State of California

GOLDEN MUSSEL RESPONSE FRAMEWORK

California Department of Fish and Wildlife
California State Parks
California Department of Water Resources
California State Lands Commission
California Department of Food and Agriculture
California State Water Resources Control Board
United States Bureau of Reclamation
United States Fish and Wildlife Service

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Acronyms

AB	Assembly Bill
Caltrans	California Department of Transportation
CCR	California Code of Regulations
CDFA	California Department of Food and Agriculture
CDFW	California Department of Fish and Wildlife
CPLM	cross-polarized light microscopy
CSLC	California State Lands Commission
CVP	Central Valley Project
DNA	deoxyribonucleic acid
eDNA	environmental deoxyribonucleic acid
DBW	(State Parks) Division of Boating and Waterways
DWR	(California) Department of Water Resources
FAQ	frequently asked questions
FAC	(California) Food and Agriculture Code
FGC	(California) Fish and Game Code
GMTF	Golden Mussel Task Force
HNC	(California) Harbors and Navigation Code
MWD	Metropolitan Water District of Southern California
PCR	Polymerase chain reaction
PSA	public service announcement
qPCR	quantitative polymerase chain reaction
QZMP	CDFW Quagga/Zebra Mussel Program
SWP	State Water Project
SWRCB	(California) State Water Resources Control Board
USFWS	United States Fish and Wildlife Service
USBR	United States Bureau of Reclamation
USGS	United States Geological Survey
VEH	California Vehicle Code

PURPOSE

This Golden Mussel Response Framework (Framework) was developed to provide recommendations to state and local policy makers, managers, and the public on how to respond to the recent detections of golden mussel through a common framework across agencies and jurisdictions. In many instances the recommendations are intended to provide options, with some applying more to a statewide response, while others may be more appropriate on a local scale. Some of the recommendations are already being implemented, while others may need additional effort, legal authority, and resources to fully implement.

RESPONSE FRAMEWORK GOAL

It is the goal of the State of California to prevent further introductions and spread of golden mussel within the state, contain mussels within currently infested waters, and suppress mussel populations within infested waters to minimize impacts to the environment, economy, infrastructure, and human health.

BACKGROUND

Golden mussel (*Limnoperna fortunei*), an invasive, non-native freshwater/brackish water bivalve, was discovered in the Sacramento-San Joaquin Delta (Delta) in October 2024. This discovery is the first known occurrence of golden mussel in North America and was likely introduced to California by a ship traveling from an international port.

Golden mussel is native to rivers and creeks of China, Thailand, Korea, Laos, Vietnam, Indonesia, and Cambodia. They are known to be established outside of their native range in other Asian countries including Hong Kong, Taiwan, Japan, and South American countries including Argentina, Bolivia, Brazil, Paraguay, and Uruguay. Within the invaded range significant impacts are documented resulting from the dense colonization (biofouling) of golden mussel on hard surfaces. Heavy encrustations have blocked municipal and industrial water intakes, necessitated ongoing biofouling removal, altered species assemblages, and diminished water quality.

Golden mussel poses a significant immediate threat to the natural ecosystems, water conveyance systems, infrastructure, agriculture, economy, and water quality throughout California and across the United States (US). Golden mussel is similar in appearance, biology, and impacts to quagga (*Dreissena bugensis*) and zebra (*Dreissena polymorpha*) mussels (collectively termed “dreissenid” mussels). Golden mussel can establish in waters with considerably lower calcium levels than dreissenid mussels require, and thus most California waters are at risk for golden mussel establishment.

While preventing the introduction of invasive species is the preferred management strategy, the recent detection of golden mussel has triggered the need for immediate and widespread

response action by California agencies, water managers, and the public to contain golden mussel and stop its spread.

On October 17, 2024, several mussels were detected in the Port of Stockton (San Joaquin County) by California Department of Water Resources (DWR) staff. DWR immediately reported finding these mussels (of unknown species at the time) to the California Department of Fish and Wildlife (CDFW). CDFW and DWR concurrently sent samples of the mussels to diagnostic laboratories for morphological and genetic species identification. On October 23 and 24, 2024, University of California, Davis and California Department of Food and Agriculture (CDFA) independently returned genetic analysis results identifying the organisms as golden mussel. On October 25, 2024, California State Parks (State Parks) staff reported detection of mussels, later confirmed to be golden mussel, in O'Neill Forebay (Merced County), downstream of the Delta.

CDFW was designated as the lead state agency for dreissenid mussels when they were discovered in California in 2007. This lead capacity is embodied in statute (FGC sections 2301 and 2302). CDFW capacity includes statewide headquarters' staff and regional staff, henceforth collectively termed the Quagga/Zebra Mussel Program (QZMP). The goal of this program is to prevent further introductions and spread of dreissenid mussels. QZMP headquarters staff leads policy development and statewide implementation, and regional staff conduct on the ground implementation. CDFW staff work collaboratively across all levels of government and nationally.

CDFW's QZMP coordinates with water managers of dreissenid mussel-infested waters to develop measures to contain adult mussels and mussel-infested water, and with water managers of uninfested waters to develop and implement programs to prevent the introduction of dreissenid mussels. In addition, CDFW conducts early-detection mussel monitoring to detect new infestations, educates and engages the public in preventing the spread of mussels, inspects and releases watercraft under a quarantine hold by the California Department of Food and Agriculture (CDFA), and assists water managers on a range of training and support needs.

