its partnership with CDFW and State Parks' DBW on aquatic weed control, with a still-active hydrilla (*Hydrilla verticillata*) program (CDFA 2015).

### County Agricultural Commissioners

CACs have long been at the forefront in addressing invasive species throughout the state. They work collaboratively with CDFA and other agencies to exclude, detect, and eradicate or manage a wide range of pest species. CACs perform numerous inspections of incoming plant materials, checking for compliance with quarantine requirements and for noxious weeds and other pests. Nurseries and pet stores are also inspected. The CACs have worked with CDFA to obtain additional resources to fund more effective programs. Once plant materials enter the state, it is generally the CACs who perform inspections and carry out most of the weed eradication and management activities. While the CACs are not a "state" agency, they form a statewide system, represented at the state level by California Agricultural Commissioners and Sealers Association (CACASA) and have specific authorities granted by state law to carry out pest prevention programs. From 2000 to 2010, CACs received seed grants from the state through the WMA program, resulting in significant progress on the ground and substantial in-kind contributions from a wide array of partners (CACASA 2015). CACs also coordinate with state and federal agencies on the new Weed Free Forage program. Weed Free Forage is hay, feed, straw, or straw mulch that has been inspected and certified to not contain propagative plant parts or seeds from species on the California Noxious Weed List.

### California Department of Pesticide Regulation

The California Department of Pesticide Regulation (DPR) is vested with the primary responsibility to enforce federal and state pesticide laws and regulations pertaining to the proper and safe use of pesticides in California. DPR regulates pesticides under a comprehensive program that includes enforcement of pesticide use in agricultural and urban environments, prevention of environmental contamination, environmental monitoring for emergency eradication projects, and other related functions. DPR conducts monitoring of emergency invasive species eradication projects to ascertain that the public and the environment are being protected and the correct amounts of pesticides are being applied. DPR conducts sampling in consultation with the CACs, CDFW, the Regional Water Quality Control Boards, and other stakeholders. DPR works cooperatively with other government agencies to share information and monitoring results (DPR 2015).

### California Department of Transportation

California Department of Transportation (Caltrans) manages invasive plants along rights-of-way for state highways. These management activities are critical because roadways are a significant pathway of spread for invasive plants. Caltrans has worked on best management practices (BMPs) for preventing the spread of invasive plants during construction and maintenance, and reviews roadside landscaping palettes for plant species that could be invasive (Caltrans 2015).

## Federal Agencies

More than 40 percent of lands in California are federally managed; consequently, federal land and natural resource agencies have an important role in addressing invasive species issues. The roles and efforts of some of the major federal agencies to manage invasive species or conduct research on invasive species control are described below.

### U.S. Fish and Wildlife Service

The U.S. Fish and Wildlife Service (USFWS) is the only agency of the U.S. Government whose primary responsibility is the conservation of the nation's fish, wildlife, and plants. Because of these responsibilities, USFWS is very concerned about the impacts that invasive species are having on wildlife across the nation. National Wildlife Refuges in California control invasive species as part of their mission to protect wildlife habitat. Invasive species are often part of the reason that species are listed under the Endangered Species Act, which is administered by USFWS.

Also under the purview of USFWS is the listing and regulation of injurious wildlife under the Lacey Act. Injurious wildlife are mammals, birds, amphibians, reptiles, fish, crustaceans, mollusks and their offspring or gametes that are injurious to the interests of human beings, agriculture, horticulture, forestry, wildlife or wildlife resources of the United States. Listing of species as injurious wildlife prohibits their importation into the U.S. and interstate transport among the states and U.S. territories, unless under a permit from USFWS. The Service's Office of Law Enforcement, using wildlife inspectors at major airports, ocean ports, and border crossings, seeks to prevent the introduction of injurious wildlife through its wildlife inspection program. However, possession and intrastate transport of injurious wildlife is not prohibited under the Lacey Act, and is the discretionary responsibility of each state. http://www.fws.gov/invasives/

### National Park Service

The National Park Service (NPS) works to manage invasive species on park lands through a suite of national and local programs, each based upon the following strategies: cooperation and collaboration, inventory and monitoring, prevention, early detection and rapid response, treatment and control, and restoration. At the national level, NPS has fostered a successful invasive plant management program with the creation of the Exotic Plant Management Teams. These 16 teams provide highly trained mobile assistance in invasive plant management to parks throughout the National Park System. Almost all parks have incorporated invasive species management into long range planning goals for natural and cultural landscapes, as well as in day to day operations. Nationally, 70 percent of the invasive species in National Parks are invasive plants (NPS 2009).

### U.S. Forest Service

The U.S. Forest Service (USFS) manages 20 million acres in California and implements several programs that manage invasive species to protect resources. The USFS implements an Invasive Species Program to reduce, minimize, or eliminate the potential for introduction, establishment, spread, and impact of invasive species across all landscapes and ownerships. The Invasive Species Program integrates many divisions of the agency. The State and Private Forestry program of the USFS is one that connects a

variety of stakeholders across different forests, states, communities, and includes private landowners. This program provides funds to the state for implementing weed management projects on non-federal lands (USFS 2014).

### USDA Agricultural Research Service

The Pacific West Area Agricultural Research Services (ARS) facility in Albany, California houses the Exotic and Invasive Weeds Research Unit of the U.S. Department of Agriculture (USDA). This group develops biological control agents for invasive plants by working with collaborating institutions around the world to identify host-specific insects from the home range of the plants. They have developed biocontrol agents for many invasive plant species in California, including the highly effective tamarisk beetle (USDA 2015).

