

Guidance for Developing a Dreissenid Mussel Prevention Program

California Department of Fish and Wildlife

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Purpose

This document is intended to provide guidance for developing a program that prevents the introduction of quagga and zebra (dreissenid; i.e. Family Dreissenidae) mussels to reservoirs where public recreation occurs and meets the statutory requirements of Fish and Game Code (FGC) Section 2302 (Appendix 1) and California Code of Regulations (CCR) Title 14, Section 672.1(b) (Appendix 2). This guidance provides a process for assessing a waterbody's vulnerability to the introduction of dreissenid mussels, recommendations for monitoring activities to detect the presence of adult and veliger dreissenid mussels, and options for managing recreational activities to prevent dreissenid mussel introductions. California Department of Fish and Wildlife (CDFW) staff welcome the opportunity to assist throughout the development of any prevention program, and their contact information is provided in Appendix 3.

CCR Title 14 Section 672.1(b) requires submission of a written document describing the three key elements of the prevention program: assessment of vulnerability, monitoring, and management of recreational activities to prevent the introduction of dreissenid mussels; and additionally requires the submission of annual reports demonstrating program implementation. This guidance includes suggested formatting for documenting the mandated prevention program and annual reports. The written document describing the prevention program is referred to as a "prevention plan" throughout this document. Use of this guidance and suggested formatting is not required to comply with FGC and CCR, rather, it is offered as a tool to assist water managers, and others, in developing and implementing dreissenid mussel prevention programs. Therefore, to provide guidance that is applicable to all managers of aquatic settings, we use the term "waterbodies" throughout the rest of this document.

General Considerations

Investing in Prevention

Invasive species, and particularly dreissenid mussels, pose a serious threat to the waters of California, and preventing their introduction and spread is the most effective and economical means for protecting ecosystems, recreational uses, infrastructure, and water conveyances. Once established, dreissenid mussels are costly to manage and virtually impossible to eradicate. Significant economic and environmental costs are incurred by a dreissenid mussel infestation, including containment actions to prevent the release and spread of mussels via water conveyance and recreation, alterations in the ecology of the waterbody, a reduction or modification in recreational use, and added maintenance of infrastructure. In the long-run, a robust prevention program is less costly than managing a waterbody that is infested with mussels, therefore, preventing the introduction of mussels should be a high priority goal in the management of a waterbody. Additionally, a robust dreissenid mussel prevention program has the added benefit of protecting a waterbody from the introduction of many other aquatic invasive species.

Critically Assessing Each Waterbody

It is important to recognize that each waterbody is unique; to that end, this guidance may not be an all-inclusive list of pathways (also known as vectors) that may exist for a waterbody. For the purposes of this guidance document, pathways are defined as natural processes and human activities by which dreissenid mussels may be introduced into a waterbody. To develop a prevention program for any waterbody it is critical that water managers comprehensively evaluate all activities that involve movement of water and contact with the water as potential means by which dreissenid mussels may be introduced. Some of the most common pathways for the introduction of dreissenid mussels are summarized in Table 1. Once all potential pathways have been identified and critically evaluated, water managers can then develop, prioritize, and implement actions to prevent mussels from being introduced into their waterbody via those pathways. Often, prevention actions that are needed to address one pathway will also address other pathways.

Considering the Biology of Dreissenid Mussels

When evaluating the potential threat, the biology of dreissenid mussels is important to consider. Dreissenid mussels have two life stages: the attached, shelled adult, and the microscopic, free-floating larvae. Adult mussels may range in size from less than 0.25 inch to 1.5 inches. When removed from the water, adult mussels tightly close their shells, protecting themselves from drying out. As a result, adult mussels can survive out of water for days, and up to weeks, depending on temperature and humidity. Dreissenid mussel larvae are also hardy, and have been demonstrated to survive in damp conditions and in small volumes of water for several days, again temperature and humidity permitting. The ability to survive out of a waterbody is what enables dreissenid mussels to spread via overland conveyances like trailered watercraft. Therefore, prevention efforts developed to address overland pathways must consider the biology of dreissenid mussels to ensure they are effective.

