

Wyoming Game and Fish Department Administrative Dreissenid Mussel Rapid Response Plan

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SUMMARY

Zebra and quagga (dreissenid) mussels are aquatic invasive species that have spread to most of the lower 48 United States. Wyoming is one of the few states where these invasive mussels have not been detected, but recent detections in neighboring states have heightened concerns about their introduction. As a result, dreissenid mussel rapid response plans have been developed for the 23 highest risk waters in Wyoming. These plans detail how invasive mussels would be contained in each water after initial detection. This administrative rapid response plan is a companion to individual water rapid response plans, providing an overview of the existing Aquatic Invasive Species (AIS) program in Wyoming, which focuses on keeping invasive mussels and other AIS out of the state. This plan also details the existing AIS regulations and potential changes needed if dreissenid mussels were detected in Wyoming. This document then gives an overview of individual water rapid response plans and outlines how dreissenid mussels would be detected and confirmed through sampling and laboratory testing. Next, this plan details the steps that should be followed after an initial detection of dreissenid mussels, including a communication plan, follow-up sampling, implementation of the water-specific rapid response plan, personnel hiring and equipment acquisition, National Environmental Policy Act compliance and an overview of what a local boater program may entail. Finally, this plan gives an overview of the statewide communication plan needed to disseminate information about a dreissenid mussel detection to the public. In concert with the individual water plans, this plan provides resource managers with a process by which they can respond quickly and effectively to contain a dreissenid mussel detection in a Wyoming water.

INTRODUCTION

Zebra mussels (*Dreissena polymorpha*) are native to the Black and Caspian seas and were first discovered in the Great Lakes in 1988. Quagga mussels (*Dreissena bugensis*) are native to the Dnieper River Drainage in Ukraine and were first found in the Great Lakes in 1989. These mussels were initially introduced via ballast tanks on ocean-going ships and watercraft continue to be the primary vector for their spread in North America. The veliger (larval) form of dreissenid mussels can be transported in water in boats and other conveyances. Juvenile and adult mussels can be transported on boats and boat trailers where they attach with byssal threads and can survive for up to 30 days out of water under ideal conditions. Since their initial introductions, these species have spread across most of the United States, and have been detected in Wyoming's neighboring states of Nebraska, South Dakota, Montana, Colorado, and Utah (Figure 1). The close proximity of zebra and quagga mussels to Wyoming elevates the threat of introduction and increases the need for plans to contain them if detected. Of particular concern are lakes Powell and Mead in the southwestern United States. High boater use on these reservoirs, coupled with extremely high abundances of quagga mussels, have contributed to a recent increase in watercraft transporting live mussels and heightened concerns about dreissenid mussel establishment in Wyoming.

Zebra and quagga mussels are aquatic invasive species (AIS) that have far-reaching negative impacts on aquatic resources, recreation, and water-dependent infrastructure. These invasive dreissenid mussels are filter feeders that disrupt aquatic ecosystems by consuming planktonic food resources at the base of the food chain. Outcomes include decreases in the abundance and diversity of phytoplankton and zooplankton, and declines in native benthic invertebrates, including native mussels (Grigorovich and Shevtsova 1995, Haynes et al. 2005). In turn, these disruptions at the base of the food web can negatively impact the fisheries resources at higher trophic levels (Higgins and Vander Zanden 2010).

Infestations of dreissenid mussels also have negative impacts on recreation. Boaters must deal with infestations of mussels that encrust boat hulls and motors and clog water intakes for engine cooling, livewell and ballast tank systems. They also colonize hard surfaces such as boat docks, breakwalls and cobble beaches. Their sharp shells are a hazard to swimmers and other recreational users. Dreissenid mussel infestations have been linked to increases in harmful cyanobacterial blooms (Knoll et al. 2008) and mussel-induced increases in water clarity can contribute to overabundance of aquatic macrophytes. Lastly, accumulation of dreissenid mussel waste products (pseudo-feces) can cause water quality issues.

Invasive dreissenid mussels have significant economic impacts to water-dependent infrastructure. From 1989 through 2007, an estimated \$1-1.5 billion was spent in 23 states to combat zebra and quagga mussels (O'Neill 2008). Half of that cost was borne by the electric power generation industry, one third by drinking water treatment facilities and one tenth by industry. A more recent risk assessment in Montana found that the three top stakeholder groups facing the largest potential economic impacts from dreissenid mussel invasion were tourism, irrigation and hydropower (Nelson 2019). The most pervasive issue is mussels colonizing the inside of pipes that transport water from an infested source to water treatment plants, power plant cooling systems or other industrial uses. The mussels will inhibit flow in and eventually completely clog pipes, crippling the end user dependent on this water. Invasive mussels can also negatively impact agriculture in the west since they can disrupt the flow of water through irrigation canals and sprinkler systems. In Montana, it was estimated that dreissenid mussel

damage costs to irrigation could range from \$3.8-7.9 million in the Columbia River Basin and \$25.4-52.6 million in the Missouri River Basin (Nelson 2019).

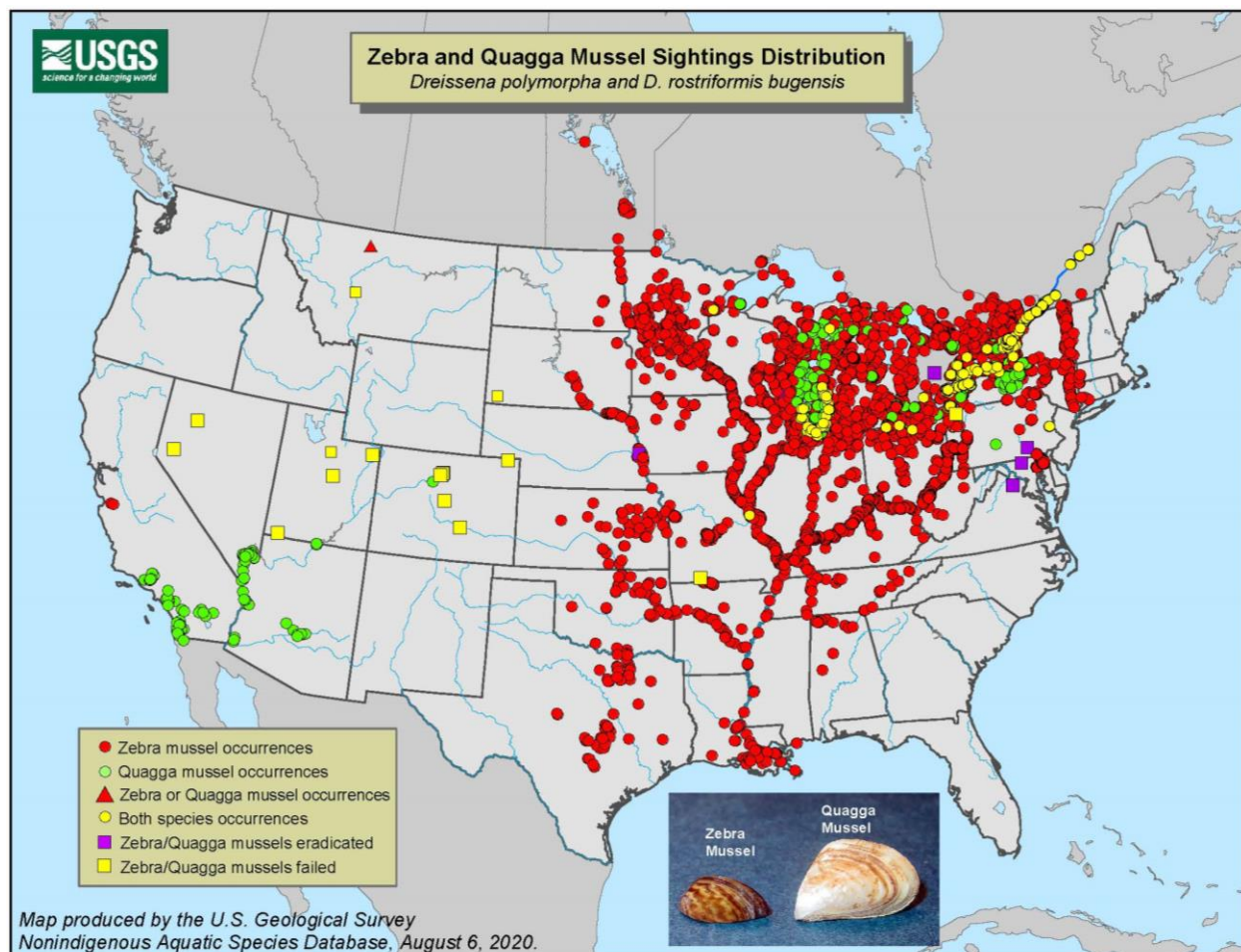


FIGURE 1. Distribution of zebra and quagga mussel detections in the lower 48 United States, as of August 6, 2020. Map courtesy of the U.S. Geologic Survey Nonindigenous Aquatic Species Database.

Wyoming is a headwater state and is the source for three major North American river drainages; the Missouri, Colorado and Columbia. In addition, the southeastern corner of Wyoming is within the land-locked Bonneville Basin. The detection of dreissenid mussels in Wyoming would trigger a cascade of downstream impacts in one of these drainages and would put them in close proximity to the other drainages. Zebra and quagga mussels have been detected in most of the lower 48 United States (Figure 1). The southeastern states of Florida, Georgia, South Carolina and North Carolina do not have confirmed detections of zebra or quagga mussels (Figure 1). However, the lack of monitoring in these states coupled with their proximity to known populations has led the WGFD AIS program to consider these states positive for dreissenid mussels when evaluating importation risk (WGFD 2020a). The northwestern states of Washington, Oregon, and Idaho, as well as New Mexico are the only lower 48 states that have monitoring programs in place and have not detected dreissenid mussels. The

northwestern states comprise the Columbia River drainage, the only major river drainage in the lower 48 states where invasive mussels have not been detected. The WGFDD AIS program is currently working to keep the Columbia drainage and the upstream extents of the Colorado and Missouri drainages free of invasive mussels. However, in the event that invasive mussels are detected in Wyoming, a deliberate and timely response will be critical to preventing their spread to vast portions of the western United States. Therefore, Wyoming dreissenid mussel rapid response plans will not only be critical for safeguarding the aquatic resources of our state, but for a significant portion of the western United States.