### Bureau of Land Management

Although the Bureau of Land Management (BLM) participates in the control of large invasive plant infestations, the agency's primary focus is providing adequate capability to detect and treat smaller weed infestations in high-risk areas before they have a chance to spread. The BLM Weed Management and Invasive Species Program receives support from a number of BLM programs that are affected by invasive species. These include the BLM Rangeland Management, Forestry, Fire Fuels Reduction, Soil, Water, Air, and Riparian programs. In most cases, BLM works with county governments, local community governments, and private landowners to detect and treat weed infestations. To leverage funding and share expertise, the BLM partners with more than 50 Coordinated Weed Management Areas (CWMAs) in the Western United States. CWMA partners include state, federal, county, and private land managers (BLM 2014).

### National Oceanic and Atmospheric Administration

To help prevent and control invasive species in our coastal waters and along our coasts, the National Oceanic and Atmospheric Administration (NOAA) provides funding for restoration and also oversees the National Marine Fisheries Service (NMFS). NOAA provides BMPs for activities such as cleaning watercraft and equipment, decontamination of shells, decontamination of crane bags used in unloading ships, and replanting restoration project sites. It also hosts an online database of Aquatic Nuisance Species experts. NOAA also supports the West Coast Ballast Outreach Project to educate the maritime industry. NOAA has a leadership role as the co-chair of both the NISC and the Aquatic Nuisance Species Task Force (NOAA 2015).

## Inter-Agency Partnerships

### Invasive Species Council of California

Invasive Species Council of California (ISCC) represents the highest level of leadership and authority in state government regarding invasive species. The ISCC is an inter-agency council created to help coordinate and ensure complementary, cost-efficient, environmentally sound, and effective state activities regarding invasive species. The ISCC was first proposed by the legislature in 2004 in a bill that

was vetoed. It was subsequently established by departmental action on February 10, 2009. The ISCC approved the ISCC By-Laws and CISAC Charter on April 8, 2009.

ISCC is chaired by the Secretary of the CDFA and vice-chaired by the Secretary of the California Natural Resources Agency. Its members also include Secretaries from the California Environmental Protection Agency; California Business, Transportation and Housing Agency; California Health and Human Services Agency; and California Emergency Management Agency.

### California Invasive Species Advisory Committee

California Invasive Species Advisory Committee (CISAC) comprises 24 stakeholder representatives from federal and local agencies, non-governmental organizations (NGOs), industry, and academia. The purpose of the CISAC is to advise the ISCC on a broad array of issues related to preventing the introduction of invasive species and providing for their control and/or eradication, as well as minimizing the economic, ecological, and human health impacts that are caused by invasive species.

### California Agency Aquatic Invasive Species Team

California Agency Aquatic Invasive Species Team (CAAIST) is comprised of members from each state agency and/or department that has identified a lead representative for Aquatic Invasive Species (AIS) work. This team meets regularly to coordinate implementation of the state AIS plan. This team also reports to executive level managers to implement actions in the plan and is led by CDFW's State Invasive Species Coordinator.

### Interagency Quagga/Zebra Mussel Team

Interagency Quagga/Zebra Mussel Team, comprised of federal and state agencies and private partners, has been working together to contain and control quagga and zebra mussels in California since the discovery of quagga mussels in Lake Mead in January 2007 and subsequently in water bodies in southern California.

### California Interagency Noxious and Invasive Plant Committee

California Interagency Noxious and Invasive Plant Committee (CINIPC) is an ad hoc group formed in 2000 to provide coordination between state and federal agencies involved in invasive plant management. The group meets regularly to share updates and has produced a Strategic Blueprint identifying agreed-upon approaches to landscape-level management of invasive plants.

## Non-Governmental Organizations

### California Invasive Plant Council

California Invasive Plant Council (Cal-IPC) is a NGO that serves as a hub for invasive plant management in the state. Cal-IPC brings together partnerships to plan and execute high-priority projects, while providing informational resources and decision-support tools to support the state's land managers (Cal-IPC 2015).

# Invasive Species by Taxonomic Group

Invasive species in California can be categorized into taxonomic groups for plants, insects and terrestrial invertebrates, aquatic and marine invertebrates, and vertebrates (mammals, birds, fish, amphibians, and reptiles). The approaches that various agencies and organizations use to manage invasive species are organized by taxonomic group below.

## Plants

Statewide leadership and coordination on invasive plant management was historically provided by CDFA. However, in 2010 their programs were mostly eliminated due to budget cuts. Restoring CDFA or another agency to provide statewide leadership and coordination has been identified as a major need by CISAC. From the NGO sector, Cal-IPC provides substantial coordination for invasive plant management at the statewide level. CDFA has the statutory authority to regulate noxious weeds. Cal-IPC evaluates and lists invasive plant species based on environmental harm.

At the local level, CACs lead invasive plant management efforts. They are typically the lead agency for the local WMA. They have a mandate to control noxious weeds in partnership with CDFA.
Virtually all land management agencies, from the USFS and its 21 million acres across the state to hundreds of local regional parks, work on invasive plants in one form or another. State Parks and CDFW control invasive plants on their properties to protect habitat value. Caltrans manages invasive plants along roadways. Management of aquatic invasive plants in the Delta is conducted by State Parks' DBW. CDFA is the lead agency for detecting and eradicating hydrilla across the state. As of 2014, the Program has eradicated *Hydrilla* from 25 sites across 15 counties and is currently treating 6 sites in Nevada, Shasta, Yuba, and Lake counties, including sites in Clear Lake. Leadership on invasive aquatic plants in other parts of the state is ad hoc.

## Insects and Terrestrial Invertebrates

The Pest Exclusion Branch of CDFA works to keep exotic agricultural and environmental pests out of the state of California and to prevent or limit the spread of newly discovered pests within the state. CACs work closely with CDFA on monitoring and eradication efforts.

Forest pests are handled by a partnership between the USFS, California Department of Fire and Forestry Protection (CAL FIRE), and CDFA.

