Marine Invasive Species in San Francisco Bay

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The Marine Invasive Species Program analyzes and inventories nonindigenous species (NIS) invasions in marine and estuarine waters of California. Through a multi-agency effort, we maintain an inventory of NIS in open coast, bays and estuaries, and monitor for new introductions and spread of existing NIS, and assess the effectiveness of ballast water controls. This poster will 1) describe the our monitoring program and results, 2) discuss NIS trends in the San Francisco Bay, and 3) highlight enhancements to our database.

Keywords: Marine, Invasive, Non-Indigenous, Species, California, San Francisco Bay, Spread

Poster Cluster: Aquatic Invasive Species Activities in California/Bay-Delta: Threats, Prevention, and New Invaders

Decreasing the Risk of Aquatic Species Invasion from Vessels Arriving at Bay-Delta Ports

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Nonindigenous species (NIS) are organisms that pose significant threats to human health, the economy, and the environment. NIS are intentionally or unintentionally transported through human activities to new habitats such as California's marine, estuarine, and freshwater environments. Once an NIS is moved, established in a new geographic location, and has impacts, it is considered an invasive species. The California State Lands Commission's Marine Invasive Species Program (MISP) strives to reduce the risk of aquatic nonindigenous species introduction into California's waters. This poster provides an overview of the structure and activities of the Marine Invasive Species Program, examines the risk vessels pose for introducing invasive species, and presents data on the MISP's efforts to reduce the risk of vessel-mediated introductions.

Keywords: Invasive, Species, Marine, Aquatic, Nonindigenous, California, prevention, risk, introductions, organism

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Invasive Watersnake Poses Threat to California Native Species

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Watersnakes of the genus *Nerodia* are native to North America east of the Rocky Mountains. Two species of watersnakes, *N. sipedon* and *N. fasciata*, have established populations in California including the Sacramento River watershed south of Sacramento, a constructed marsh in Folsom, and near Lake Natoma, a reservoir along the American River. A study identifying areas climatically suitable for *N. sipedon* and *N. fasciata* showed that large parts of western North America have habitat capable of supporting the two watersnake species and identified several species of fish, amphibians, and gartersnakes that could be at risk from their presents. For these reasons, it is important to understand the distribution, ecology, and potential for controlling populations of *N. sipedon* and *N. fasciata*. A coalition of biologists is working together to foster partnerships and build capacity to address issues surrounding the management, eradication, or control of *Nerodia* populations in western states. Group efforts included research to assess the status and ecology of *N. fasciata* and the feasibility of eradication. Results provided a better understanding of the potential impacts of *N. fasciata* in an urban habitat and sampling methods to detect incipient populations before high population densities are achieved. Environmental DNA (eDNA) provides a promising new method for the detection and monitoring of invasive species. Molecular tools may provide a cost-effective tool for detecting watersnake populations at low densities. If incipient populations are detected, intensive rapid-response efforts might allow local eradication. Research to integrate Nerodia eDNA sampling with occupancy modeling, a statistical framework that quantifies the probability of detection for a given sampling method using a repeated survey design, is near completion. This poster summarizes the current status of populations, reasons for concern, and details accomplishments and current efforts to develop future management strategies.

Keywords: Watersnakes, invasive, *Nerodia*, *sipedon*, *fasciata*, eDNA, eradication

Poster Cluster: Aquatic Invasive Species Activities in California/Bay-Delta: Threats, Prevention, and New Invaders

Invasive Watersnakes (*Nerodia spp.)* in California: Monitoring, Detections, and Eradication

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Watersnakes of the genus *Nerodia* are native to the eastern U.S., but through the pet trade and subsequent owner releases have been introduced to and established in environments far beyond their native range. *Nerodia* are highly aquatic, non-venomous snakes that primarily prey upon amphibians and fishes. In 1992, a population of *N. fasciata pictiventris* was discovered within a constructed marsh and adjacent watershed in Folsom (Sacramento County). In 2007, a population of *N. sipedon* was discovered in a freshwater wetland in Roseville (Placer County). A 2014 observation of *N. sipedon* 3.5 km north of the known *N. sipedon* population suggests the progressing drought and diminishing habitat may be driving dispersal of individuals in search of aquatic habitat and resources. The establishment and spread of *Nerodia* in California is of particular concern given their proximity to a number of special status prey species, and inherent ecological overlap with the state/federally threatened giant gartersnake (*Thamnophis gigas*). For the conservation of native species and their habitats, in 2015 the California Department of Fish and Wildlife, in collaboration with UC-Davis and the Nerodia Working Group, initiated a project to eradicate the *N. sipedon* population from Roseville. In 2016, the on-going eradication efforts were broadened to the *N. f. pictiventris* population in Folsom and survey efforts will commence at reported detection sites within the Sacramento-San Joaquin Delta. Up-to-date results and implications will be reported.

Keywords: Invasive, watersnake, gartersnake, predator, competition, pet release, conservation, amphibians, fish

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Assessing Invasiveness of Aquatic Plants to Facilitate Management in the Sacramento-San Joaquin Delta

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The California State Parks' Division of Boating and Waterways (Division) is the lead agency of the state for the purpose of cooperating with other state, local, and federal agencies in identifying, detecting, controlling, and administering programs to manage, control, and when feasible, eradicate invasive aquatic plants in the Sacramento-San Joaquin Delta (Delta), its tributaries, and the Suisun Marsh. However, until 2015, the Division was authorized to treat only 3 aquatic plant species, *Egeria densa*, *Eichhornia crassipes*, and *Limnobium laevigatum*, and each required individual legislation to do so. Recent legislative action (AB763; 2013) reformed the approach for granting the Division the authority to treat additional invasive aquatic plant species, now requiring that the California Department of Fish and Wildlife (CDFW), in consultation with partner agencies, conduct a risk assessment determining whether the aquatic plant is to be considered invasive. CDFW utilizes the U.S. Aquatic Weed Risk Assessment tool to assess the species' ecology, reproductive potential, dispersal mechanisms, competitive ability, actual and potential impacts (including impacts to navigation and recreation, the environment, economy, and human health as specified in Harbors and Navigation Code (HNC) §64.5), and resistance to management. To date, CDFW has conducted assessments of five aquatic plant species: *Potamogeton crispus*, *Myriophyllum spicatum*, *Ludwigia* spp., *Ceratophyllum demersum*, and *Cabomba caroliniana*. Each species was determined to be an invasive aquatic plant, per the definition provided in HNC, and authorized for treatment within the Delta. Assessment accuracy, questions, scores, and findings will be incorporated.

Keywords: weed risk assessment, invasive plants, aquatic weeds, herbicides

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