Wyoming's Current AIS Program

Currently, Wyoming's AIS Program is focused on outreach, watercraft inspection, and monitoring, with the overall goal of keeping invasive species such as zebra and quagga mussels out of the state. In 2020, the AIS Program consisted of one full time AIS Coordinator, three full time Regional AIS Specialists, three 12-month contract Regional AIS Specialists, two contract 9-month Regional AIS Specialists, and 45 seasonal technicians.

Outreach

Public outreach has been a focus of the Wyoming AIS Program since its inception in 2010. The goal of public outreach efforts is to educate boaters about the threats of AIS and what they can do to help limit their spread. The primary avenue for public outreach is educating boaters who stop at check stations throughout the state. Outreach efforts also focus on providing AIS information at local events, fairs, and in schools. In addition, the AIS Program provides education and outreach at the annual WGFDD Outdoor Expo in Casper, and at regional boat shows in surrounding states. Over the past several years, the WGFDD has also conducted a boater appreciation raffle to thank boaters for cooperation with watercraft inspections, increase compliance by incentivizing watercraft inspections, and gather information from boaters about the inspection process. Raffle entry details are found on the back of each watercraft inspection receipt. Boaters fill out an online survey and are entered in a drawing for a chance to win prizes.

Inspections

Wyoming law requires inspection of all watercraft entering the state between March 1 and November 30, or year round if the watercraft was last on an infested water. The WGFDD currently maintains 14 inspection stations (primarily at Department of Transportation Ports of Entry) that intercept incoming watercraft and inspect them for the presence of AIS (Figure 2). The WGFDD AIS program also conducts inspections by roving personnel at waters, and at regional offices. A total of 75,620 watercraft were inspected between April 18 and September 13, 2020. Of these, twenty-two watercraft were intercepted with suspected dreissenid mussels attached, all of which were determined to be dead and not viable.

Several training courses are conducted throughout the state each year to certify inspectors. In 2019, a total of 19 watercraft inspection and decontamination trainings were conducted in 12 different locations, certifying a total of 167 individuals. Since 2010, over 1,800 individuals have been certified to inspect and decontaminate Wyoming watercraft. Training manuals (WGFDD 2020a) are updated regularly to provide the most current information to inspectors charged with keeping AIS out of Wyoming.

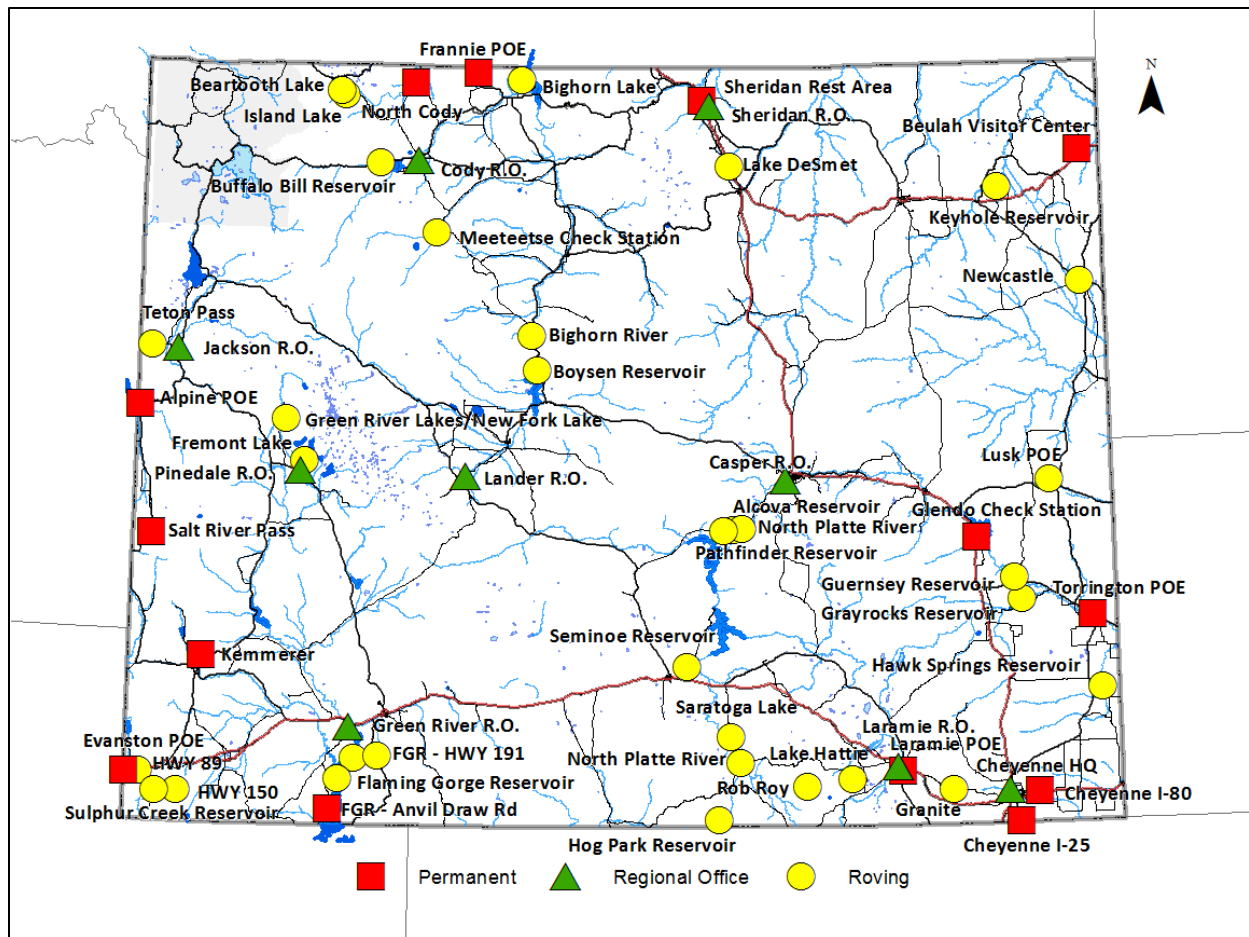


FIGURE 2. Distribution of permanent, regional office and roving AIS check stations in Wyoming.

Monitoring

Annual monitoring for AIS, including zebra and quagga mussels, is conducted on priority waters throughout Wyoming according to procedures outlined in WGF (2020b). High and moderate risk waters are sampled twice per year, whereas low priority waters are sampled once per year. In 2020, monitoring was conducted at a total of 376 sites on 76 waters, including 68 lakes and 8 streams or rivers. To date, no zebra or quagga mussels have been detected in Wyoming. For more information on zebra and quagga mussel monitoring, see the “Confirmation of AIS” section, below.

Regulations

Wyoming’s current rules concerning aquatic invasive species can be found in statute (Title 23, Chapter 4, Sections 201-206) and regulation (Chapter 62). These statutes and regulations enacted to prevent unwanted species from being introduced into Wyoming. However, current regulations may not be sufficient to contain dreissenid mussels should they become established in a Wyoming water. The primary goal of dreissenid mussel rapid response

plans for Wyoming waters is to prevent the spread of mussels from a suspect, positive or infested water, to other waters. To meet this goal, it will be necessary to require all boats leaving a suspect, positive or infested water to be inspected and, if necessary, decontaminated. In addition, full or partial closures may be necessary to consolidate watercraft at a limited number of points to facilitate exit inspections. Finally, if a local boater program is pursued at a suspect, positive or infested water, that program will need to be crafted so it is consistent with AIS statutes and regulations.

Watercraft Inspections

Under current statute [W.S. 23-4-203(a)], the "...commission, and the department of state parks and cultural resources..." has the statutory authority to "promulgate rules and regulations to administer and enforce the provisions of this article and to establish, operate and maintain aquatic invasive species check stations in order to inspect conveyances." Currently, all watercraft entering the State of Wyoming by land are required to be inspected for AIS prior to contacting waters of this state [Chapter 62, Section 4(g)]. In addition, all watercraft that encounter an AIS check station are required to stop and be inspected [Chapter 62, Section 4(g)]. However, there is currently no regulation that requires an inspection and, if necessary, decontamination, when a watercraft leaves a Wyoming water that is suspect, positive or infested with dreissenid mussels. Chapter 62, Section 4(a(ii)) states that "if a person refuses to allow inspection of a conveyance or to complete any required removal and disposal of aquatic invasive species prior to departure from any waters of this state known to contain an aquatic invasive species, the conveyance is subject to impoundment until an aquatic invasive species inspection and decontamination is completed." Chapter 62, Section 4(i) states that "a conveyance suspected to contain an aquatic invasive species shall be decontaminated before said conveyance shall be allowed to contact any waters of this state." Although both of these statements may give the WGFD the authority to require decontaminations of watercraft leaving suspect, positive or infested waters, neither of them actually require an inspection after use on such a water. It would be advantageous to clarify language in Chapter 62 to require any boat leaving a suspect, positive or infested Wyoming water be inspected and, if necessary, decontaminated prior to contacting any other water of the state. Some neighboring states require watercraft leaving a suspect, positive or infested water be inspected and decontaminated prior to "leaving the water body" instead of prior to "contacting any other water of the state." If regulations state "prior to contacting any other water of the state," boaters would not be in violation if an inspection was not available when leaving the water body.

Closures

If a Wyoming water is deemed suspect, positive or infested with dreissenid mussels, it may be necessary to close that water completely. Some complete closures could be temporary. For example, a water may need to be closed temporarily to allow time for resources to be put in place to inspect exiting watercraft. Once check stations are established, the water would be reopened. Other complete closures could be permanent. For example, it may be prudent to completely close a water to watercraft if use is low enough that the expense of containment cannot be justified. Under Chapter 23 (Regulation governing uses of lands and waters acquired or administered by the Wyoming Game and Fish Commission), Section 5(c), the Wyoming Game and Fish Commission currently has the authority to institute temporary or permanent

closures on lands owned or administered by the Commission. Closing waters that are owned or administered by the Commission would be as simple as posting signs. However, the Commission currently does not have the ability to restrict use on waters that they do not own or administer. If a closure is necessary on a water that is not owned or administered by the Commission, that closure could be instituted by the agency with management authority for that water (e.g., U.S. Forest Service, National Park Service, Wyoming Department of State Parks and Cultural Resources). On waters managed directly by the Bureau of Reclamation (BOR), or reservoirs where BOR has an agreement with a managing partner to manage recreation facilities, any proposed actions that would require a prolonged closure or limiting of public access must adhere to 43 CFR. The WGFD would need to work alongside BOR and their managing partners to implement any closures for compliance with 43 CFR Part 423.