## Aquatic and Marine Invertebrates

Several agencies oversee different aspects of invasive invertebrates in the freshwater aquatic and marine environments. CDFW's invasive species program works to control and prevent the spread of aquatic invasive species, such as quagga mussels, zebra mussels, and New Zealand mudsnails (*Potamopygrus antipodarum*). DWR tracks invertebrates such as Asian clams as part of their surveys in the Sacramento-San Joaquin Delta. As described above under the discussion of CDFW and SLC, MISP is

an interagency program based out of SLC that enforces regulations on ballast water discharge by cargo ships.

## Vertebrates

CDFW oversees regulation and management of vertebrate species (mammals, birds, fish, amphibians, reptiles) in California, including invasive species. CDFW removes invasive fish and amphibian species to improve the survival of native species, especially those that are listed as threatened or endangered. State Parks conducts feral pig removal on its lands, as do other land-owning agencies.

## Selected Species Accounts

### Giant Reed

Giant reed (*Arundo donax*) is a grass that lives up to its name by growing as much as 8 meters tall. Giant reed arrived in California in the 1700s, initially planted for erosion control; however, it is now a serious problem along many waterways. Giant reed reduces habitat value along riparian areas for some wildlife species because it greatly changes the structure of the vegetation along waterways. Among these changes, it provides less food for aquatic insects and arthropods than other vegetation types, affecting animals higher up the food web that depend on these insects. Along the Santa Ana River in Ventura County, populations of the endangered least Bell's vireo (*Vireo bellii pusillus*) rebounded after giant reed was removed and replaced with native species. A study examining potential effects of arundo on threatened and endangered wildlife species identified several species on which arundo has moderate to severe negative impacts. Many of these impacts result from the changes to water flow and channel structure. Threatened or endangered species for which giant reed has been identified as a specific negative impact include arroyo toad (*Anaxyrus (= Bufo) californicus*), least Bell's vireo, southwestern willow flycatcher (*Empidonax traillii extimus*), western yellow-billed cuckoo (*Coccyzus americanus occidentalis*), western snowy plover (*Charadrius alexandrinus nivosus*), tidewater goby (*Eucyclogobius newberryi*), unarmored three spine stickleback (*Gasterosteus aculeatus williamsoni*), southern steelhead (*Oncorhynchus mykiss*), Santa Ana sucker (*Catostomus santaanae*).

### Red Brome

The spread of red brome *(Bromus madritensis* ssp. *rubens*) has significantly increased the frequency of fires in the Mojave Desert. This annual was introduced into California in the 1800s and now invades chaparral, woodland, and grassland habitats. Burning and disturbance by livestock grazing or off-highway vehicles can increase red brome. Years of high rainfall result in population explosions and spread. It may spread rapidly and recolonize areas where drought previously caused it to die back. Red brome represents a higher potential fuel load compared to native desert plants. By increasing fires, red brome may promote the conversion of native shrubland to invasive annual grassland, reducing food and habitat for threatened and endangered species such as the desert tortoise (*Gopherus agassizii*) and the greater sage grouse (*Centrocercus urophasianus*).

### Brazilian Elodea

Brazilian elodea (*Egeria densa*), also known as *Egeria*, is a fast-growing shallow-water submerged aquatic plant that infests approximately 12,000 acres of the 50,000 surface acres of the San Joaquin/Sacramento River Delta (Delta). This species is a native of Brazil and Argentina and has invaded much of the United States. *Egeria*'s introduction is believed to have resulted from someone cleaning an aquarium and discarding the plant into the Delta. *Egeria* grows in subsurface mats that can be several feet thick. *Egeria* can obstruct waterways, forcing boaters to stop and clear propellers, or in more extreme cases, prevent passage of vessels. The plant can also impede migration of anadromous and pelagic fish. *Egeria* changes the structure of shallow water ecosystems, forming walls between deepwater and inter-tidal habitat. Impenetrable mats of *Egeria* can force fish such as salmon and Delta smelt (*Hypomesus transpacificus*) into more open waterways, where food resources may be scarce and where fish are more vulnerable to predators. The mats of *Egeria* can also impede water flows, crowd out native plants, entrap sediments, alter the food web by impeding light access, depleting dissolved oxygen, and clog agricultural and municipal water intakes.

### American Bullfrog

American bullfrogs (*Lithobates catesbeianus*) have become widespread throughout California. Bullfrogs are native to the central and eastern United States. American bullfrogs occupy a wide range of both natural and manmade aquatic habitats. American bullfrogs were intentionally introduced into the western United States as a food source and for biological control of insects, and may have been accidentally introduced into some areas during fish stocking. Adult American bullfrogs have voracious appetites and will eat anything they can fit into their mouths, including invertebrates, birds, bats, rodents, frogs, newts, lizards, snakes, and turtles. Bullfrog tadpoles mainly eat algae, aquatic plant material, and invertebrates, but they will also eat the tadpoles of other frog species. As a result of these feeding behaviors, all life stages of bullfrogs prey upon and are able to out-compete native frogs and other aquatic species. Additionally, bullfrogs are a known carrier of chytrid fungus, which causes the potentially fatal skin disease in frogs called chytridiomycosis. Chytridomycosis is believed to be a leading cause of the decline of native amphibian populations all over the world and responsible for the extinction of over 100 species since the 1970s.