Following the October 2024 confirmed detection of golden mussel, QZMP coordinated rapid-assessment surveys for the presence of golden mussel to better understand their prevalence in locations around the first detections. Concurrently, QZMP coordinated notifications to agency leadership, partner agencies, and impacted water managers, and issued a press release.

On November 8, 2024, CDFW convened several state and federal agencies together to form a Golden Mussel Task Force (GMTF). Participants included DWR, California State Lands Commission (CSLC), CDFA, State Water Resources Control Board (SWRCB), State Parks-Division of Boating and Waterways (State Parks-DBW), US Bureau of Reclamation (USBR), US Geological Survey (USGS), and US Fish and Wildlife Service (USFWS). Additional partners have been added to the GMTF, including Fish and Game Commission, Delta Conservancy,

Delta Protection Commission, Delta Stewardship Council, Sacramento-San Joaquin Delta Conservancy, Coastal Commission, State Parks, along with several water agencies and academics.

The GMTF was instituted to lead the delineation of golden mussel within the Delta, the State Water Project (SWP), and Central Valley Project (CVP) systems, with a focus on protecting the natural environment, infrastructure, agriculture, economy, and human health and safety. Initial discussions focused on sharing information about what was known regarding the recent detections of golden mussel, gaining a better understanding of existing monitoring and inspection efforts, identifying opportunities for enhancement of education and outreach, and how to organize the different agencies moving forward. The culminating work of multiple GMTF meetings, along with teams of subject-matter experts focused on each of the objectives outlined below, informed the information and recommendations provided in this Framework.

OBJECTIVES

The GMTF identified seven objectives that provide a targeted response to ensuring the prevention, detection, and containment of golden mussel in California. Teams of subject-matter experts developed a common understanding of what actions were already in progress, and developed recommendations for actions that are needed over the near and long term. The recommendations that resulted from those discussions are provided below. In addition, existing laws, regulations, and policies were reviewed and recommendations necessary for the state to respond are presented, as well as existing and potential funding mechanisms to undertake response efforts.

Objective 1. Communication

In response to the January 2007 detection of quagga mussels in Lake Havasu, Nevada, CDFW and CDFA co-led a Unified Incident Command System. Following demobilization of the Incident Command System, the Quagga/Zebra Mussel Interagency Team (Interagency Team) was formed to continue coordination with CDFW's QZMP. The Interagency Team is comprised of CDFW, DWR, State Parks-DBW, CDFA, California Department of Transportation, SWRCB, California Department of Forestry and Fire Protection, CSLC, USFWS, USBR, US Bureau of Land Management, US Forest Service, US Army Corps of Engineers, USGS, National Park Service, and several water agencies. The Interagency Team has consistently coordinated on education and outreach with state, federal, and local agencies, non-governmental organizations, and the public.

During the first several years following the creation of the QZMP, CDFW dedicated Office of Communications, Education and Outreach staff to support the Interagency Team's coordinated education and outreach efforts, including the development of an outreach strategy, creation and revision of outreach materials, dissemination of outreach, and media engagement.

For the past 18 years efforts have continuously been made to reach and remind Californians and visitors of the continuing threat dreissenid mussels pose to the state, and how to prevent their further spread. Outreach efforts have been directed at recreational boaters, anglers, hunters, and related associations, non-profits, non-governmental organizations, and the public.

Information has been distributed through interagency press releases, ads and articles in regulations booklets, magazine and newsletter articles, radio and in-person interviews, presentations to a variety of audiences, and the production of a public service announcement (PSA) video. From 2007 through 2024, CDFA engaged with over 2.4 million boaters at their 16 Border Protection Stations by way of their watercraft inspections and distribution of outreach material. State Parks-DBW has kept registered watercraft owners informed about dreissenid mussel and the mussel prevention sticker fee via inserts in vessel registrations mailed by the California Department of Motor Vehicles, articles in boating and fishing publications, interviews on boating radio shows, and at outreach events including the major outdoor/sports shows, local festivals, and community events.

In addition, information has been distributed to businesses (e.g., license agents), business organizations (e.g., chambers of commerce), non-profit and non-governmental organizations, and to managers of waterbodies (both public and private) where recreation is permitted.

The Interagency Team has periodically refreshed the design of outreach materials (rack cards and posters) with the messages “Don’t move a mussel” and “Clean, Drain, Dry” and standardized messages regarding risks, impacts, and importance of preventing the spread of dreissenid mussels. In response to the detection of golden mussel, the Interagency Team revised the existing rack card to add golden mussel and printed 100,000 copies in January 2025.

As the lead agency for the dreissenid mussel response, CDFW maintains a comprehensive website for dreissenid mussel information, and each of the other agencies have pages of relevant information specific to their authorities and audiences. The CDFW website continues to be regularly updated to offer the most current infestation information and research documents and accompanying links for the public and professionals, a web-based reporting platform, and dedicated email and telephone reporting options. CDFW’s email and telephone are also the primary means by which the public contacts CDFW with questions and concerns. Some of the available outreach material on the website includes Frequently Asked Questions (FAQs), Fact Sheets, outreach flyers and posters, camera-ready files available for others to take to commercial print shops, a map of infested waters, a contact list of regional scientists, a contact list for waterbody prevention programs, an identification guide to watercraft inspection bands/seals and their meaning, a Boat Cleaning Guidebook, and the Invasive Mussel Guidebook for Recreational Water Managers and Users. These materials can be downloaded and reproduced at no charge. Regulations,

inspection and decontamination information for boaters and professionals, and protocols for biologists on early-detection monitoring for invasive mussels are also available on the website.