Table 1. Common Pathways of Dreissenid Mussel Introduction

Natural Pathways	Potential management actions to prevent dreissenid mussel introduction via this pathway (including education and outreach)
Open water flowing from upstream sources	Chlorination, filtration
Flooding	
Human-mediated Pathways	
Watercraft <ul style="list-style-type: none"> Motorized Ballast ski boats Non-motorized Law enforcement Natural resource agencies Rental 	Self-inspections, inspections by trained staff at the waterbody, mandatory dry periods, decontamination, etc.
Fishing <ul style="list-style-type: none"> Anglers Angling equipment Fishing tournaments Live bait Fish planting 	Inspect fishing gear, provide gear cleaning stations, conditions on fishing tournaments, inspect live bait (check origin of live bait), restrict live bait, etc.
In-water equipment <ul style="list-style-type: none"> Construction equipment Docks Buoys Floating restrooms Firefighting tanker trucks or equipment 	Inspect all incoming equipment, allow sufficient dry time if equipment cannot be drained, coordinate with firefighting agencies for inspections of equipment, decontaminate equipment used previously, etc.
Facility maintenance <ul style="list-style-type: none"> Large equipment Field gear and equipment 	Inspect maintenance gear and equipment, if managing multiple waterbodies have dedicated equipment, etc.
Aerial contact <ul style="list-style-type: none"> Sea planes Float planes Firefighting aircraft 	Prohibit planes coming from infested waters, etc.
Research	Inspect gear, require mandatory decontamination of equipment prior to use at waterbody, etc.

Assessment of Vulnerability

Assessing the risk of dreissenid mussel introduction can be effectively approached by examining each pathway that is applicable to a given waterbody. This includes considering pathways such as the sources of water, the visitation and recreational activities allowed, and the threat each pathway poses for the intentional and inadvertent introduction of mussels.

Assessing the vulnerability of a waterbody can be approached as a process. It is an opportunity to objectively assess the obvious pathways of dreissenid mussel introductions, as well as discover and explore less obvious pathways that might otherwise be overlooked. With a comprehensive understanding of the vulnerabilities of the waterbody it is then possible to identify which actions are needed to avoid or mitigate the introduction of dreissenid mussels via each pathway. The information developed through the following three-step process should be included in the prevention plan to fulfill the requirements of CCR Title 14, Section 672.1(b)(1)(A). An example of a pathway assessment is provided in Appendix 4.

Step 1: Identify the Pathways

Pathways are means by which dreissenid mussels may be introduced into the waterbody, and are both natural processes as well as human-mediated events. Pathways are activities that involve either the movement of water or contact with the water and could serve to introduce dreissenid mussels. Pathways can be described in varying levels of detail, however the more specifically a pathway is defined, the easier it will be to describe and develop specific measures/actions to address it. For example, a pathway might be defined as “recreational water uses,” however defining the uses relative to their type of recreation (ski boaters, anglers (shoreline), anglers (boat), swimmers, etc.) will enable critical evaluation of each pathway.

Table 1 summarizes some of the most common pathways including, but are not limited to, inflowing water, recreation, seaplanes, emergency equipment, maintenance equipment, in-water facilities, etc. Include an evaluation of each pathway in the prevention plan, even if they are currently being managed to prevent the introduction of dreissenid mussels.

Step 2: Describe the Pathways

Provide a general description of each pathway. A systematic method for describing each pathway may begin by breaking each pathway down into its fundamental parts: “who,” “what,” “where,” and “when.” Identifying and describing these aspects of a pathway will facilitate a thorough evaluation, as well as help inform what actions can be taken to avoid or mitigate the pathway.