### New Zealand Mudsnails

As their name implies, these mudsnails (*Potamopyrgus antipodarum*) are native to the rivers and lakes of New Zealand. In California, they are found in many lakes and river systems. New Zealand mudsnails are found on a wide variety of substrates and vegetation in fresh and brackish lakes, rivers, streams, and estuaries. They are tolerant of turbidity, siltation, increased salinity, poor water quality, cold temperatures, and short-term desiccation. It is believed that mudsnails were introduced to western rivers through shipments of live gamefish, but subsequent spread is likely due to recreational activities. Dense populations become the dominant macroinvertebrate through displacing and outcompeting native species. They may consume up to half of the food resources in a stream and have been linked to reduced populations of aquatic insects, including mayflies, caddisflies, chironomids, and other insects important to trout and salmon. High-density New Zealand mudsnail populations are likely to cause substantial negative impacts on fisheries by replacing preferred, nutritious foods.

### Quagga and Zebra Mussels

Quagga and zebra (*Dreissenid*) mussels are typically the same size as a fingernail but can grow up to about 2 inches long. They attach to aquatic plants, boats, motors, trailers, and recreation equipment or can be present in water (in addition to substrates, docks, piers, anchors, etc). Both species arrived to the Great Lakes in ballast water discharge from ships from Europe in the late 1980s. They have spread throughout the U.S. primarily through human-related activities, such as on trailered boats, transported in bilges, live wells, motors, or on any fishing, boating, other equipment or wet surfaces, and pet fur. In California, quagga mussels have been found in Orange, Riverside, San Diego, San Bernardino, and Ventura counties while zebra mussels have been found in San Benito County, according to CDFW data. Spread of the mussels threatens water delivery systems, hydroelectric facilities, agriculture, recreational boating and fishing, and fresh water ecosystems. They will ruin beaches with razor sharp foul smelling shells. California could spend hundreds of millions of dollars protecting the state's water system from infestations.

### Brown-headed Cowbird

In California, brown-headed cowbirds (*Molothrus ater*) are a common resident and summer visitor that breed throughout much of the state. Brown-headed cowbirds are native to the Great Plains region of the United States and prefer open habitats interspersed with shrubs or trees and that provide ample forage and host nests. Brown-headed cowbirds originally evolved in a symbiotic relationship with herds of grazing animals, moving throughout the Great Plains region with herds as they kicked up insects for easy foraging. Brown-headed cowbirds parasitize the nests of more than 220 bird species, meaning they lay their eggs solely in other species' nests. They often remove the egg(s) of the host bird. Brown-headed cowbird chicks usually hatch sooner, are larger, and develop faster than the host chicks. Their larger size and persistent behavior gains them more care from the host parents. Nest parasitism lowers the reproductive success of host birds and has led to population declines in several bird species. In California, the riparian songbirds least Bell's vireo (*Vireo bellii pusillus*) and willow flycatcher (*Empidonax traillii*) are listed as endangered due to loss of riparian habitat and nest parasitism by brown-headed cowbirds.

### Feral pigs

Pigs (*Sus scrofa*) are native to Eurasia and northern Africa. In the early 1700s Spanish and Russian settlers introduced domestic pigs to California as livestock and, over time, many became feral. In the 1920s, a Monterey county landowner introduced the European wild boar, a wild subspecies of *Sus scrofa* into California, which bred with the domestic pigs. The result of these introductions is a wild boar/feral domestic pig hybrid. Wild pigs currently exist in 56 of the state's 58 counties and can be found in a variety of habitats ranging from woodland, chaparral, meadow and grasslands. Pigs disturb natural plant communities, opening up space for invasive plants. They also compete with wildlife for food and carry diseases that can infect native wildlife.

The full list of objectives and tasks from NISC is below in Table F-1. Table F-2 provides the objectives and implementation tasks from the National Invasive Species Management Plan.

**Table F-1 SWAP Conservation Strategies and Actions Listed by National Invasive Species Management Plan Objectives**

| NISC Objectives and Tasks | SWAP Province |
|---|---|
| **PREVENTION** | |
| Objective P.2: Prevent establishment of unintentionally introduced invasive species introduced through high risk pathways. | |
| Advocate for post-burn weed control. | South Coast |
| Coordinate with Caltrans and county transportation agencies. | Bay Delta – Central Coast |
| Objective P.3: Improve the international, federal, state, and tribal standards and guidelines to protect the united states from invasive species. | |
| Conduct research focused on informing the development of Best Management Practices (BMPs) for invasive species. | Central Valley – Sierra Nevada |
| Advocate BMPs for grazing practices. | Central Valley – Sierra Nevada |
| Reduce impacts to native fish as a result of roads and railroads and invasive species through development and use of BMPs. | Deserts |
| **EARLY DETECTION AND RAPID RESPONSE** | |
| Objective EDRR.1: Enhance current monitoring efforts for early detection. | |
| Conduct assessment of the distribution and type of invasive species. | Central Valley – Sierra Nevada |
| Conduct assessment/map invasive species occurrence by watershed. | Bay Delta – Central Coast |
| Create early detection rapid response program for new occurrences of invasive species. | Marine |
| Prioritize early detection of invasive species. | Klamath-North Coast |
| Provide education and outreach, with the following objectives: private landowners have increased knowledge in the identification and management of invasive species; …public is participating in monitoring invasive species and rapid response. | Central Valley – Sierra Nevada |
| **CONTROL AND MANAGEMENT** | |
| Objective CM.2: Reduce the spread and harm caused by invasive species. | |
| Manage invasive species; control invasive and problematic native vegetation (introduced from roads, pack animals, livestock feed), control invasive fish and wildlife (livestock, pack animals, non-native fish), and prevent wet meadow habitat degradation. | Central Valley – Sierra Nevada |
| Coordinate with land management agencies to reduce spread of invasive grasses such as cheat-grass and medusa head. | Cascades-Modoc Plateau |
| Develop partnerships with agencies and non-governmental organizations (NGOs). | Bay Delta – Central Coast |
| Collaborate with existing agencies or groups involved with invasive species monitoring and treatment. | Bay Delta – Central Coast |
| Implement integrated resource management, with focus on coordination and integration of ongoing management activities (e.g., grazing BMPs, invasive species, water management, land use), and enhancing working landscapes to benefit fish and wildlife. | Bay Delta – Central Coast |
| Develop Invasive Coordination Group to streamline and coordinate current agencies, organizations, activities. | South Coast |
| Maintain partnerships through the Bi-state Action Plan, BLM, USFS, NPS, and USGS to help coordinate data collection and implement management plan. | Deserts |

NISC objectives are in shaded rows with the relevant SWAP actions below them.