In some cases, it may also be necessary to partially close a water in response to a dreissenid mussel detection. For instance, it may be necessary to close some ramps in order to consolidate watercraft at fewer ramps. Similarly, it may be necessary to prohibit the launching of watercraft from the shoreline other than at a designated boat ramp (shore launching). Also, it may be necessary to close a water to launching and/or trailering of watercraft at night or prohibit mooring of watercraft. Similar to a complete closure, the Commission currently has the authority to institute these partial closures on waters they own or administer. However, the Commission does not currently have the authority to institute such partial closures on waters they do not own or administer. In those instances, partial closures would need to be instituted by the agency with management authority.

According to W.S. 23-4-203(c), "...the commission, in consultation with the department of state parks and cultural resources, may restrict watercraft usage on waters of the state as provided in W.S. 41-13-211(b) upon a finding that a specific body of water is threatened with the imminent introduction of an aquatic invasive species or an aquatic invasive species has been introduced to the specific body of water." Therefore, under current statute, the Commission could institute closures in response to a detection of dreissenid mussels by enacting an emergency regulation, a process that could be accomplished in a matter of days. This process would entail consulting with the Department of State Parks and Cultural Resources (SPCR), holding emergency public meetings, having the Commission make a finding on the record that the body of water is threatened with imminent introduction of AIS or an AIS has already been introduced, and then approving an emergency regulation that designates the water body as restricted. This restricted designation would then allow a water to be closed for a limited amount of time, until the emergency regulation expires. A similar process could be undertaken to establish an actual (not emergency) regulation, but it is anticipated that process could take considerably longer.

Given that closures may be necessary on waters not owned or administered by the Commission, consideration should be given to making changes to existing regulations. Under the Aquatic Invasive Species Act, no person shall "launch any conveyance into the waters of this state without first complying with aquatic invasive species prevention requirements established by commission rule..." [W.S. 23-4-202(a,i)]. Therefore, the Commission could develop regulations that clarify cases in which they could designate locations as restricted. As noted above, the Commission already has the authority to close waters that they own or administer. These new regulations would assist in limiting the spread of AIS from waters the Commission does not own or administer. When developing these regulations, they should allow for partial closures (e.g., night, shore launching, or specific boat ramp closures), as current statutes (e.g.,

W.S. 41-13-211(b)) and regulations may only allow for complete closures. Given the language in W.S. 23-4-203(a), the Commission and SPCR can already make changes to regulations. The only reason for a change in this statute would be to remove the necessary consultation with SPCR. The reason for their inclusion in the statute is unclear, but does not seem logical or necessary in cases where SPCR does not have management authority over a water body.

Local Boater Program

If a local boater program (see below) were initiated on a Wyoming water, it would be necessary to make additional changes to regulation. If regulations are enacted to require inspection of watercraft leaving a suspect, positive or infested water, there will need to be exemptions included for boats enrolled in a local boater program.

Rapid Response Plans

Rapid response plans have been developed for the 23 highest priority waters in Wyoming (Table 1). Prioritizations are based on risk assessments completed by Bear (2009) and Leonard and Bear (2019) and take into account both the potential for mussels to become introduced as well as the suitability for mussels to become established. A water with high likelihood for invasive mussel introduction would have high boater use, particularly by out of state boaters. A water with high suitability for mussel establishment would have water with chemical and physical characteristics that favor zebra or quagga mussel survival and colonization.

These rapid response plans outline the steps needed to quickly mobilize personnel and equipment to provide exit inspections and, if necessary, decontaminations of all boats leaving a water that is suspect, positive or infested with dreissenid mussels. Figure 3 conceptualizes the process by which dreissenid mussels would be detected in a Wyoming water. Plans will be initiated when zebra or quagga mussel veligers (larvae) or adults are detected in a sample from a particular water and are verified by independent experts and genetic analysis. At that point, the water will enter Short-term Suspect Status. This coincides with the period of time necessary to conduct additional sampling and testing necessary to verify whether zebra or quagga mussels are present (up to six weeks). If follow-up sampling does not detect zebra or quagga mussels, the water will enter Long-term Suspect Status and monthly monitoring will be initiated. If zebra or quagga mussels are not detected for three years, the water will once again be considered negative. Conversely, if two sampling events within a 12-month period detect zebra or quagga mussels, the water will enter Positive Status and will not be considered negative again unless mussels are not detected in monthly monitoring for five years. Finally, a water will enter Infested Status when evidence shows a recruiting and reproducing population of zebra or quagga mussels is established. At this point, eradication of mussels is highly unlikely and containment efforts will be necessary for the foreseeable future.

These plans are intended to be implemented quickly and act as guiding documents for initial decision making following detection. They are not intended as long-term containment plans, but will outline the actions necessary to provide short-term containment while a long-term containment and monitoring plan is developed.

TABLE 1. Wyoming waters with the highest potential for establishment of invasive dreissenid mussels. Priorities are based on risk assessments by Bear (2009) and Leonard and Bear (2019).

Water	Fish Management Region	Priority
Glendo Reservoir	Casper	Very High
Alcova Reservoir	Casper	High
Seminole Reservoir	Casper	High
Guernsey Reservoir	Casper	Moderate
Pathfinder Reservoir	Casper	Moderate
Grayrocks Reservoir	Laramie	Very High
Granite Reservoir	Laramie	High
Hawk Springs Reservoir	Laramie	Moderate
Wheatland Reservoir #3	Laramie	Moderate
Flaming Gorge Reservoir	Green River	Very High
Fontenelle Reservoir	Green River	High
Viva Naughton Reservoir	Green River	High
Sulphur Creek Reservoir	Green River	Moderate
Boysen Reservoir	Lander	High
Ocean Lake	Lander	Moderate
Pilot Butte	Lander	Moderate
Bighorn Lake	Cody	High
Buffalo Bill Reservoir	Cody	High
Jackson Lake	Jackson	Very High
Palisades Reservoir	Jackson	Moderate
Keyhole Reservoir	Sheridan	Very High
Lake DeSmet	Sheridan	Moderate
Fremont Lake	Pinedale	Moderate

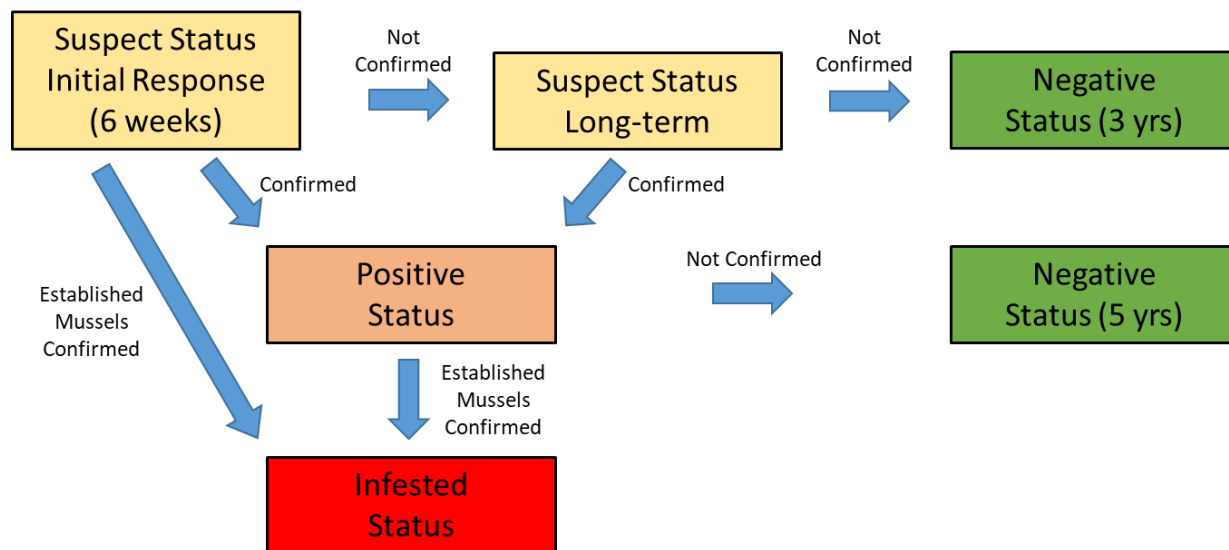


FIGURE 3. Conceptual model of the process by which dreissenid mussels would be detected in a Wyoming water. The model would begin in the Suspect Status Initial Response box when a sample meets the minimum criteria of detection (verification by two experts and genetic confirmation). “Confirmed” and “Not Confirmed” indicates whether subsequent samples met this minimum criteria for detection.

The purpose of this administrative rapid response plan is to serve as an overarching guide for the 23 individual water rapid response plans. It provides a detailed description of how waters are monitored for dreissenid mussels and the process by which mussels are detected and confirmed. It also details the steps that should be taken in response to a dreissenid mussel detection, including a communication plan to alert key stakeholders, plans for follow-up sampling to confirm initial detection, and plans for hiring personnel and acquiring equipment to contain the threat of mussels in the suspect water. In addition, it contains a public outreach plan detailing how information concerning the detection and confirmation of dreissenid mussels in a Wyoming water will be disseminated to the public. Finally, this plan outlines a general process by which a long-term containment plan will be developed in the event that mussels become established in a Wyoming water.