Who: Begin by identifying whether the pathway is a natural or human-mediated pathway. For natural pathways the “who” will not be a person, but rather a natural process, such as flooding, downstream flow, etc. For human-mediated pathways, identify the specific groups or individuals that may be responsible, such as waterbody staff, staff from other agencies, the public, etc.

What: Identify and describe the mechanism(s) of introduction associated with the “who,” described above. The mechanisms may include, but are not limited to, the equipment that they use, the activity performed, etc.

Where: Identify the potential points or locations that dreissenid mussels may be introduced to the waterbody by the pathway. The points may include, but are not limited to, boat ramps, shoreline, from the air, upstream, facilities, etc.

When: Describe the time period of the potential risk for the pathway. The time period may be a year-round threat or seasonal. If the threat is seasonal, identify the range of dates for the pathway.

Other: Any other features of the pathways that are important and not otherwise captured by the descriptors above.

Step 3: Identify Potential Actions to Prevent or Mitigate Introductions via the Pathways

Through a comprehensive understanding of the waterbody's vulnerabilities, all possible management actions that would prevent or mitigate the introduction of dreissenid mussels via each pathway should be identified. Include both those currently being implemented and those that would be needed to manage the pathway. If multiple options exist, then include them all. Identifying potential options for management allows a water manager to evaluate options, and creates no obligation that they be implemented.

An important opportunity to manage pathways is through education and outreach, which is specifically identified in the regulations as being a necessary component of management of recreational activities. When developing actions to address pathways, specifically include actions in the form of education and outreach to fulfill the requirements of CCR Title 14, Section 672.1(b)(1)(C).

Monitoring Program for Adult and Juvenile Dreissenid Mussels

Knowing whether dreissenid mussels are present in a waterbody is not only important prior to initiating a prevention program, but also during its implementation. Early-detection monitoring serves to validate the efficacy of the prevention program, as well as functions to protect other waterbodies should mussels be discovered. In such case, prevention efforts would be redirected to containment efforts, thereby preventing the spread of dreissenid mussels from the waterbody.

Monitoring programs should be individually tailored to each waterbody. Monitoring may include one or more methods, carried out on a regular basis relative to water temperature and available resources. CDFW has developed protocols (appendices 5-8) for three generally applicable monitoring methods targeting adult and juvenile life stages of dreissenid mussels. These include surface survey monitoring, artificial substrate monitoring, and plankton monitoring. A fourth method, the biobox, is applicable for low volumes of flowing water.

Each monitoring protocol includes guidance for its use, including target life stage, location selection, frequency, timing/seasonality, etc. CDFW staff (Appendix 3) are available to assist in developing a waterbody-specific monitoring program, including selection of method(s), location(s), frequency, and timing/seasonality, and are available to provide training on each method. In addition, how monitoring data will be reported to CDFW should be discussed, as this will facilitate reporting of monitoring results in the annual report.

The prevention plan must describe the monitoring that will be implemented. To fulfill the requirements set forth in CCR Title 14, Section 672.1(b)(1)(B), this description should include sufficient detail for CDFW to assess its adequacy, minimally including the monitoring method(s) and protocols that will be used, the locations within the waterbody where monitoring will be conducted, the anticipated months/dates and frequency when the monitoring will occur, and how the monitoring data will be provided to CDFW. A sample table for presenting this information is provided in the prevention program template (Appendix 4).

Management of Recreational Activities, Including Public Education and Outreach

With an understanding of the pathways that pose opportunities to introduce dreissenid mussels and the management actions necessary to address those vulnerabilities developed above, it is now possible to select what actions will be taken to prevent the introduction of dreissenid mussels. While managing to prevent a dreissenid mussel infestation is more cost-effective than managing an infestation, a comprehensive prevention program can be costly and exceed an agency's available resources. Therefore, management efforts may need to be prioritized.