**Table F-1 SWAP Conservation Strategies and Actions Listed by National Invasive Species Management Plan Objectives**

| NISC Objectives and Tasks | SWAP Province |
|---|---|
| Establish joint partnerships with desert land managers, particularly to manage invasive species on conserved lands. | Deserts |
| Manage invasive species. | all |
| Objective CM.3: Develop workforce competencies to perform control and management activities. | |
| Provide training to staff and managers on non-native genetic issues, invasive species management and control techniques, and fish identification. | Central Valley – Sierra Nevada |
| Provide criteria on how to conduct eradication and/or control measures for invasive species | Marine |
| Design and conduct training for local CDFW staff, other agencies, NGOs, and consultants. | Deserts |
| RESTORATION | |
| Objective R.2: Restore high-value areas impacted by invasive species. | |
| Set priorities for treatment of invasive species | Cascades-Modoc Plateau |
| Identify highest priority areas for restoration and rehabilitation to protect from annual grass or weed invasion. | Cascades-Modoc Plateau |
| Develop plan to prioritize/control invasive species. | Bay Delta – Central Coast |
| Identify highest priority areas for restoration and rehabilitation to manage and protect from annual grass and weed invasion. | Deserts |
| Restore and protect priority areas: identify highest priority areas for restoration, rehabilitation, and protection from fire, invasive species, or wild burros. | Deserts |
| (For implementation of HCPs) - Prioritize plant communities requiring invasive weed treatment or restoration from OHV or grazing impacts. | Deserts |
| Manage invasive species, with focus on controlling or eradicating them in grassland habitats in the Central California Coast Ecoregion. | Bay Delta – Central Coast |
| ORGANIZATIONAL COLLABORATION | |
| Objective OC.6: Enhance outreach on invasive species. | |
| Provide education and outreach by educating the public on the development, status and need for BMPs and about invasive species. | Cascades-Modoc Plateau |
| Provide outreach and education: raise public awareness and support for native fish restoration projects, and educate the public on the risks of invasive species and the importance of aquatic biodiversity management plans. | Central Valley – Sierra Nevada |
| 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. | South Coast |
| Develop and implement an outreach program on the impacts of invasive species. | Deserts |
| Objective OC.8: Enhance data standards and quality to improve access and ability to search across data bases and federal data sources. | |
| Increase content within, and accessibility to, the CDFW invasive species database. | Marine |

Source: NISC 2008.

NISC objectives are in shaded rows with the relevant SWAP actions below them.

| Table F-2 Objectives and Implementation Tasks from the National Invasive Species Management Plan |
|---|
| **PREVENTION** |
| Objective P.1: Prevent establishment of intentionally introduced invasive species. |
| P.1.1: Develop screening processes to evaluate invasiveness of plants which are intended for planting and are moving in trade. |
| P.1.2: Develop screening processes to evaluate invasiveness of terrestrial and aquatic nonnative wildlife (e.g., fish, mollusks, crustaceans, mammals, birds, reptiles and amphibians) moving in trade. |
| P.1.3: Develop a process to identify high-priority invasive plants, animals, and plant or animal pathogens for agencies' actions. |
| Objective P.2: Prevent establishment of unintentionally introduced invasive species introduced through high risk pathways. |
| P.2.1: Reduce the movement of invasive plants pests and pathogens with propagative plant material. |
| P.2.2: Sponsor research on new technologies for ballast water management and formally assess their efficacy. Sponsor research on other ship-based pathways, assessing their impacts to the environment. |
| P.2.3: Support efforts in new techniques or practices to reduce the spread of aquatic invasive species through recreational activities. |
| P.2.4: Reduce movement of invasive species on or in Solid Wood Packing Materials (SWPM). |
| Objective P.3: Improve the international, federal, state, and tribal standards and guidelines to protect the United States from invasive species. |
| P.3.1: Strengthen and/or support the development of risk-based sanitary and phytosanitary international standards and guidelines under IPPC, Office International des Epizooties (OIE), North American Plant Protection Organization (NAPPO) and other international flora. |
| P.3.2: Improve and expand domestic and international risk analysis processes. Include new risk methodologies and scientific advances in understanding invasive species. Expand the scope of conducting risk assessments to include all nonnative terrestrial and aquatic organisms moved as a result of human activity or action. |
| P.3.3: Design a process to identify and rank pathways by invasive species risk. Encourage agencies to modify and incorporate the process into their own regulatory and nonregulatory programs. |
| P. 3.4: Integrate agency data sets to improve assessment of invasive species threats prior to arrival. |
| P.3.5: Support efforts by non-federal stakeholders to develop/enhance codes of conduct and Best Management Practices (BMPs). |
| P.3.6: Share BMPs among NISC members to prevent or mitigate invasive species establishment or movement. |
| **EARLY DETECTION AND RAPID RESPONSE** |
| Objective EDRR.1: Enhance current monitoring efforts for early detection. |
| EDRR.1.1: Identify and evaluate monitoring efforts for high-priority invasive species and supporting technological infrastructure including an evaluation of their geographic and temporal coverage. |
| EDRR.1.2: Prepare protocols to identify high priority locations for targeted monitoring efforts. Initiate three systematic monitoring pilot programs. |
| EDRR.1.3: Improve and support recruitment and training of volunteers for EDRR efforts at the local level, utilizing existing programs and infrastructure (such as Master Gardeners, Master Naturalists, Cooperative Extension, Sea Grant, National Wildlife Refuge "Friends" Groups, 4-H Groups, National Park support groups, and others). |
| EDRR.1.4: Enhance plant and animal pathogen detection methods. |
| Objective EDRR.2: Make taxonomic information more readily available to governments and the public. |
| EDRR.2.1: Develop or enhance taxonomic expert lists to facilitate identification of terrestrial and aquatic organisms. |
| Objective EDRR.3: Develop and enhance capacity and tools to support EDRR efforts. |
| EDRR.3.1: Prepare protocols to evaluate and map invasive species risks. |
| EDRR.3.2: Engage risk assessment experts to provide authoritative and timely assessments of current or potential invasions. |
| EDRR.3.3: Develop and evaluate the use of predictive models to forecast the spread of specific invasive species. |
| Objective EDRR.4: Enhance existing capability to conduct planning for EDRR. |
| EDRR.4.1: Prepare model guidance or plans that encourage RR contingency planning at the appropriate level (such as, international, national, state, regional or local). Include planning for communications, response funding, cooperative mechanisms and other relevant issues. |