Following the detection of golden mussel, CDFW created a new, dedicated webpage for information about golden mussel. This page includes a fact sheet, map of golden mussel survey detections and non-detections, and guidance and a portal for reporting sightings. In addition, staff from each agency provide presentations and engage with affected groups and interests as needed to share updates and information.

Historical outreach efforts for dreissenid mussels have included boaters and outdoors recreators, seaplane pilots, wildland firefighting agencies, commercial haulers, marinas, refueling stations, aquatic centers, fishing tournament organizers, and others. Dreissenid prevention outreach materials have been made available to these groups, to kiosks and park entrance booths, Caltrans highway rest stops, CDFA Border Protection Stations, and other appropriate venues where the public frequents. With the growth of social media as a leading means for engaging the public, all agencies have worked to expand their reach through these platforms, their own email distribution list, the *Eye On Invasives* Newsletter, and the annual California Invasive Species Action Week.

1.a. Media

Distributing information through traditional media outlets including television, radio, newspapers, and periodicals remains an important means for reaching a wide audience. Agency Public Information Officers coordinate with subject-matter experts within their organizations to develop and distribute information to the media when there are significant developments, when new laws or policies are enacted, or when there is a call to the public to act.

Following the first detection of golden mussel, CDFW notified water managers statewide of the discovery of golden mussel on October 31, 2024. Following the notification to water managers, CDFW's Office of Communication, Education and Outreach issued a multi-agency joint press release the same day. Following the press release, Public Information Officers representing agencies of the GMTF fielded questions and requests for interviews from television stations, podcasts, and internet publications.

To continue engaging media to communicate developments related to the response to golden mussel and enlist the assistance from agencies and the public in preventing their spread, the GMTF makes the following recommendations:

- Formalize and standardize coordinated and consistent responses to media requests about golden mussel across agencies
- Public Affairs Offices should work together to develop a Media Plan for use across all agencies, water managers, and the public that includes:
    - Fact sheets

    - Frequently asked questions and their answers
    - Talking points
    - Advisories
    - Photograph gallery
    - Samples of quagga, zebra, and golden mussel infested items
    - Agency staff contact list
    - Tag line for press communications “Don’t move a mussel” and “Clean, Drain, Dry”
- Develop an internal notification tree and protocols for GMTF members to follow when wanting to coordinate coverage of media requests, and to notify others that media requests were fulfilled
- Water managers should proactively develop media plans to inform the public about efforts to prevent the introduction of golden mussel, changes in public access operations, and to inform the public, should golden mussel be detected in a waterbody they manage.

1.b. Outreach and Education

Building upon the past and continuing outreach and education efforts across state, federal, and local governments, the GMTF has identified several other outreach and education needs to respond to golden mussel, and makes the following recommendations:

- Provide updates to affected parties through email, regular meetings, conference calls, websites, and internally within their organizations.
- Provide regular updates via webpage and dedicated email lists and webpage, and via email lists with audiences affected by the golden mussel issue
- Develop an Outreach and Education Plan (Plan) that defines the strategy that effectively informs the public about steps they can take to prevent spreading golden mussel. The Plan would include, at a minimum, the following content:
    - Press releases, social media posts, outreach events, articles, materials, educational podcasts, workshops including speaking engagements, and recorded videos.
    - Identify and participate in public events (e.g., sportsmen shows)
    - Develop rack card and provide signage/graphics to share to waterbody managers/owners
    - Develop a social marketing plan utilizing Facebook, Instagram, X, TikTok, and YouTube to reach new and niche audiences
    - Identify and engage special interest groups (anglers, kayakers, boaters, duck hunters, fishing tournament directors and sponsors, agriculture industry, commercial manufactures, etc.) to better reach target audiences.
- Coordinate with the Communications Team, Objective #1.a.
- Maintain a list of waterbodies to inform boaters about their watercraft inspection program (Watercraft Inspections in California and Vessel Restrictions)
- Update Invasive Mussel Guidebook for Recreational Water Managers and Users to

include golden mussels
- Incorporate golden mussel into existing invasive species identification guidance
- Expand the content of CDFW's golden mussel website
- Maintain CDFW's reporting hotline and email for the public

Objective 2 – Containment at Infested Waters

Quagga mussels were introduced to California from the Colorado River, by way of the Colorado River Aqueduct, a 242-mile-long pumping and canal system operated by Metropolitan Water District of Southern California. Water from the canal is distributed to a network of other waterbodies and canals throughout Southern California, resulting in the introduction, and subsequent infestation, of 42 waterbodies and waterways. Despite the number of infested waters in Southern California, the overland movement of quagga mussels to hydrologically unconnected waters has been low, with only two waters believed to have become infested as the result of an overland introduction.