CONFIRMATION OF AIS

Description of monitoring protocols

Sampling and monitoring is an important component of the Wyoming AIS program and focuses on early detection of AIS to allow for rapid response plan implementation. Regular monitoring is necessary to determine when the introduction of an invasive species occurs. Early detection results in greater potential for containment or eradication, ultimately minimizing the negative impacts and financial burden from AIS. Post-detection sampling and monitoring provides insight into population persistence and impacts on the ecosystem, infrastructure, and human use of those waters. Monitoring provides an understanding of how environments are changing as a result of the invasion. Currently, there are few, if any, effective control measures

for most AIS. Monitoring efforts can contribute data to research on the success or failure of new control strategies. Sampling and monitoring are integral in understanding the size and nature of an infestation and can be important tools when planning the future of water management in Wyoming.

A water body risk assessment for zebra and quagga mussels was completed in 2019 for 71 waters in Wyoming (Leonard and Bear 2019). The risk assessment identified 13 *High* risk waters, nine *Moderate* risk waters, and 49 *Low* risk waters.

Plankton Tow Sampling

Plankton tows are performed to detect the initial microscopic life stage of mussels (veligers) while they are free floating in the water column. This allows for early detection to identify when the mussels are introduced into a water. Sampling occurs after water temperatures are above 60°F and preferably during times when turbidity is low. Samples are taken strictly from the water column to avoid large amounts of sediment unless the system has high amounts of suspended sediment regularly.

Plankton tows are taken at a minimum of two locations at every water. Typical sampling locations include areas where mussels are likely to be introduced (e.g. marinas, docks, boat launches, inlets, outlets, etc.), open water locations, and near dams. Plankton tow sites are spread out to increase the likelihood of detecting veligers in both open water and near shore.

Each tow location consists of at least six individual tows. The first individual tow at a sample location is used as a replicate copy that is stored until the end of the season. The remaining five individual tows at the same location are consolidated in a single sample bottle. As a result of the number of locations at each water body and the number of tows at each location, there are a minimum of 10 tows (2 sample jars) per water sent to the lab for analysis.

High/Moderate risk waters are sampled twice per season with the first sampling conducted once surface water temperatures are above 60°F (June/July). If surface water temperature does not regularly exceed 60°F, the first sampling is conducted when temperatures are at their warmest. The next sampling occurs during the fall in late September or early October. *Low* risk water bodies are sampled once per season in the summer (between June and September).

All plankton tow samples processed for dreissenid identification follow a three-tier identification process. Samples are first analyzed by visual identification using cross-polarized light microscopy. If positive or suspected positive results occur from microscopy, the samples are sent to an independent lab for DNA analysis via PCR and gene sequencing.

Existing Surface Sampling

Existing surfaces or substrates are sampled for the presence of dreissenids and other AIS with relative ease. These surveys involve a visual survey to look for any attached dreissenids or other AIS on objects residing in the water for a prolonged time. Preferred locations for surveys are underside of docks, shaded side of permanent structures, underside of buoys, and natural materials such as rocks, wood, or aquatic plants/animals. Existing surface sampling is conducted once per season at each water at the time the water is visited for plankton tow sampling.

Shoreline Surveys

Sampling and monitoring lentic (shorelines of lakes, reservoirs, and ponds) waters is conducted to document populations of AIS including mussels, snails, crayfish, and plants. Shoreline surveys are completed every year at all waters when conducting water sampling. Sampling occurs at sites where initial introductions of AIS are likely to occur. These are typically areas of high recreation use such as docks, marinas, launch sites, and river access points, and only wadeable portions of shorelines and streams are sampled.

These surveys include a visual search for mussels, clams, and snails on large substrates (rocks, logs, plants, roots) in or adjacent to the stream or along the shoreline for 100 ft above and 100 ft below access point, boat dock, launch site, etc. (200 ft. total surveyed). An AquaScope underwater viewer assists in viewing deep waters and limiting disturbance. In addition, kick nets are sometimes used when shoreline sampling to assist in detection of AIS.

Description of laboratory testing

Plankton tow water samples are preserved in ethanol and shipped to the Montana Fish Wildlife and Parks (MTFWP) Veliger Lab in Helena. Samples from water bodies with facilities operated by the U.S. Bureau of Reclamation (BOR) are split and half the sample is also sent to the BOR Lab in Denver for analysis.

Samples are analyzed using cross polarized light microscopy (CPLM) as a primary early detection technique according to widely accepted standards as outlined in the MTFWP Aquatic Invasive Species Early Detection and Monitoring Program Laboratory Standard Operating Procedures (MTFWP 2019). Cross-polarized light is one of the simplest and most efficient methods for distinguishing between items found in planktonic samples. Bivalve larvae are one of the few birefringent (optical property of a material having a refractive index that depends on the polarization and propagation direction of light) objects found in plankton samples. Polarized light is used to quickly detect mineralized material (such as a shell) in the sample. Larvae are birefringent due to the crystalline calcite structure of the larval shell and glow as bright spots under polarized light. Because of the arrangement of the calcite crystals, portions of the shell in line with the axes of the cross-polarizing filters do not reflect the light and thus the veligers appear with a small, glowing Maltese cross. A Maltese cross is a cross with arms of equal length that broaden from the center and have their ends indented in a shallow “V” shape. Corbicula larvae, other dreissenid larvae, ostracods (seed shrimp, a type of microscopic, freshwater crustacean), and glochidia (the microscopic larval stage of some native mussels) must be distinguished based on morphology, behavior, size, shape, or other features. However, given the quantity of extraneous material that may be present in a plankton sample, cross-polarized light provides a simple way to narrow the range of possibilities (MTFWP 2019).

Most samples processed in the lab are preserved using 95% ethanol (ETOH), though live samples may also be viewed. Some larval characteristics cannot be seen with preserved samples (such as the presence of a foot or siphon). Montana FWP requires all preserved samples have a final concentration of ETOH at 70%. Trained technicians use visual identification to differentiate between invasive species and commonly occurring native species and inorganic particles. If a suspect veliger is detected, that sample may be sent to a partner lab for genetic analysis, but that testing does not occur in-house. CPLM is critical to quickly locate bivalves in a plankton sample. All samples that are received in the lab are prioritized and the pH tested to ensure that the samples will be stable on the shelves. Each sample is filtered using two separate

filters and the contents of the filter are rinsed into a glass petri dish. To reduce the chances of sample cross-contamination, each state has its own designated set of filters (MTFWP 2019).

Samples are analyzed visually through CPLM by moving the petri dish from side to side. All suspect organisms are measured using an ocular micrometer and photographed. Any suspect veliger(s) found are photographed and verified with each microscope's camera. A compound microscope is used to examine and photograph the specimen in closer detail. Higher levels of magnification on the compound microscope are used to inspect suspect objects for characteristics and morphological features. When a suspect organism is found, the lab technician will transfer the organism from the petri dish to a glass slide using a micropipette before being examined and photographed under the compound microscope (MTFWP 2019).

If a sample contains a suspect dreissenid veliger, the lab technician captures digital images (both from the dissecting microscope and compound microscope). The lab technician, lab manager, and another FWP designated expert will examine the images, and when possible, the suspect under the microscope. It is always best for an expert to see the suspect organism under the microscope so it can be manipulated and looked at from different angles. If the sample is still suspected to be a dreissenid veliger, the digital images are sent to two independent labs/experts for verification. The independent labs used for verification identify positive dreissenid samples on a regular basis. The remaining half of a sample may be processed either internally or by another lab (for both microscopy and/or PCR) if considered suspect. A sample is positive if any zebra or quagga mussel veligers are found no matter the quantity (after independent verification using both photographic evidence and the remaining half of suspect sample).

This method is not one hundred percent accurate, but it is very useful in early detection. Accuracy is reduced when samples are not preserved correctly, or when there is a large amount of detritus in the sample. If samples are negative (veligers are undetected), the lab technician will notify the WGFD AIS Coordinator when the samples are completed. If suspect veligers are found, the Coordinator will be notified by the lab manager and provided with the photos of the suspect organisms as well as the explanation on species and age (MTFWP 2019).

Definition of each status level

Sampling of Wyoming waters is conducted annually in accordance with the "Wyoming Game and Fish Department Aquatic Invasive Species Sampling and Monitoring Manual." High priority waters are sampled twice per season (June/July, and September/October), and lower priority waters are sampled once per season in September/October. To determine whether Wyoming waters contain evidence of AIS, specimens of adult or juvenile crayfish, snails, mollusks, plants, etc. are collected during routine sampling and any specimen suspected of being AIS must be positively identified by at least two independent experts. Only samples collected by the WGFD may be used to change the classification of a water. Samples collected by a third party will be used as a notification of a possible detection which must further be confirmed by a WGFD sample.

To meet the minimum criteria for detection of dreissenid mussels, an adult or juvenile specimen must be verified by two independent experts and confirmed by DNA, or a veliger (larval form) must be identified and verified using cross-polarized light microscopy by two independent experts and confirmed by DNA analysis (PCR and gene sequencing).

Based on sampling results, waters are given certain classifications related to their dreissenid mussel status:

A water body that has not been sampled for aquatic invasive species is classified as *Unknown/Not Tested*. A water body at which sampling is ongoing and nothing has been detected (or nothing has been detected within the time frames for de-listing) is classified as *Negative*. Currently, all waters in Wyoming are classified as either *Unknown/Not Tested*, or *Negative*.

A water body classified as *Inconclusive* has not met the minimum criteria for detection but evidence of dreissenids has been documented. For example, evidence of a mussel veliger is detected via microscopy but cannot be confirmed by DNA analysis. This is a temporary classification and additional sampling of this water will be conducted to determine whether the water body is classified as negative (no detections in subsequent sample) or suspect (verified detection in subsequent sample).

A water body classified as *Suspect* indicates a water at which one sample has been verified by visual confirmation (visual identification of adult or microscopy identification of veliger) and this sample was confirmed as dreissenid by DNA analysis (PCR and gene sequencing). In this scenario, additional sampling will be conducted to determine whether another sample taken within 12 months detects evidence of dreissenids. If a subsequent sample does detect dreissenids, this water will then be classified as positive.

A water body classified as *Positive* indicates a water at which two or more sampling events within a 12-month period meet the minimum criteria for detection. For example, samples from two different sampling events are verified by both visual identification (including microscopy) and DNA confirmation (PCR and gene sequencing).