NISC objectives are in shaded rows with the relevant SWAP actions below them.

| Table F-2 Objectives and Implementation Tasks from the National Invasive Species Management Plan |
|---|
| Objective EDRR.5: Develop options paper to fund rapid response efforts. |
| EDRR.5.1: Work with ISAC, states and others to develop mechanisms for cooperation and funding rapid response efforts, such as options for matching grants to states.<br>EDRR.5.2: Explore options for research funding for preparedness and other programs that are required for RR. |
| **CONTROL AND MANAGEMENT** |
| Objective CM.1: Evaluate control and management capabilities and identify strategic gaps. |
| CM.1.1: Identify and evaluate regional invasive species control and management efforts.<br>CM.1.2: Identify and address strategic gaps in regional invasive species control and management efforts and tools. |
| Objective CM.2: Reduce the spread and harm caused by invasive species. |
| CM.2.1: Reduce the spread of invasive species. |
| CM. 2.2: Support on-the-ground control and management efforts |
| Objective CM.3: Develop workforce competencies to perform control and management activities. |
| CM. 3.1: Increase invasive species training for land and water resource managers, and others as appropriate. |
| Objective CM.4: Enhance ecosystem recovery processes that contribute to control and management. |
| CM.4.1: Enhance ecosystem recovery decision tools and conduct ecosystem assessments. |
| **RESTORATION** |
| Objective R.1: Include invasive species considerations in formal guidance for restoration projects. |
| R.1.1: Address invasive species concerns in planning for restoration projects in federal land and water management field and guidance manuals. |
| Objective R.2: Restore high-value areas impacted by invasive species. |
| R.2.1: Restore sites that have the highest ecological or economic value or contribute most to protecting human health. |
| Objective R.3: Restore habitat at multiple scales and demonstrate model approaches that engage local communities and the public. |
| R.3.1: Coordinate multi-taxa restoration projects at the regional, watershed or landscape level (Healthy Lands Initiative, for example), addressing water quality, fisheries (both fresh and marine), and terrestrial plants and animals (including their pests and pathogens) in restoration planning. |
| **ORGANIZATIONAL COLLABORATION** |
| Objective OC.1: Improve knowledge and understanding of legal and regulatory tools available to address invasive species. |
| OC.1.1: Complete an analysis of current federal laws and regulations dealing with invasive species. |
| OC.1.2: Provide information and briefings as requested on invasive species issues. |
| Objective OC.2: Expand the coordination of invasive species programs and expenditures to leverage resources. |
| OC.2.1: Update the invasive species crosscut budget for Federal agency expenditures concerning invasive species. |
| Objective OC.3: Improve federal research capacity and coordination to address a broader array of invasive species issues. |
| OC.3.1: Improve the coordination and effectiveness of federal research. |
| OC.3.2: Improve economic modeling of invasive species impacts. |
| Objective OC.4: Enhance policy and improve regulatory processes on invasive species. |
| OC.4.1: As required by EO 13112, prepare, in cooperation with the President's Council on Environmental Quality (CEQ), guidance to federal agencies to prevent and control invasive species that is fully compliant with the National Environmental Policy Act (NEPA). |
| OC.4.2: Collect, organize and make available federal agency guidance to prevent, control and manage invasive species. |
| OC.4.3: Develop an improved regulatory process for the development, testing, assessment and approval of biological control agents. |

NISC objectives are in shaded rows with the relevant SWAP actions below them.

| Table F-2 Objectives and Implementation Tasks from the National Invasive Species Management Plan |
|---|
| Objective OC.5: Strengthen coordination among federal agencies to facilitate the development of international priorities for invasive species. |
| OC.5.1: Promote and facilitate communication on international invasive species issues and activities. |
| OC.5.2: Represent NISC interests in the formulation of United States policy positions related to invasive species in the context of discussions under relevant international organizations and agreements. |
| OC.5.3: As appropriate, seek to incorporate invasive species issues into the environmental cooperation mechanisms developed in connection with free trade agreements (FTA). |
| Objective OC.6: Enhance outreach on invasive species. |
| OC.6.1: Determine approaches regarding invasive species pathways for strategic outreach to targeted user groups and businesses. |
| OC.6.2: Work with existing educational organizations to enhance invasive species information delivery to primary and secondary educators. |
| OC.6.3: Develop basic messages for common public awareness concerning invasive species for NISC member agencies and staff to utilize. |
| Objective OC.7: Improve and streamline NISC members' reporting on invasive species programs and activities. |
| OC.7.1: Require performance reports from NISC members. |
| Objective OC.8: Enhance data standards and quality to improve access and ability to search across data bases and federal data sources. |
| OC.8.1: Develop and provide portal and reference information, as well as public access to federal research information, as appropriate and consistent with applicable law. |
| OC.8.2: Work cooperatively to develop common data standards and enhance databases. |

Source: NISC 2008.