While golden mussel are anticipated to spread within the Delta and its tributaries, and via the state and federal water conveyance systems because there are no mechanisms to prevent it, overland spread of invasive mussels can be prevented. To prevent overland spread, the GMTF makes the following recommendations across different environmental settings and jurisdictions, as applicable:

- Develop a containment plan to prevent overland spread
- Develop a list/map of Delta launch sites to prioritize management at highest use sites
- Investigate other potential pathways of spread and means to address them
- Implement education and outreach strategies (Objective 2. Outreach and Education Plan)
- Post signage messaging presence of golden mussel and containment precautions (as appropriate for the given site/usage)
- Increase watercraft inspection and decontamination capacity
    - Train inspectors and decontaminators
- Partner, promote, and incentivize businesses providing watercraft cleaning services within and around the Delta
- Prohibit existing and/or new slipped and moored boats in infested waters, where practicable
- Promote rental boat industry in infested waters, where practicable
- Promote the use of the Watercraft Inspection and Decontamination database in conjunction with inspections and decontaminations
- Mandatory decontamination of vessels that have been in mussel-infested waters 5 days or longer (See Laws, Regulations and Policies section below)
- Mandatory decontamination of equipment that has been in mussel-infested waters 5 days or longer (See Laws, Regulations and Policies section below)
- Track commercial vessel movement and alert destination port when vessels depart infested waters

- Condition all permits for in-water work to include decontamination of equipment prior to movement off-site
- Promote development of Hazard Analysis Critical Control Point plans for in-water activities
- Install and staff watercraft decontamination capacity at State-managed access points to infested waters

Objective 3 - Prevention at Uninfested Waters

Preventing the introduction of golden mussel to uninfested waters is a critical component in managing golden mussel. California water managers and recreational water users have demonstrated that the spread of dreissenid mussels need not be inevitable. Through the combined efforts of water managers that prepared and implement dreissenid mussel prevention programs, and recreational users cleaning, draining, and drying their watercraft between launches, only two non-hydrologically connected waterbodies in California have become infested with quagga mussel since 2007. These prevention programs, created to prevent the introduction of dreissenid mussels, are equally effective for preventing the introduction of golden mussel. The QZMP assists water managers to develop these programs and plans and approves them when they meet all the requirements defined in FGC Section 2302. To date, the QZMP has approved 30 prevention plans covering 108 waterbodies statewide. Guidance and templates for developing prevention programs and prevention plans meeting FGC requirements are available on the QZMP website. These documents are also adaptable to waters not required to comply with FGC Section 2301.

CDFW has trained its law enforcement scent detection K9s on quagga, zebra and, in late 2024, golden mussel, and provided dead golden mussels to private dog trainers that are contracted by water manager's watercraft inspection programs. Both CDFW and privately contracted scent detection K9s support watercraft inspection efforts.

The GMTF makes the following recommendations:

- Establish prevention programs at all accessible, private and public, uninfested waters (not just reservoirs open to the public for recreation)
- Promote adoption of the Watercraft Inspection and Decontamination Database by all agencies that control or otherwise manage watercraft access
- Set statewide standards on watercraft inspection programs
- Set statewide standards for watercraft banding programs
- Work with water managers to build reciprocal inspection/decontamination programs
- Promote mandatory watercraft inspection and decontamination (if watercraft is not Clean, Drain, Dry)
- Promote mandatory inspection of equipment prior to being put in water (if equipment is not Clean, Drain, Dry)
- Implement education and outreach strategies (Objective 2. Education and Outreach Plan)

- Update existing dreissenid Prevention Plan Guidance Document to include golden mussel
- Utilize K9 scent detection in inspection programs
- Encourage fishing contest tournament organizers to institute measures to prevent participants from spreading invasive mussels
- Implement education and outreach strategies (Objective 2. Education and Outreach Plan)
- Enhance inspection hours of operation at CDFA Border Protection Stations and consider inspection of outgoing moored vessels

Objective 4. Monitoring for the Presence of Golden Mussel

Early-detection monitoring for golden mussel builds on existing statewide invasive mussel early-detection monitoring that was developed and implemented in response to the arrival of dreissenid mussels in California. Monitoring methods include existing surface and/or artificial substrate monitoring for adult mussels, and cross-polarized light microscopy (CPLM) of plankton samples for larval mussels. The methods used to monitor for dreissenid mussels are also effective for detecting golden mussel. Given golden mussel can establish in waters with low calcium concentrations, the number of waters that should be monitored throughout the state is far greater than are currently being monitored for dreissenid mussels.

While the existing QZMP ceases monitoring following the confirmation of an established population, at this time the golden mussel response will continue to monitor within the Delta to track the expansion of the infestation. In addition, environmental DNA (eDNA) is not a method that has been widely applied to dreissenid mussels monitoring in California. However, there are potential applications for widespread implementation of eDNA monitoring for golden mussel within the state and nationally.