In many cases, a water classified as *Positive* will ultimately become *Infested* which is a water body with an established (recruiting and reproducing) population of AIS. For example, Lakes Mead and Powell are considered infested waters as they have large populations of reproducing dreissenids and mussels are readily evident on the shoreline and submerged materials such as docks, buoys, etc.

Criteria for de-listing

In some instances, the classification of a water body can be downgraded over time. The exact reasons why dreissenids are detected at a water once, then not again in subsequent sampling, or are detected in a water classified as positive but never establish a population, remains largely unknown.

A water body initially classified as *Inconclusive* can be de-listed to *Negative* status after one year of negative testing results including at least one sample taken in the same month of subsequent year as the initial positive sample (to account for seasonal environment variability). The time frame for de-listing a water body extends from there, with a water body initially classified as *Suspect* requiring three years of negative testing to re-classify to *Negative*, a *Positive* water body requiring five years of negative testing to re-classify to *Negative*, and an *Infested* water body requiring a successful eradication or extirpation event and a minimum of five years of negative testing results post eradication event to re-classify to *Negative*.

Environmental DNA Monitoring

Environmental DNA (eDNA) is an evolving technique for detection of invasive species. The U.S. Department of Interior Bureau of Reclamation has begun using this technique to monitor for invasive mussels in western reservoirs (including in Wyoming) and some western states such as Utah have begun investigating use of the technique as well. Sampling for

dreissenid mussel eDNA consists of collecting a sample with the plankton tow method or by filtering water, extracting and amplifying the DNA in the sample and analyzing it to determine if the DNA from a species of interest is present. Although the technique can detect organisms at very low abundances, interpretation of results can be complicated by a number of factors. For instance, eDNA for a particular organism is not distributed evenly in the environment. Therefore, a negative sample does not necessarily indicate the species is not present. In addition, eDNA techniques do not differentiate between live and dead DNA. Therefore, DNA material may be present (e.g., dead mussels sloughing off boats at a ramp) without the presence of live mussels. Due to these and other complicating factors, the WGFD will not consider a “positive” eDNA sample as evidence to classify a water body as Inconclusive, Suspect or Positive. A “positive” eDNA sample could be used to target additional sampling to see if dreissenid mussels can be detected using conventional laboratory techniques outlined above.

In 2020, the Western Invasive Species Coordinating Effort (WISCE) approved and released a statement and resolution regarding the results of eDNA sampling. The statement (in its entirety) reads:

“Detection of dreissenid mussel environmental DNA (eDNA) does not, in and of itself, constitute proof of detection that a water body contains live dreissenid mussels, but rather an indicator of likelihood that a water body was exposed to some level of live or dead dreissenid mussel eDNA (biological matter). The distinction between exposure to eDNA and the actual presence of a live organism is critical for resource managers both for communication of results and when determining when to initiate any response. Therefore, the members of the Western Invasive Species Coordinating Effort are in consensus that detection of dreissenid mussel eDNA, in and of itself, is insufficient to meet detection standards for classifying a water body for the presence of dreissenid mussels. States will respond to and share eDNA results as they deem appropriate.”

As of May, 2020, the resolution (WISCE 2020) had been forwarded to the AIS committee of the Western Association of Fish and Wildlife Agencies for their adoption. Adoption of the resolution essentially makes it clear that the member states of the Western Association of Fish and Wildlife Agencies will adopt and fully utilize the zebra and quagga mussel water body listing and notification standards developed by the Western Regional Panel’s Building Consensus Workgroup (WRP 2019). This document clearly states that, “Currently, eDNA is not a scientifically accepted technique to verify a dreissenid mussel detection.” Therefore, Wyoming Game and Fish Department will continue to use the water body listing standards outlined above, which concur with WRP 2019.

STEPS IN RESPONSE TO INITIAL DETECTION

Communication Chain

If a sample from a Wyoming water body meets the minimum criteria for detection, both the Administrative and Individual water communication chains will be activated. If a sample is deemed inconclusive (has evidence of zebra or quagga mussels, but does not meet the minimum criteria for detection), the communication chains will not be activated.

Upon receiving notice a sample has met the minimum criteria for detection, the AIS Coordinator will begin the Administrative Communication Chain (Figure 4). The AIS Coordinator will contact the Fish Division Chief, who will contact the WGFD Director, Fish Division Staff and the chiefs of the Wildlife and Services divisions. The WGFD Director will also notify the Wyoming Game and Fish Commission and relevant Wyoming state agency directors (e.g., State Parks and Cultural Resources, Transportation, etc.).

The AIS Coordinator will also contact the affected Regional Fisheries Supervisor who will initiate the Individual Water Communication Chain (Figure 5). This will entail contacting regional WGFD personnel and various division supervisors within the region. Regional Fish Division Personnel will also begin contacting key stakeholders identified in the individual water rapid response plan, including relevant state and federal agencies, local government officials, concessionaires and marinas, local property owners, irrigation districts and fishing tournament directors. The AIS Coordinator will also notify the WGFD Communications Director who will initiate the Public Outreach Plan (see below).

Finally, it will be the AIS Coordinator's responsibility to communicate the dreissenid mussel detection to the greater AIS community, including, but not limited to, the Western Regional Panel on Aquatic Nuisance Species, the Columbia or Missouri river basin teams of the 100th Meridian Initiative (if applicable), and the U.S. Geological Survey Nonindigenous Aquatic Species Database.

The goal of the communication chain(s) will be to notify all interested parties as soon as possible and alert them to the potential threat of dreissenid mussels at a particular water body. When contacting individuals about a dreissenid mussel detection, pertinent information to convey includes the name of the affected water, which species was collected, who collected the sample, where the sample was collected, which agency/expert analyzed the sample, any relevant information about the sample, who to contact for more information and a brief description of containment protocols that will be put in place. Contacting regional WGFD personnel will begin the mobilization of individuals to staff inspection stations and assist with other tasks in the Short-term Suspect Status response of the Individual Water Rapid Response Plan. Contacting key stakeholders is critical, given the need for assistance in locating check stations, and initiating partial closures on a particular water. Every effort should be made to quickly contact all partners and stakeholders before beginning public outreach efforts. The regional Fisheries Supervisor will attempt to make all contacts within 24 hours of detection and will contact the Communications Director once enough contacts have been made to initiate outreach efforts.

The communication chain should be revisited when any change in dreissenid mussel status occurs. All stakeholders should be regularly updated and stakeholder meetings should be considered as a way to keep all interested parties informed of current status and to coordinate the response.

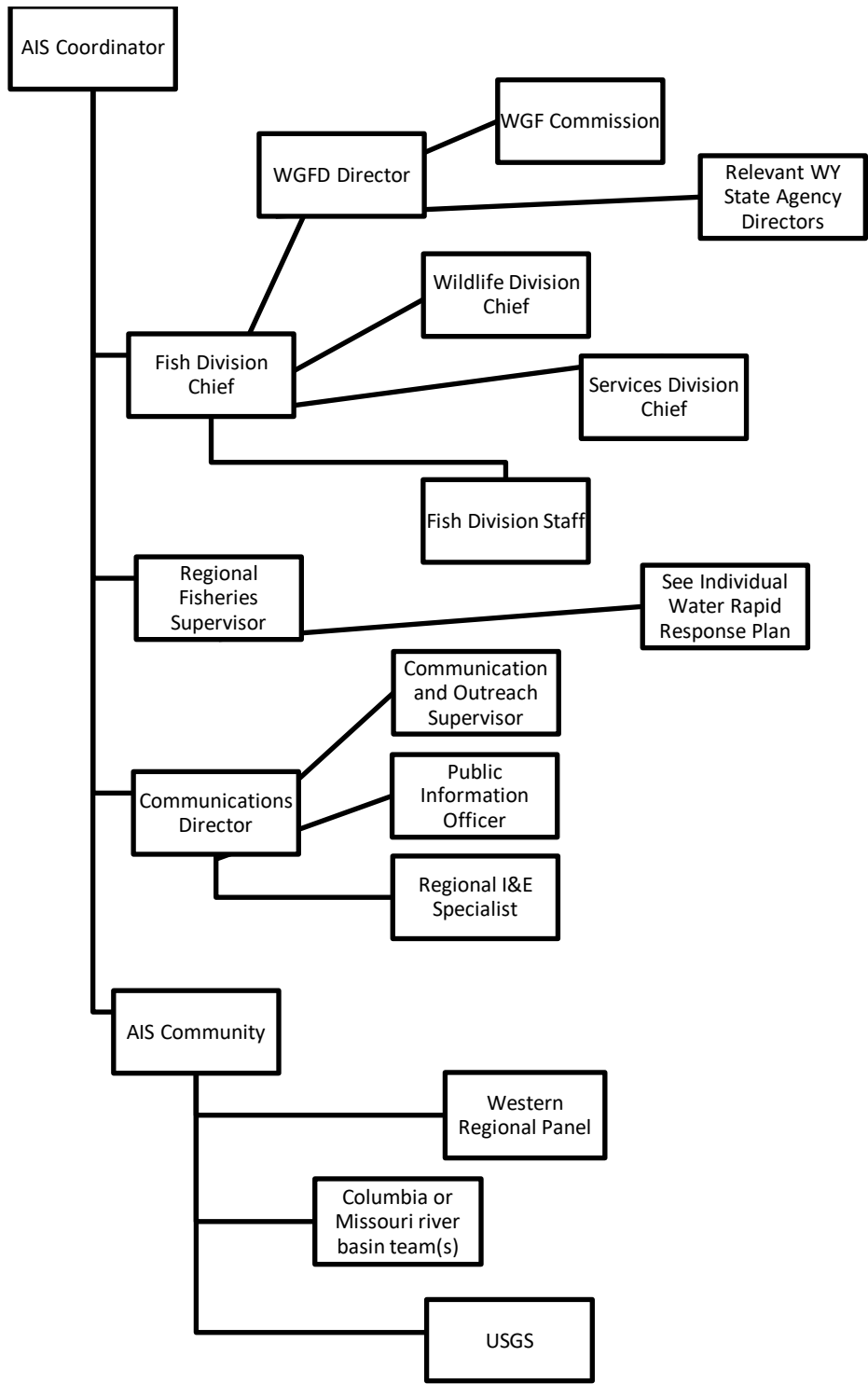


FIGURE 4. Administrative communication chain for dissemination of information following a dreissenid mussel detection in a Wyoming water.