NISC objectives are in shaded rows with the relevant SWAP actions below them.

Table F-3 lists recommended actions from the ISCC Strategic Framework (shaded boxes) followed by SWAP conservation actions and strategies that fulfill those recommendations (ISCC 2011). Many provinces included more general actions such as managing invasive species, conducting outreach, or coordinating with the California Invasive Plant Council, that are important but that do not fit neatly within ISCC actions. Other actions, such as restoring important habitat, may address invasive species indirectly. Each SWAP action is listed only once in the table.

**Table F-3 SWAP Conservation Strategies and Actions by ISCC Strategic Framework Recommended Actions**

| ISCC Strategic Framework Recommended Action | SWAP Province |
|---|---|
| **LEADERSHIP AND COORDINATION** | |
| LC-1. Secure adequate long-term funding to sustain effective invasive species programs. | |
| Develop invasive plant tax. | South Coast |
| **PREVENTION AND EXCLUSION** | |
| PE-1. Identify and address new and existing pathways for entry and movement of invasive species. | |
| Manage invasive species; control invasive and problematic native vegetation (introduced from roads, pack animals, livestock feed), control invasive fish and wildlife (livestock, pack animals, non-native fish), and prevent wet meadow habitat degradation. | Central Valley – Sierra Nevada |
| Advocate for post-burn weed control. | South Coast |
| PE-2. Increase interagency communication to ensure coordinated prevention approaches. | |
| Coordinate with National Resources Conservation Service (NRCS), other agencies. | Central Valley – Sierra Nevada |
| PE-4. Develop and Implement Best Management Practices (BMPs) to prevent invasive species spread. | |
| Conduct research focused on informing the development of Best Management Practices (BMPs) for invasive species. | Central Valley – Sierra Nevada |
| Advocate BMPs for grazing practices. | Central Valley – Sierra Nevada |
| Reduce impacts to native fish as a result of roads and railroads and invasive species through development and use of BMPs. | Deserts |
| PE-7. Maintain a list of invasive species that harm or could harm California. | |
| Increase content within, and accessibility to, the CDFW invasive species database. | Marine |
| **DETECTION AND RESPONSE** | |
| DR-3. Align regulatory processes to facilitate rapid response and eradication of newly discovered invasive species. | |
| Streamline regulatory process for CDFW staff and other entities to implement control and eradication work | Marine |
| DR-4. Expand invasive species surveillance efforts, integrating new tools in risk assessment to set priorities. | |
| Prioritize early detection of invasive species. | Klamath-North Coast |
| DR-6. Train key individuals and organizations to detect new invasive species. | |
| Create early detection rapid response program for new occurrences of invasive species. | Marine |
| **ERADICATION AND MANAGEMENT** | |
| Develop strategy for removal of brook trout from Pine Creek. | Cascades-Modoc Plateau |
| Manage invasive species: control or eradicate invasive species on 1,000 acres of public lands by watershed. | Bay Delta – Central Coast |

**Table F-3 SWAP Conservation Strategies and Actions by ISCC Strategic Framework Recommended Actions**

| ISCC Strategic Framework Recommended Action | SWAP Province |
|---|---|
| Manage invasive species, with focus on controlling or eradicating them in grassland habitats in the Central California Coast Ecoregion. | Bay Delta – Central Coast |
| EM-2. Support regional collaborations and public-private partnerships. | |
| Coordinate with land management agencies to reduce spread of invasive grasses such as cheat-grass and medusa head. | Cascades-Modoc Plateau |
| Develop partnerships with agencies and non-governmental organizations (NGOs). | Bay Delta – Central Coast |
| Collaborate with existing agencies or groups involved with invasive species monitoring and treatment. | Bay Delta – Central Coast |
| Develop Invasive Coordination Group to streamline and coordinate current agencies, organizations, activities. | South Coast |
| Maintain partnerships through the Bi-state Action Plan, BLM, USFS, NPS, and USGS to help coordinate data collection and implement management plan. | Deserts |
| Establish joint partnerships with desert land managers, particularly to manage invasive species on conserved lands. | Deserts |
| EM-6. Establish standardized mapping and reporting protocols. | |
| Conduct assessment of the distribution and type of invasive species. | Central Valley – Sierra Nevada |
| Conduct assessment/map invasive species occurrence by watershed. | Bay Delta – Central Coast |
| EM-8. Minimize invasive plant spread along roadsides and utility corridors. | |
| Coordinate with Caltrans and county transportation agencies. | Bay Delta – Central Coast |
| EM-9. Develop and implement prioritization models for managing invasive species. | |
| Set priorities for treatment of invasive species | Cascades-Modoc Plateau |
| Identify highest priority areas for restoration and rehabilitation to protect from annual grass or weed invasion. | Cascades-Modoc Plateau |
| Develop plan to prioritize/control invasive species. | Bay Delta – Central Coast |
| Identify highest priority areas for restoration and rehabilitation to manage and protect from annual grass and weed invasion. | Deserts |
| Restore and protect priority areas: identify highest priority areas for restoration, rehabilitation, and protection from fire, invasive species, or wild burros. | Deserts |
| (For implementation of HCPs) - Prioritize plant communities requiring invasive weed treatment or restoration from OHV or grazing impacts. | Deserts |
| Coordinate with California Invasive Plant Council. | Klamath-North Coast, Bay Delta – Central Coast, South Coast, Deserts |
| EM-10. Expand training programs for using Integrated Pest Management (IPM) principles and Best Management Practices (BMPs). | |
| Provide training on invasive species management (for local CDFW staff and NGOs). | Klamath-North Coast |
| Provide education and outreach, with the following objectives: private landowners have increased knowledge in the identification and management of invasive species; …public is participating in monitoring invasive species and rapid response. | Central Valley – Sierra Nevada |
| Implement integrated resource management, with focus on coordination and integration of ongoing management activities (e.g., grazing BMPs, invasive species, water management, land use), and enhancing working landscapes to benefit fish and wildlife. | Bay Delta – Central Coast |
| Provide training to staff and managers on non-native genetic issues, invasive species management and control techniques, and fish identification. | Central Valley – Sierra Nevada |