The GMTF makes the following recommendations that support monitoring statewide:

- Coordinate monitoring and reporting across entities to detect new infestations statewide and delineate and track current extent/periphery of golden mussel distribution in the Delta and its tributaries
- Centralized collection and reporting of golden mussel monitoring results using the Survey123 and Esri ArcGIS applications created and maintained by CDFW. Monitoring results are viewable on a public map on the CDFW's golden mussel website. GMTF interagency monitoring partners can also view eDNA results and sightings of suspect specimens pending confirmation on an interagency map
- Assess water quality suitability for golden mussel statewide
- Assess connectivity of the Delta to waters throughout California to inform prioritization of monitoring
- Assess the overall vulnerability of waters statewide through a comprehensive assessment of water quality suitability, recreational watercraft access, and connectivity to the Delta to inform monitoring prioritization

- Compare detection methods across multiple locations, sites, and seasons to assess performance/efficacy under various conditions. Base future monitoring efforts and recommendations on results

4.a. Early-Detection Monitoring - Adults and Veligers

Early-detection monitoring is conducted in waters not known to be infested with invasive mussels for the purpose of detecting a new infestation as early as possible. Knowledge that invasive mussels are present is necessary to trigger a water manager to implement actions to contain invasive mussels being moved out of the waterbody, thereby preventing spread to other waterbodies.

The existing statewide early-detection monitoring network includes efforts by CDFW, DWR, USBR, and water agencies and recreation managers across the state. CDFW conducts invasive mussel monitoring when water managers are unable to monitor themselves, and in waters of the state under no water managers' authority. DWR and USBR monitor waterbodies, conveyances, and facilities connected to the SWP and CVP. Numerous water agencies and recreational boating access managers conduct early-detection monitoring at their own waterbodies. CDFW provides training and resources (protocols, lab analysis, technical assistance) to water agencies and requires monitoring as an essential element of an approved dreissenid mussel prevention program.

The GMTF has conducted an initial assessment of ongoing actions, needed actions, and resource needs, and makes the following recommendations:

- CDFW's early-detection monitoring protocols (surface survey, artificial substrates, and plankton tows) should be updated to include golden mussel and distributed
- Efforts should be taken to develop and implement capacity and standards for golden mussel veliger analysis and species identification verification (cross-polarized light microscopy [CPLM] and polymerase chain reaction [PCR])
- Identify other closely related bivalve species that could be confused with golden mussel
- CDFW should develop standards for laboratories reporting results
- Priority waters should be surveyed statewide
    - CDFW is in the process of finalizing its annual statewide invasive mussel early-detection monitoring plans. These consist of regional monitoring plans for each of CDFW's six inland regions and a separate plan for the Delta
    - CDFW will continue to assist water agencies in building early-detection monitoring capacity by providing training and resources
    - Concerted efforts will be needed across all parties to maximize statewide monitoring coverage. This includes increasing resources to support monitoring efforts, coordinating with local water agency monitoring efforts, utilizing community science monitoring, and creating efficiencies.
- Water managers should prioritize monitoring of waters suitable for golden mussel

establishment, that have public water recreation access
- Develop and maintain a list of public and private labs in California and across the US that provide CPLM and/or PCR services to analyze plankton samples and adult mussel identification
- Community science monitoring efforts to supplement monitoring by agency staff should be developed. These efforts will have dual functions of monitoring and an education and outreach tool (Objective 2). The effort should adapt current monitoring methods and reporting suitable for implementation by the public

4.b. Early-Detection Monitoring - Environmental DNA (eDNA)

Living organisms, to varying degrees, are constantly shedding cells and content of their cells into the environment from the surface of their bodies, with excrement, and as gametes. Monitoring water for the presence of this DNA loose in the environment (termed eDNA) is a highly sensitive method used as an indicator of a species' presence. eDNA alone only demonstrates the presence of a species' DNA, not the presence of that species. eDNA is one of several monitoring tools that can be used to prioritize additional monitoring efforts to detect the presence of the species of interest.

Prior to the first detection, DWR was conducting eDNA monitoring for dreissenid mussels in the Delta. The value of expanded capacity and expertise with eDNA for golden mussel was immediately recognized, and the Monitoring Team formed an eDNA Sub-Team of molecular science experts from state, federal, and local water agencies. The eDNA Sub-Team worked quickly to reach agreement on the best methods and reporting limits and developed and validated an eDNA detection method by quantitative PCR (qPCR). The eDNA Sub-Team evaluated eDNA methodologies for golden mussel detection and harmonizes efforts between organizations to provide the best defensible scientific method for eDNA detection.

The GMTF makes the following recommendations for the continued development and application of eDNA to support monitoring statewide:

- Creation of eDNA sampling protocols and videos for use by agencies and other organizations to ensure appropriate sampling technique
- Determination of the best sampling strategy (locations and periodicity) for early-detection of golden mussel in order to focus traditional monitoring techniques on likely occupied areas
- Field and laboratory capacity to collect and analyze eDNA samples

4.c. Track Population Trends and Expansion Within the Delta and Tributaries

In response to the discovery of golden mussel in the Delta, CDFW, DWR, State Parks-DBW, Contra Costa Water District, US Geological Survey (USGS), and others expanded presence/absence monitoring in November and December 2024 to delineate the current extent of the golden mussel population in the Delta. The golden mussel is expected to

expand in range given the interconnectedness of waters, in-water movement of watercraft, and the flows of Delta water.