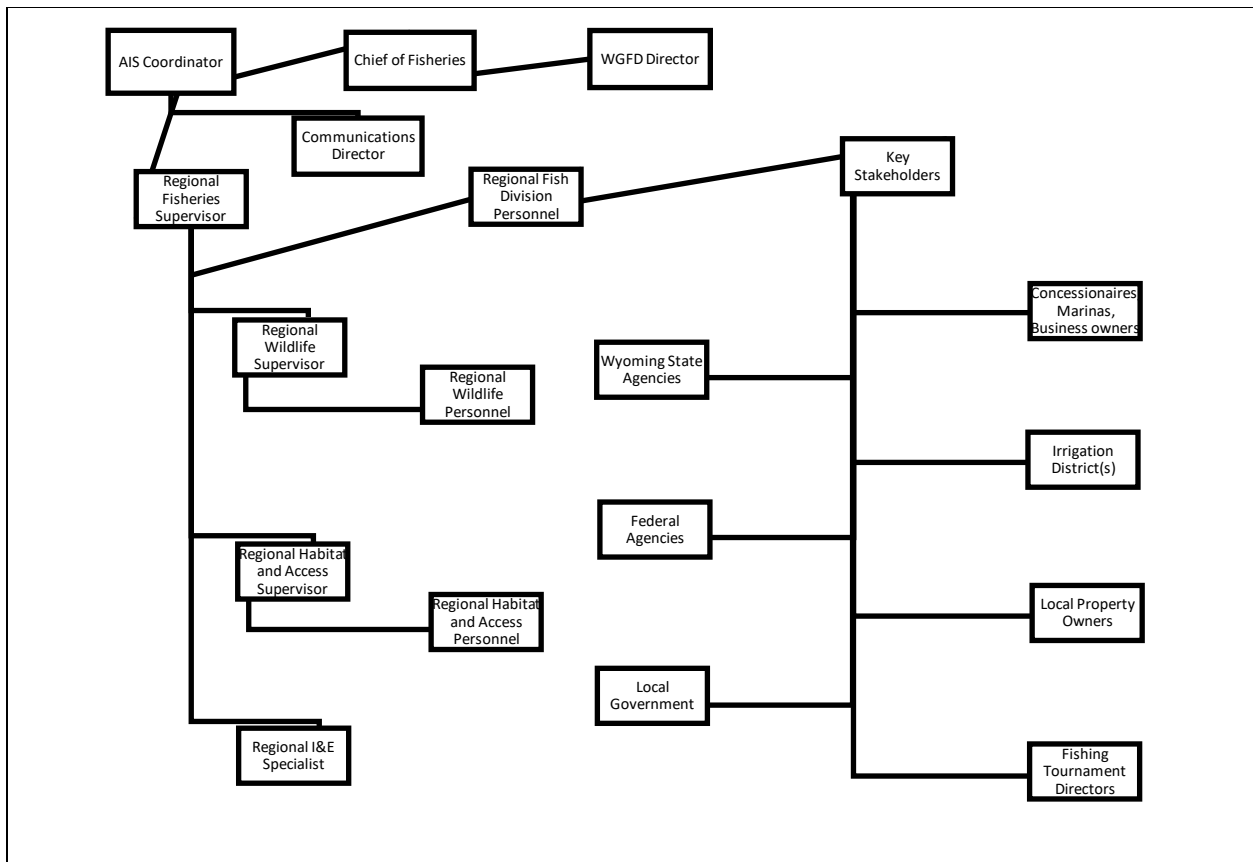


FIGURE 5. Communication chain for dissemination of information on the local level following a dreissenid mussel detection in a Wyoming water.

The focus of this plan is on containing invasive mussels through inspection and decontamination of exiting watercraft. Consideration should be given to other potential vectors that could spread invasive mussels (e.g., aircraft used to combat wildfires, commercial water hauling equipment) and communication and coordination should occur with these entities to ensure containment. Current information on preventing the spread of aquatic invasive species in firefighting and water hauling equipment can be found on the WGFD website at <https://wgfd.wyo.gov/Fishing-and-Boating/Aquatic-Invasive-Species-Prevention/AIS-Construction-and-Fire>.

Follow-up Sampling

In the event that a sample is deemed inconclusive (has evidence of zebra or quagga mussels, but does not meet the minimum criteria for detection) or suspect (meets the minimum criteria of detection), additional follow-up sampling will occur in an attempt to validate these results. Sampling crews will be deployed as soon as possible after initial detection. Sampling will be conducted and samples will be analyzed according to the WGFD Aquatic Invasive Species Sampling and Monitoring Manual (WGFD 2020b). Initial follow-up sampling and analyses should yield results within the six week Short-term Suspect Status period. After initial follow-up sampling and analysis, monitoring will continue at least once per month to track the

spread of dreissenid mussels. Initial follow-up sampling would occur in close proximity to the initial detection. If presence is confirmed, additional sampling should be conducted to ascertain the distribution of invasive mussel in that water body. Additional monitoring should be conducted to track the potential downstream spread of mussels. Detection should occur before attempting containment on downstream waters.

Implement Water-Specific Rapid Response Plan

Coincident with follow-up sampling, the rapid response plan for the individual water should be implemented. If a rapid response plan is not available for the suspect water, a rapid response plan for a similar water should be consulted and adapted to the particular water.

Personnel Hiring/Supply and Equipment Acquisition

Immediately after a sample meets the minimum criteria for detection, job announcements should be posted to begin the process for hiring personnel to staff inspection stations. Inspectors will be necessary to lead containment efforts regardless of whether the water remains in Suspect Status or is elevated to Positive Status. Beginning the process early will allow personnel to be hired as soon as possible, preferably by the end of the six-week Short-term Suspect Status period.

In addition to hiring personnel, requisitions will need to be processed to purchase equipment such as decontamination units, DMS signs, office trailers, camper trailers and water storage equipment. If applicable, contracts should also be developed for amenities such as water hauling, toilet rental, etc.

National Environmental Policy Act and National Historic Preservation Act

If it is necessary to develop parking or inspection areas, or install water, electrical service, or comfort stations on federal lands (e.g., National Forest, BOR or BLM), these improvements must comply with the National Environmental Policy Act (NEPA) and National Historic Preservation Act (NHPA). Many individual water rapid response plans have already investigated NEPA compliance needs. Additional time may be necessary to provide facilities for rapid response plan implementation if NEPA or NHPA compliance is necessary. In high priority waters, it is advisable that WGFD work with the appropriate federal agencies to obtain as many NEPA and NHPA clearances as possible prior to detection of dreissenid mussels.

Local Boater Program

An integral component of some rapid response plans for suspect, positive and/or infested waters is a “local” or “certified” boater program. Local boater programs are intended for boaters who only launch their watercraft on a single water, or who venture to other waters on rare occasions. The primary goal of rapid response and containment plans is to minimize the risk of spreading invasive mussels to other water bodies. Therefore, watercraft that only use the suspect, positive or infested water have little or no risk of spreading invasive mussels to other waters. A local boater program would provide a process by which these boaters could spend less time waiting for exit inspections and/or decontaminations. In turn, inspectors would spend less

time on these watercraft, freeing them up to spend more time inspecting and decontaminating higher risk watercraft that visit multiple waters.

Such a program is currently in place in Montana for Tiber Reservoir. In 2016, Tiber Reservoir was found positive and Canyon Ferry Reservoir was found suspect for dreissenid mussel larvae. No larval or adult mussels have been found in either reservoir since 2016 and Canyon Ferry Reservoir was downgraded to negative status in early 2020. A Certified Boater Program was initiated on both reservoirs to ease the inspection process for boat owners and to decrease the volume of boats at decontamination stations at these reservoirs. The program allows watercraft inspectors to focus on boats traveling between many different waterbodies instead of spending time on boats that only visit a particular water. Certified boaters can depart from the reservoir without going through a full inspection and decontamination if their next boating trip is on that reservoir. One additional benefit to boaters in the Montana program is that they can access additional boat ramps that are not available to boaters that are not certified. To enroll in the Montana Certified Boater program, a watercraft owners must choose either Tiber or Canyon Ferry reservoir as their designated water. They cannot be certified for both. Participants must pass a test (taken either online or in person), register their watercraft and trailer (if applicable) and sign a contract agreeing to abide by the Certified Boater rules. Certified boaters receive three decals per watercraft, two affixed to the watercraft and one affixed to the trailer that signify participation in the program. If a boater wishes to launch on a different waterbody, they must go to a decontamination station at their designated reservoir where their boat will be inspected, decontaminated if necessary, and sealed. Registration must be done annually, and watercraft must be re-certified if a change in ownership occurs. Only Montana boaters are eligible to enroll in the program and their watercraft must be registered in Montana. Boaters residing west of the Continental Divide must still get an inspection when crossing the divide from east to west, which makes the program less appealing to boaters residing west of the divide. Otherwise, certified boaters are still required to stop at AIS check stations, but will be expedited through the station, usually with only a brief interview.

A similar program was developed for Lake Powell by the Utah Division of Wildlife Resources. Dreissenid mussels were first detected in Lake Powell in 2012 and since then have infested the reservoir. The Utah program is called the Local Boat Program, and to be eligible individuals must reside in Page or Leechee, AZ, Grenehaven, Big Water or Church Wells, UT. In addition, watercraft that remain in local storage in Page, AZ or Big Water, UT are eligible. Individuals are required to fill out a Lake Powell Mussel Awareness Form and complete Utah's Mussel Aware Boater Program Course and the associated form. If the watercraft is locally stored, they also need to provide a receipt to confirm storage at the boat storage facility. Paperwork is submitted to a certified AIS Exit Inspection staff member, and the local boater receives a car dashboard tag and sticker that is applied to the boat's port bow. The boat operators are still required to clean, drain and begin drying the watercraft on the boat ramp before departing, but AIS staff will not need to oversee this process or apply an inspection seal to the watercraft. If a boater participating in the program wishes to launch their watercraft in another water body in the state of Utah, it must receive a full professional decontamination from a certified AIS staff and the watercraft may be required to dry for a period of time based on the season. In 2020, the Arizona Game and Fish Department also made a local boater program available for Lake Powell boaters. Local boaters in this program are defined as those residing or storing a boat within 20 miles of Page, AZ and participants are required to submit a program

registration form with all questions answered correctly. Aside from program registration being an online process, all other aspect of Arizona’s program are similar to Utah’s.