Prioritization of management efforts can be evaluated based on several considerations, including, but not limited to, the potential for dreissenid mussel establishment, immanency of threat, magnitude of threat, costs relative to available resources, authority, and feasibility. How to factor in these considerations is complicated and beyond the scope of this document, but with pathways evaluated and an understanding of your waterbody, CDFW staff are available to assist with prioritizing actions relative to available resources and the unique situation of each waterbody.

If prevention program implementation will require a series of steps, prioritizing efforts is also an opportunity to plan for long-term efforts and to explore partnerships to enhance efforts, lower direct costs, and identify lower-cost alternatives to meet prevention needs.

Recreational users play a significant role in many of the pathways of dreissenid mussel introduction. Therefore, informing and reminding them of the issue and engaging their cooperation in prevention is critical to the success of prevention efforts at your waterbody, and other waterbodies. Public education and outreach can take a variety of forms, including signage, handouts, seminars, interpretive displays, direct communication, etc. Education and outreach actions chosen for implementation should be relevant to the visitors, have high visibility, and be readily accessible. Considerable effort has already been invested in developing outreach for a variety of audiences, and many agencies invite others to utilize or adapt their existing materials. In addition, CDFW staff are available to assist with messaging and the development of education and outreach actions specific to a waterbody's needs.

To fulfill the requirements of CCR Title 14, Section 672.1(b)(1)(C), the prevention plan must state the management actions that will be implemented to prevent the introduction of dreissenid mussels by recreational activities; these actions must include public education and outreach. Include management activities that are currently underway and anticipated to continue, as well as any new efforts and those planned for the future that will be implemented. If actions are included for which uncertainty exists whether they will be implemented, clearly state that their implementation is uncertain.

Documenting Prevention Programs

Preparation

To fulfill the requirements of CCR Title 14, Section 672.1(b)(3), a written document describing the prevention program that includes the three elements detailed above must be submitted to CDFW. The document (termed a ‘prevention plan’) can be a stand-alone document that covers only the prevention program. The statutory requirement can also be satisfied when the three required elements are contained within another document. In either case, the document must contain adequate information and detail for CDFW to evaluate the prevention program within the context of the agency and environmental setting (Appendix 4), provide detail about the pathways that pose threats of introduction, specifics about the dreissenid mussel monitoring that will be implemented, and identify the actions that will be implemented to manage recreation, which must include public education and outreach.

The Dreissenid Mussel Prevention Program Template (Appendix 4) may be used independent from, or in conjunction with, this guidance to prepare a prevention plan. Additional sections, headings, and content may be included at the discretion of the author.

Submitting Prevention Plans to CDFW

Upon completion of the prevention plan, the agency should contact the appropriate CDFW contact (Appendix 3). CDFW will confirm receipt of the document and provide written comments and suggestions as appropriate.

Annual Reports

As required under CCR Title 14 Section 672.1 (b)(5), to demonstrate the prevention program’s implementation, annual reports (January 1-December 31) must be submitted to CDFW each year. These reports must summarize any changes to the waterbody’s vulnerability, the results of monitoring, and what management activities were implemented. An optional template is provided in Appendix 9.

As with the prevention plan, adequate detail must be included in the annual reports to allow CDFW to assess whether the prevention program is being implemented. Annual reports must be submitted to the appropriate CDFW contact by March 31 of each year.

Updating

There are no statutory requirements for periodically updating the prevention plan; however CDFW recommends the program be updated if there are new or significant changes in the management or conditions of the waterbody. Updates should be submitted to CDFW following the same process as a new plan would be.

Appendices

1. Fish and Game Code Section 2302
2. California Code of Regulations, Title 14, Section 672-672.2
3. CDFW Regional Scientist Contact List
4. Dreissenid Mussel Prevention Program Template
5. Surface Survey Monitoring Protocol
6. Artificial Substrate Monitoring Protocol
7. Plankton Tow Monitoring Protocol
8. Biobox Monitoring Protocol
9. Dreissenid Mussel Prevention Program Annual Report Template