The GMTF makes the following recommendations:

- Continued periphery tracking of golden mussel distribution in the Delta
    - CDFW QZMP coordinates monitoring and reporting across entities to delineate and track current extent/periphery of golden mussel distribution in the Delta by means of presence/absence monitoring
- Develop a process to determine breeding season in infested locations (i.e. spawning and larval development temperature requirements) and track population changes (density) over time
- Develop and implement a long-term population monitoring effort using standardized sites, frequency, and settlement substrates to inform future population suppression efforts

Objective 5 – Partner Engagement

Coordination of activities with state, federal, Tribes, local agencies, water managers, academia, non-governmental agencies, and others is a critical component in preventing the further introduction and spread of golden mussel within the state, containing mussels within currently infested waters, and moving towards any population suppression efforts. In addition, because there is no baseline information about golden mussel in North America, partner engagement for golden mussel has expanded to include participation from academia.

The Quagga/Zebra Mussel Interagency Team, whose members include departments under the
California Natural Resources Agency, and federal lands and water management agencies, formed to continue the coordinated efforts for dreissenid mussels, including the development and revision of outreach material and efforts. The Quagga/Zebra Mussel Interagency Team meets on a quarterly basis. Efforts have included working with the bordering states of Nevada and Arizona, along with federal agencies including the US Army Corps of Engineers, USBR, National Parks Services, US Forest Service, and USFWS, in addition to all appropriate state agencies, to ensure consistency in message and maximization of resources.

Through these efforts, partnerships with non-governmental organizations have been established, including with fishing tournament operators, water agencies, chambers of commerce, and recreational boating and fishing organizations. These partnerships have expanded dissemination of invasive mussel prevention messages, outreach materials, social messaging, and web content across organizations.

Since the discovery of golden mussel, the Quagga/Zebra Mussel Interagency Team has

maintained their focus on quagga/zebra mussel efforts, and folded in golden mussel efforts to address time-sensitive needs including production of outreach material while the GMTF focuses on efforts that require executive-level leadership. In addition, the existing connections of the CDFW QZMP and State Parks-DBW Grant Program served as the conduit for convening water managers throughout the state for a virtual summit held on January 28, 2025, to update them on the presence of golden mussel and the actions of the GMTF. The summit also served as an opportunity to encourage development of dreissenid mussel prevention programs and awareness of the State Parks-DBW's upcoming quagga/zebra mussel prevention grant opportunity. One key topic at the summit was the need to mobilize prevention efforts to prevent overland spread of invasive mussel, and pursue collaborative, reciprocal mussel watercraft inspection programs between waters.

Based on partner engagement effort thus far, the GMTF makes the following recommendations:

- Continued identification and engagement of additional partners
- Facilitate information sharing with local agencies to support development of programs
- Share information about the golden mussel response and recruit participation in preventing the spread of golden mussel
- The QZMP to host regional Water Agency Summits throughout the state to encourage localized coordination (reciprocity) of watercraft inspection/decontamination programs between water managers
- The QZMP to host a Water Agency Summit for water managers of mussel-infested waters to share lessons learned and population suppression options with other water managers
- Facilitate information sharing with local agencies to support development of programs

Objective 6 – Population Suppression

While eradication would be ideal, realistically there are limited circumstances where invasive mussels could be completely eliminated (eradicated). However, there are potential options and multiple benefits to suppressing golden mussel populations in open water and closed water systems. These benefits include reduced impacts on ecosystems and the species dependent on them, a reduction in the number of veliger and adult mussels that can inadvertently be moved overland, reduced frequency and intensity of removal of mussels, disruptions to function, such as impeded water flow or operational functionality of machines, aesthetics qualities, and biofouling of watercraft hulls and motors.

The GMTF makes the following recommendations to support protection of the natural environment, infrastructure, agriculture, economy, and human health and safety:

- Conduct a chemical pilot study to evaluate efficacy of chemical treatments (e.g.

Zequanox, EarthTec QZ) in open and closed water systems
- Explore potential emerging genetic techniques to reduce populations (e.g. gene drive)
- Evaluate the use of tarps to smother golden mussels
- Provide information to agricultural irrigators in infested waters to mitigate biofouling on diversion intakes
- Evaluate the lethality of turbulence on veligers
- Evaluate the manipulation of water levels and stratification of lakes for suppressing mussel populations
- Evaluate options for removing mussels on marinas
- Evaluate options for in-water hull cleaning of recreational watercraft
- Evaluate anti-biofouling coatings for recreational watercraft, submerged intakes, pumps, fish screens, etc.
- Explore opportunities for proactive permitting for application of molluscicides

Objective 7 – Science and Capacity Building

Golden mussel is new to North America, and at this time the population from which it originated is unknown. Knowledge about the origin population might provide insight into what might be expected in terms of the invasion potential. Regardless, information about its invasion in other countries may be helpful to management of the species in California. Currently Agency staff are prioritizing immediate response efforts, and lack capacity to research golden mussel biology, collaborate with scientists in other countries, nor translate foreign language scientific publications. Engaging others, such as academia and research scientists in mollusk biology, genetic identification, and invasion ecology could help inform California's response, identify critical research needs, and identify opportunities to implement those research needs. Not only would their efforts benefit California, but they would be of national value to other states, and other countries, working to prevent the introduction of golden mussel.