South Dakota has developed a similar program to assist watercraft operators in compliance with AIS possession and transportation regulations, and to help slow the spread of AIS from “containment waters” to other water bodies. Zebra mussels were first detected in South Dakota in Lewis and Clark Lake on the Missouri River in 2014 and they were detected upstream in lakes Sharpe and Francis Case in 2019. They have also been detected in some smaller lakes in close proximity to the Missouri River. South Dakota’s Local Boat Registry is a free program available to any person (resident or non-resident) with a watercraft registered in South Dakota. The program designates a Transportation Zone that encompasses several containment waters in the southeast corner of the state. The program allows watercraft enrolled in the program certain exemptions from AIS regulations. For instance, watercraft may be transported within the Transportation Zone without being decontaminated, and may have live zebra mussels attached or onboard while transported or stored within the Transportation Zone. In addition, boats with ballast tanks, as well as boats moored for three or more days may be transported in the Transportation Zone and launched in a containment water without being decontaminated. Enrollment is one-time only, and is valid for as long as the enrollee owns the watercraft. Enrollees must file an application and are issued a decal to place on the port side of the vessel near the stern. Registered boats must have drain plugs removed before transportation and fish and bait cannot be transported in lake, river or stream water. Each registered boat will be issued a boat log, in which the owner must log the decontamination process if the boat is transported outside the Transportation Zone or launched in another water body. Watercraft enrolled in the Local Boat Registry only require a department-approved decontamination if they leave the designated Transportation Zone or are launched in a non-containment waterbody.

Local or certified boater programs should be considered if a Wyoming water becomes suspect, positive or infested with dreissenid mussels. The enrollment process for a Wyoming local boater program could be very similar to the Montana Certified Boater Program. Watercraft owners would need to read a tutorial, pass a certification test, complete a registration form and sign a contract agreeing to abide by the local boater rules. Upon certification, the boater would receive decals to place on the boat and boat trailer signifying participation in the program. Participants would still be required to stop at AIS check stations, but should expect only minimal delay. Boaters would still be expected to clean, drain, and dry their watercraft, but would not be obligated to receive a full inspection if returning to the same water.

If a participant in the program wishes to boat on a water other than the local boater water, they would need to visit an inspection station and receive an inspection, and, if necessary, decontamination. They would have their watercraft sealed and would receive an inspection receipt which would serve as evidence of inspection while boating on a water other than the local boater water. If multiple waters in Wyoming were suspect, positive or infested with dreissenid mussels, multiple local boater programs could be instituted, but watercraft owners would only be allowed to enroll each watercraft in one local boater program.

Eligibility based on residency may be dealt with on a water-by-water basis. Montana’s program requires that all participants be residents of Montana, whereas the Lake Powell programs in Utah and Arizona require participants reside or store their boats in very close proximity to that reservoir. Wyoming’s program could require Wyoming residency or Wyoming watercraft registration, or it could be open to residents of surrounding states. For instance, there may not be much advantage to allowing non-resident boaters to enroll in a local boater program

at Boysen Reservoir, which is centrally located in the state. However, there may be advantages to allowing non-resident boaters to enroll in a local boater program for a more peripheral water such as Flaming Gorge Reservoir, Palisades Reservoir or Bighorn Lake. Compliance with the terms of the program will be enforced through contact with boaters at AIS check stations, but perhaps more importantly, by local game wardens at waters throughout the state. Enforcement personnel will need to be on the lookout for boats with local boater decals and verify that decontamination requirements were met before the boat was transported to a different water. If non-residents are allowed to enroll in Wyoming local boater programs, close coordination with AIS and enforcement personnel in surrounding states will be necessary to ensure compliance with the program.

Watercraft enrolled in a Wyoming local boater program could also have the ability to launch and be trailered at ramps not available to other watercraft. Watercraft enrolled in Certified Boater programs at Tiber and Canyon Ferry reservoirs in Montana are allowed to use several boat ramps that are not available to other watercraft. This would be another incentive for boaters to enroll in the program and would also ease congestion at ramps that offer inspection and decontamination services.

STATEWIDE COMMUNICATIONS

After all internal and external contacts are made according to the administrative and individual water communication chains (see above), the AIS Rapid Response Communication Plan will be initiated. The regional Fisheries Supervisor will attempt to make all contacts within 24 hours of detection and will contact the Communications Director once enough contacts have been made. The Communications Director will then initiate the Communications Plan. The AIS Rapid Response Communication Plan was developed to disseminate information to the public about a dreissenid mussel detection in Wyoming. Informing the public about the detection of AIS in Wyoming is critical to make them aware of the potential threat of AIS in a Wyoming water and to educate them about how they can assist in minimizing that threat. In addition to informing the public about the detection of dreissenid mussels in Wyoming, it should be consistently noted that Wyoming will continue our efforts to keep AIS out of the state. We will continue to inspect incoming watercraft at check stations and monitor waters statewide for the presence of AIS. Any rapid response to a dreissenid mussel detection will be in addition to these existing programs.

AIS Communications Toolkit

An AIS Communications Toolkit was developed by WGFD Communications and Outreach personnel to assist in disseminating AIS Rapid Response information to the public. The toolkit can be found in a Google Drive folder and will be shared with appropriate personnel if dreissenid mussels are detected. Information in the toolkit is intended for internal WGFD personnel. Some of the information included in the toolkit includes an AIS Rapid Response Communications Plan, a draft statewide press release, and an AIS Media Resource Issue Template with general talking points about AIS in Wyoming.

The AIS Rapid Response Communications Plan is the overarching document for the information in the Google Drive folder. It provides details on the various tools that are available, including an infographic and talking points about the various dreissenid mussel status levels,

examples of signs that will be posted at suspect, positive and infested waters, a checklist for boaters with status-specific protocols, and updates that may be included in the Monthly Fishing Update as a means of information dissemination. It also summarizes the types of information that should be sent out at the various status levels, as well as audiences and recipients of this information. In addition, it provides information on ongoing messages that should be publicized throughout the process. There is also a list of example questions that could be asked and a list of templates that are housed in the Google Drive.

The statewide press release template is written so that it can easily be adapted to a specific water and status level (Appendix A). It includes information on where and what was found, how the WGFD will react and how this will impact boaters at that water. It also steers readers to the AIS status website for additional information. Checklists for boaters will be available that outline what to expect at inspection stations and how to prepare for an inspection. Finally, frequently asked questions and talking points will be available to assist WGFD personnel in providing a consistent message about a dreissenid mussel detection in Wyoming.

AIS Rapid Response Website

Game and Fish will have a website for concise public information if there is a dreissenid mussel detection. Upon detection, the website will be public and press releases and other communications will direct readers to the site for additional information. The website will provide specific information about the suspect, positive or infested water, including maps of where to launch and where to receive inspections. It will also include frequently asked questions (FAQs), informational videos, and infographics about status levels and associated responses. The site will be updated by regional Information and Education (I&E) Specialists – depending on the water location – regularly to reflect the current water status.

Local Outreach

In addition to the statewide public outreach efforts outlined above, local outreach efforts will be pursued as well. Details for most of these efforts can be found in individual water rapid response plans. Local outreach efforts will be led by regional I&E Specialists in coordination with the Communications Director, with assistance from the regional AIS Specialist and fisheries management crew. Potential local outreach efforts could include public meetings, as well as radio, television and newspaper interviews and information at local license selling agents, inspection stations and regional offices that outline the issue and how boaters can help contain the threat.

RESOURCE PLANNING

If dreissenid mussels are detected in a Wyoming water, it will increase considerable cost and effort to the WGFD and will impact watercraft and other water users significantly. Rapid response plans written for these 23 waters have been crafted to minimize closures to these waters while attempting to contact all boaters in a timely manner. In preparation for a detection of dreissenid mussels in Wyoming, consideration should be given to the cost of the response, equipment and infrastructure needs, and personnel needs. This section will address these topics,

as well as issues that still need to be addressed and next steps in planning for a detection of dreissenid mussels in a Wyoming water.

Costs

Responding to a detection of dreissenid mussels in a Wyoming water will come at considerable cost. Table 2 lists the estimated costs of containment for the 23 waters for which rapid response plans were developed. These costs are listed for each status level (Suspect, Positive, and Infested) and are broken into year 1 costs (including initial investments in equipment and infrastructure) and annual operating costs (mostly comprised of personnel, travel, supply and maintenance). The highest costs at all status levels are for a response to dreissenid mussels at Flaming Gorge Reservoir. Although these costs are only for the Wyoming portion of the reservoir, initial year costs range from \$1.8-2.25 million, with annual operating expenses of \$1-1.5 million each year thereafter. Mean costs for all 23 waters across all status levels are approximately \$500,000 in the initial year and \$200,000-\$300,000 each year thereafter.

Given the considerable costs of a response to dreissenid mussel detection on a Wyoming water and the impacts it will have on a broad range of interests, the WGF D should actively seek out partners to assist in shouldering these costs and/or responsibilities. These rapid response plans should be shared with other agencies and stakeholders to begin the conversation on how these costs could be shared amongst users. If cost-sharing is not an option, partners and stakeholders should consider opportunities for sharing various responsibilities and resources.

Equipment and Infrastructure

Most proposed check stations are located in undeveloped, isolated locations with few amenities. Initial year costs are higher due to investments in equipment and infrastructure, including construction of gravel or paved inspection areas, acquisition of clean water for decontaminations (often transported until a well can be drilled on site), vehicles (purchased $\frac{3}{4}$ ton pickups and leased sedans and $\frac{1}{2}$ ton pickups from State Motor Pool), decontamination units, office trailers, camper trailers, comfort station rental or construction, power (generators or electrical service connection). Plans are written so as to invest less in inspection stations during initial status levels (i.e., Suspect and Positive) as these status levels could revert back to Negative Status after 3-5 years. More investment in infrastructure is apparent at Infested Status since inspection stations will likely be used into perpetuity.