| Table F-3 SWAP Conservation Strategies and Actions by ISCC Strategic Framework Recommended Actions | |
|---|---|
| **ISCC Strategic Framework Recommended Action** | **SWAP Province** |
| Design and conduct training for local CDFW staff, other agencies, NGOs, and consultants. | Deserts |
| Provide criteria on how to conduct eradication and/or control measures for invasive species. | Marine |
| **OUTREACH AND PUBLIC ENGAGEMENT** | |
| OPE-1. Develop and deliver a consistent outreach message based on stewardship. | |
| Provide outreach and education. | Klamath-North Coast |
| Provide education and outreach by educating the public on the development, status and need for BMPs and about invasive species. | Cascades-Modoc Plateau |
| Provide outreach and education: raise public awareness and support for native fish restoration projects, and educate the public on the risks of invasive species and the importance of aquatic biodiversity management plans. | Central Valley – Sierra Nevada |
| 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. | South Coast |
| Develop and implement an outreach program on the impacts of invasive species. | Deserts |

Source: ISCC 2011.

Table F-4 lists recommended actions from *Stopping the Spread*, the strategic framework for protecting California from invasive species (ISCC 2011).

| Table F-4 Recommended actions from *Stopping the Spread*. |
|---|
| **LEADERSHIP AND COORDINATION** |
| LC-1. Secure adequate long-term funding to sustain effective invasive species programs. |
| LC-2. Share responsibility for invasive species outreach more equally among ISCC agencies. |
| LC-3. Formalize the ISCC and CISAC for longterm stability. |
| LC-4. Review California laws and regulations affecting invasive species response. |
| LC-5. Build a strong coalition of stakeholder groups. |
| LC-6. Create an online clearinghouse for information on invasive species programs, laws, and research. |
| LC-7. Create a working group to review public health risks of invasive species and their management. |
| **PREVENTION AND EXCLUSION** |
| PE-1. Identify and address new and existing pathways for entry and movement of invasive species. |
| PE-2. Increase interagency communication to ensure coordinated prevention approaches. |
| PE-3. Support uninterrupted high-risk inspection activities. |
| PE-4. Develop and Implement Best Management Practices (BMPs) to prevent invasive species spread. |
| PE-5. Partner with import industries to improve preventive screening. |
| PE-6. Encourage individual actions to prevent entry of invasive species. |
| PE-7. Maintain a list of invasive species that harm or could harm California. |
| PE-8. Strengthen California's restrictions on live non-agricultural animal imports. |
| PE-9. Adopt strong guidelines for biofuel production. |
| PE-10. Include invasive species prevention in California Environmental Quality Act (CEQA) compliance. |

**Table F-4 Recommended actions from *Stopping the Spread*.**

| |
|---|
| **DETECTION AND RESPONSE** |
| DR-1. Create a standing Rapid Response Working Group to guide response to new invasive species, supported by a Rapid Response emergency fund. |
| DR-2. Complete a Program Environmental Impact Report (PEIR) for response to new invasive species. |
| DR-3. Align regulatory processes to facilitate rapid response and eradication of newly discovered invasive species. |
| DR-4. Expand invasive species surveillance efforts, integrating new tools in risk assessment to set priorities. |
| DR-5. Formalize a standard rapid response plan. |
| DR-6. Train key individuals and organizations to detect new invasive species. |
| DR-7. Continue to train staff for rapid response. |
| **ERADICATION AND MANAGEMENT** |
| EM-1. Expand biological control efforts. |
| EM-2. Support regional collaborations and public-private partnerships. |
| EM-3. Increase the number of field biologists working on invasive species. |
| EM-4. Increase on-the-ground workforce and job training for invasive species management. |
| EM-5. Develop more effective management tools and restoration techniques. |
| EM-6. Establish standardized mapping and reporting protocols. |
| EM-7. Strengthen the state's invasive plant listing process and rating systems. |
| EM-8. Minimize invasive plant spread along roadsides and utility corridors. |
| EM-9. Develop and implement prioritization models for managing invasive species. |
| EM-10. Expand training programs for using Integrated Pest Management (IPM) principles and Best Management Practices (BMPs). |
| **OUTREACH AND PUBLIC ENGAGEMENT** |
| OPE-1. Develop and deliver a consistent outreach message based on stewardship. |
| OPE-2. Provide clear public health information for invasive species management. |
| OPE-3. Support inclusion of invasive species in environmental education curricula. |
| OPE-4. Establish activities to engage public participation. |
| OPE-5. Evaluate effectiveness of outreach and public engagement techniques. |
| OPE-6. Facilitate effective participation by volunteer groups. |
| **FUNDAMENTAL AND APPLIED RESEARCH** |
| FAR-1. Assess the ecological, agricultural and economic impacts of invasive species in California. |
| FAR-2. Study the biology of invasive species to support effective management. |
| FAR-3. Study restoration outcomes. |
| FAR-4. Study interactions of native species and invasive species. |
| FAR-5. Address invasive species in relation to climate change and other high-visibility issues. |
| FAR-6. Research new invasive species control methods and expedite the assessment of existing methods. |

Source: ISCC 2011.

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