The GMTF makes the following recommendations:

- Ensure that departments with existing Science Advisors facilitate the development of a Scientific Advisory Panel from existing experts across the nation
- Enlist experts from other countries with experience responding to golden mussels
- Develop a prioritized list of future research needs
- Conduct research on golden mussel to inform immediate management needs, including:
    - Determine lethal exposure time to hot water (adult and larvae) to inform watercraft decontamination efficacy
    - Determine lethal exposure time to drying (adult) to inform potential for overland transport
    - Determine lethal exposure to saline immersion (adult and larvae) to inform

mooring in saltwater as an alternative to hot-water decontamination
- Determine lethal exposure (temperature and duration) in standing water (adult and larvae) to inform potential for overland transport
- Determine lethal exposure to chemical treatments for equipment decontamination (adult and larvae) to inform mandatory decontamination options and protocols
- Determine lethal exposure to chemical treatments for reducing mussel biofouling at water diversions and within facilities and infrastructure to maintain equipment operation/function
- Identify and develop methods and technologies for prevention, containment and population suppression

Laws, Regulations, and Policies

Laws and Regulations – Proactive measures and changes in laws and regulations have helped shape California's response to invasive mussels in the past. Development of these laws and regulations is necessary for the protection and preservation of the health and safety of the people of the State of California, its economy, and its fish and wildlife resources. For example, the initial discovery of dreissenid mussels in California prompted legislative action, and Assembly Bill (AB) 1683, Wolk, was signed by the Governor on October 10, 2007. AB 1683 added Fish and Game Code (FGC) Section 2301, which authorizes the CDFW to conduct inspections, order quarantines, work with water managers in the development of mandated control plans (California Code of Regulations (CCR), Title 14, Section 672.1) for infested waterbodies, and to take other actions to prevent the spread of invasive dreissenid mussels. On September 30, 2008, the Governor signed AB 2065, Hancock, adding FGC Section 2302. This legislation requires that uninfested reservoirs open to the public for recreation implement a program to prevent the introduction of mussels, which includes public education, monitoring, and management of recreational activities. Similarly, in 2012 AB 2443, Williams, was signed by the Governor creating a quagga and zebra mussel infestation prevention fee program (Harbors and Navigation Code (HNC), Sections 675-677) to support implementation of FGC 2302. Additionally, CDFA administers plant quarantine inspection stations (Border Protection Stations) authorized through Food and Agricultural Code (FAC) Sections 5341-5353 to prevent the introduction of pests into, or the spread within the state.

Ensuring these types of effective programs can continue to prevent additional mussels from entering the state, prevent mussels from being introduced into any water in California where they currently do not exist, prevent mussels from being introduced to other states, and to detect and eradicate mussels anywhere in the state is a critical step in supporting a long-term response. In addition to laws and regulations directly related to invasive mussels, each agency should evaluate, across all activities and authorities, functions that prevent or facilitate the spread of invasive mussels. These include functions performed by the agency itself, as well as actions and activities permitted by the agency (e.g., commercial bait fish permits, fish stocking, hatchery operations, aquaculture permits, fishing tournament

permits, Lake and Streambed Alteration Agreements).

Policies – At the onset of dreissenid mussels in California, many state agencies and water managers began developing and implementing internal policies and procedures to prevent, detect, and contain the spread of dreissenid mussels. These types of administrative policies range from developing processes and procedures for decontaminating and cleaning in-water sampling equipment, gear, and watercraft to surveying facilities and equipment.

Since the detection of golden mussel, the GMTF has worked to assess existing laws, regulations, and policies directly related to dreissenid mussels, and those generally relevant to invasive species. A regulatory opportunity that was immediately available was adding golden mussel to CCR, Title 14, Section 671 (Importation, Transportation and Possession of Live Restricted Animals). In December 2024, in response to CDFW's petition, the California Fish and Game Commission adopted emergency regulations to add golden mussel to the list of restricted animals to make unlawful the importation, possession, and transportation of live golden mussel in California. The Office of Administrative Law approved the regulation on December 19, 2024. A certificate of compliance is expected in 2025 to make the emergency regulation permanent.

The GMTF has identified several other opportunities necessary to respond to golden mussels and makes the following recommendations:

State

Laws

- FGC Sections 2301 and 2302 (Aquatic Invasive Species)– The California State Legislature could amend these sections of FGC to include language specific to golden mussel. A more proactive approach might be to amend these sections to include "non-native" mussels more broadly. The latter would support immediate response in the future, should additional non-native invasive mussels be detected in California. Amending FGC 2301 to include golden mussel would also extend enforceability to other state agencies. Strong consideration should be given to changes in language that may restrict or disrupt the functions of water distribution systems that provide critical water supplies and the liability that water agencies have with the potential distribution of infested waters.
- HNC, Sections 675-676 (Quagga and Zebra Mussel Infestation Prevention Fee) – Existing law allows funds collected from the Quagga and Zebra Mussel Infestation Prevention Fee to be used only for quagga and zebra prevention efforts. The California State Legislature could amend the law to include golden mussel or, alternatively, more clearly define the word mussel for purposes of fund expenditure. Additionally, consideration should be given to allow these funds to be used in waterbodies already infested to help prevent the spread.
- FAC Sections 5341-5353 – A thorough review of these sections could provide opportunities to ensure CDFA has appropriate quarantine and inspection authorities to respond to golden mussel.

- Vehicle Code (VEH) Section 9853 – The California State Legislature could amend this section of VEH to include language specific to golden mussel.
- VEH Section 9860 – The California State Legislature could amend this section of VEH to include language specific to golden mussel.
- VEH Section 9863 – The California State Legislature could amend this section of VEH to include language specific to golden mussel.

Regulations

- CCR, Title 14, Article 1.5, Section 5200 et al (Quagga and Zebra Mussel Infestation Prevention Fee Regulations) – Upon authorization and amendments to HNC Sections 675-676, State Parks could revise the regulations to add golden mussel to be included with the Mussel Fee.
- CCR, Title 14, Article 1.6, Section 5300 et al (Quagga and Zebra Mussel Infestation Prevention Grant Regulations) – Upon authorization and amendments to HNC Sections 675-676, State Parks could revise the regulations to add golden mussel infestation prevention work to be included in QZ Grant Program awards.
- CCR, Title 14, Section 672, 672.1, and 672.2 (Dreissenid Mussels)– Upon authorization and amendments to FGC 2301 and 2302, CDFW could amend this section to include golden mussel allowing water operators and reservoir managers to continue to operate under the approval of a control plan and prevention plan. Strong consideration should be given to ensuring that control and prevention plans include feasible mitigation measures.
- CCR, Title 14, Section 672 – Upon authorization and amendments to FGC 2301, CDFW could amend this section to require watercraft and equipment leaving mussel-infested waters to be decontaminated.
- CCR, Title 14, Section 672 – Under existing FGC Section 2301, establish a regulation requiring mandatory removal of conveyance drain plugs when not in water.
- CCR, Title 2, Section 2293 (Performance Standards for Ballast Water Discharges) – The CSLC could amend ballast water management regulations to strengthen existing performance standards by adding an exchange requirement to more effectively kill fresh or brackish water organisms (e.g., the CSLC could add a mid-ocean ballast exchange requirement).

  Action - The CSLC is targeting Spring of 2025 to amend these regulations via emergency rulemaking, to be followed by permanent rulemaking.
- Statewide General National Pollutant Discharge Elimination System (NPDES) Permit for Residual Pesticide Discharges to Waters of the United States from Aquatic Animal Invasive Species Control.
- SWRCB should work with water operators and managers to expedite, to the extent possible, the issuance of Aquatic Animal Invasive Species Control Permits to help control and contain golden mussels.

Policies

State agencies should do a thorough assessment of existing policies and procedures

related to the detection, containment, and prevention of mussels and make any necessary additions or adjustments to reflect recent detections of golden mussel. For example:

- Assess live bait as a pathway for the spread of invasive mussels, including, but not limited to
    - Commercial live bait permits
    - Restrictions on harvest from designated areas
    - Use of live bait
- Assess fishing tournaments as a pathway for the spread of invasive mussels and consider additional special conditions for specific locations.
- Develop Hazard Analysis and Critical Control Point (HACCP) Plans for state and federal fish hatcheries and private aquaculture facilities to prevent the potential for spread of invasive mussels through fish stocking.
- Agencies and project proponents conducting fish translocations for conservation, restoration, or project avoidance and minimization measures should evaluate the potential to spread invasive mussels during project planning and development.
- Waterbody operators and managers should do a thorough assessment of existing policies and procedures related to the risk, detection, containment, and prevention of mussels and make any necessary additions or adjustments to reflect recent detections of golden mussel.
- Local entities and the public should continue to utilize outreach and education materials to inform themselves and their constituents about the risk of spreading golden mussel and what steps should be taken to stop the spread (see Objectives 1).

Local

- Local governments should evaluate and expand enforceability of watercraft inspection programs in government code/regulations/ordinances.

Funding

Since 2008, CDFW has invested well in excess of the estimated $43.9 million dollars to control the spread of quagga and zebra mussels (2025 Biennial Report on the California Marine Invasive Species Program). These efforts have been largely successful, with only two waterbodies believed to have become infested as a result of the overland transport of quagga mussels. While the environmental setting of the Delta for the discovery of golden mussels is a considerably more challenging place to contain invasive mussels, action is imperative to protect the many hydrologically unconnected waterbodies in California and across the US.

Building on the existing Quagga/Zebra Mussel Programs in CDFW and State Parks-DBW, and capacity throughout other California Natural Resources Agency departments including DWR, the GMTF has identified the following potential funding opportunities, including state and federal grants and emergency response funds, that can support immediate needs:

Existing Funding Sources:

- Federal Rapid Response (Aquatic Nuisance Species Task Force/Western Regional Panel on Aquatic Nuisance Species) – up to $600,000
- California Invasive Species Advisory Committee Rapid Response Fund - up to $100,000
- Sport Fish Restoration Act, Boater Access allotment – up to $2.5 million
- Proposition 4, Chapter 6, Section 93000 - $1.2 billion
- Directed Action Requests from Delta Stewardship Council for research activities. These are noncompetitive grants for targeted needs. https://www.deltacouncil.ca.gov/pdf/science-program/2021-12-23-dsp-directed-actions-information-sheet.pdf

Potential Funding Sources:

- General Fund
- Utilization of the Mussel Fee Sticker (aka quagga/zebra mussel sticker) revenue
- Create an out-of-state boater fee for vessels not registered in California
- Maintain a list of funding opportunities for local agencies and partners, and post it on the CDFW website and share via email, and for California opportunities, on the California Grants Portal