Significant savings could be realized if existing lake water could be used for decontaminations. The assumption was made when writing these plans that clean water other than the Suspect, Positive or Infested lake or reservoir water was needed for decontaminations. If a process could be developed to filter or decontaminate lake or reservoir water for use in decontaminations, many costs associated with hauling water or drilling wells could be eliminated. Most plans eventually include a cost estimate for drilling a well on site and providing electrical power. Many plan on hauling water and relying on generators for power during initial phases.

Table 2. Estimated costs for containment of dreissenid mussels at 23 Wyoming waters. Costs are shown for Suspect, Positive and Infested status levels. “Year 1” costs include initial investments in infrastructure and equipment, whereas “Annual” costs reflect annual operating expenses (personnel, supplies, maintenance) for each year thereafter. “Year 1” expenses for each status level assume that the response started at that status level (i.e., equipment and infrastructure was not purchased in a previous status level).

Water	Long-term Suspect		Positive		Infested	
	Year 1	Annual	Year 1	Annual	Year 1	Annual
Glendo	\$452,105	\$222,021	\$452,105	\$281,055	\$782,100	\$332,900
Alcova	\$589,442	\$169,991	\$589,442	\$265,592	\$655,342	\$259,292
Seminole	\$258,785	\$112,785	\$258,485	\$115,285	\$846,868	\$209,968
Guernsey	\$295,880	\$118,709	\$315,980	\$132,880	\$496,480	\$209,580
Pathfinder	\$392,147	\$152,647	\$583,231	\$155,147	\$583,231	\$249,231
Grayrocks	\$316,918	\$204,668	\$357,918	\$132,828	\$699,324	\$174,234
Granite	\$338,177	\$120,688	\$459,744	\$157,544	\$792,004	\$214,804
Hawk Springs	\$255,199	\$129,699	\$251,828	\$123,199	\$290,851	\$138,651
Wheatland #3	\$248,266	\$54,066	\$277,966	\$56,266	\$277,966	\$56,266
Flaming Gorge	\$1,765,493	\$952,179	\$2,269,819	\$1,173,193	\$2,256,923	\$1,494,649
Fontenelle	\$355,891	\$177,541	\$472,141	\$182,291	\$579,301	\$242,551
Viva Naughton	\$277,721	\$176,195	\$380,863	\$171,885	\$557,059	\$244,925
Sulphur Creek	\$173,446	\$83,496	\$173,446	\$83,496	\$557,059	\$244,925
Boysen	\$900,815	\$379,719	\$912,815	\$522,465	\$1,237,685	\$847,355
Ocean Lake	\$353,833	\$182,633	\$353,833	\$185,133	\$530,015	\$231,215
Pilot Butte	\$222,969	\$96,369	\$222,969	\$97,869	\$18,900	NA ^a
Bighorn Lake	\$81,488	\$68,988	\$117,826	\$105,326	\$119,826	\$105,326
Buffalo Bill	\$264,320	\$168,120	\$264,320	\$168,120	\$264,320	\$168,120
Jackson Lake	\$410,999	\$146,895	\$435,999	\$228,999	\$435,993 ^b	\$228,999
Palisades	\$242,612	\$112,230	\$242,612	\$154,812	\$491,677	\$215,277
Keyhole	\$455,702	\$197,335	\$445,586	\$286,286	\$764,286	\$282,146
Lake DeSmet	\$318,565	\$201,685	\$330,085	\$204,185	\$352,275	\$197,375
Fremont Lake	\$290,630	\$125,680	\$291,140	\$126,190	\$378,796	\$153,826
Maximum	\$1,765,493	\$952,179	\$2,269,819	\$1,173,193	\$2,256,923	\$1,494,649
Minimum	\$81,488	\$54,066	\$117,826	\$56,266	\$18,900	\$56,266
Mean	\$402,670	\$189,319	\$454,789	\$222,176	\$615,104	\$295,528

^a Year 1 cost is to close reservoir to watercraft, no annual operating costs anticipated.

^b Budget does not include cost for enlarging and paving parking lot which could be ~\$200,000.

Decontamination units are also a significant expense in these plans. Portable decontamination units cost \$12,500 each and are plagued by mechanical failures, particularly during periods of high use. Large, stationary decontamination units are costly (~\$300,000), but have the advantage of being able to reuse water (but still require a source of water and electricity). Some progress has been made in development of decontamination units better suited

for watercraft decontamination and the WGFD should be alert to the development of improved decontamination technologies in the future.

A major and highly variable cost in all 23 plans is development of inspection and decontamination areas. Cost estimates and prescriptions vary widely. Most plans initially call for clearing an area and laying a bed of gravel where boats can be inspected and decontaminated. Most plans also increase the development of these areas from Suspect through Infested status. Most call for some level of paving and drainage once the water reaches Infested Status to account for the increased amount of water used in decontaminations. WGFD engineers should be consulted at some point to develop more standardized prescriptions for inspection and decontamination area development. This could greatly increase the precision of cost estimated and lead to better designs resulting in a safer work area and improved service to watercraft users.

Most plans call for the purchase of ¾ ton pickups, mainly used to haul water and heavy equipment such as office and camper trailers. Costs for sedans and ½ ton pickups are budgeted as vehicles to be leased from State Motor Pool. Additional equipment costs include office trailers at check stations (\$20,000 each) and camper trailers (\$20,000 each) if check stations are in remote areas where inspectors need to stay overnight. Most check stations budget for rental and maintenance of portable comfort stations on a monthly basis, but many eventually resort for construction of permanent comfort stations at a cost of \$12-15,000 each.

Personnel

Annual operating costs indicate costs for continued containment after the initial year. These do not include infrastructure and equipment costs incurred during year 1, but rather reflect personnel costs, as well as vehicle lease, travel, supply and maintenance costs. Personnel costs are the primary operating cost for containment at all three status levels.

Table 3 shows the number of check stations, biologists (budgeted at the contract Biologist I level) who oversee check station operations and technicians who conduct exit inspections. The number of check stations ranges from 1 to 3 for the eight waters, and is a function of both the level of watercraft use, as well as the ability to funnel boaters from various ramps through “pinch points.” Numbers of biologists overseeing check station operations also ranges from 1 to 3, with Flaming Gorge Reservoir being the only water with more than one biologist. The number of technicians hired to conduct exit inspections is the most variable, with from 3 to 47 technicians required to perform exit inspections and decontaminations. Numbers of technicians needed generally increases across status levels, with the biggest increase occurring between Positive Status and Infested Status. This increase in technicians is necessary at Infested Status to conduct required full decontaminations of all watercraft in a timely manner.

The high number of technicians needed, coupled with the isolated nature of many of Wyoming’s lakes and reservoirs may create issues with recruitment. We should be prepared to use innovative and novel approaches, such as providing lodging and per diem during shifts, to recruit technicians in areas that do not have sufficient pools of applicants.

Biologists will be necessary to oversee the operation of check stations and these positions will come with considerable responsibility. These positions were budgeted in these plans as contract Biologist I positions, but consideration should be given to making them FTE positions to increase retention of these important employees.

Table 3. Number of check stations, biologists, and technicians necessary to contain dreissenid mussels at eight Wyoming waters. Stns=check stations; Bios=biologists; Techs=technicians.

Water	Long-term Suspect			Positive			Infested		
	Stns	Bios	Techs	Stns	Bios	Techs	Stns	Bios	Techs
Glendo	2	1	10	2	1	10	2	1	14
Grayrocks	1	1	5	1	1	5	1	1	9
Flaming Gorge	3	3	28	3	3	37	3	3	47
Boysen	3	1	18	3	1	18	3	1	30
Bighorn Lake	1	0	3	1	1	3	1	1	3
Jackson Lake	2	1	11	2	1	11	2	1	11
Keyhole	2	1	14	1	1	14	1	1	14
Fremont Lake	1	1	6	1	1	6	1	1	10
Maximum	3	3	28	3	3	37	3	3	47
Minimum	2	0	3	1	1	3	1	1	3

Issues to Address

Although these plans have attempted to address all foreseeable difficulties in containing dreissenid mussels in a particular water, several issues remain that should be considered when responding to a mussel detection.

- These plans are written to ensure an exit inspection and decontamination, if necessary, of all watercraft leaving a suspect, positive or infested water in Wyoming. There may be times when demand exceeds our ability to inspect and/or decontaminate all watercraft in a timely manner. Consideration should be given to finding a way to track boats that could not be properly inspected and/or decontaminated. This could involve an alternative seal and receipt that designates what has been completed on the watercraft and what still needs to be completed before launch in another water.
- Recruitment and retention of large numbers of employees in remote, isolated locations may be difficult. Consideration should be given to novel approaches to make these positions more attractive. For example, lodging and camp groceries could be provided during each 4-5 day shift so employees can be recruited from more populated regions.
- Given the timing of AIS monitoring in Wyoming, it is likely that a detection will occur after July and recruitment of biologists and technicians may be difficult in late summer or fall.
- Regulations will need to be adjusted per the regulations section of this report. Any progress that can be made to address these regulation changes prior to an invasive mussel detection will be advantageous.
- Rapid response will require rapid hiring and equipment purchases. Attempts should be made to stockpile some equipment and supplies (e.g., decontamination units, static and dynamic messaging signs, seals, and receipts) prior to the first detection. Upon initial

detection, job announcements and requisitions should be submitted immediately so personnel and equipment can be on hand as soon as possible.

- Rapid response will require immediate access to considerable funding. Consideration should be given to creating an “insurance account” to cover initial costs of a dreissenid mussel rapid response.
- These rapid response plans have under-emphasized the potential downstream effects of a dreissenid mussel detection in Wyoming. Follow-up monitoring should not only focus on the water where the initial detection occurred, but should also focus on tracking the potential downstream spread of mussels. Monitoring should be conducted and detection should occur before attempting containment on downstream waters.
- Cooperation from other agencies that manage lakes and reservoirs in Wyoming will be essential to containment of dreissenid mussels. WGFD should have conversations with these agencies to address potential coordination issues and opportunities prior to detection.
- Given the considerable costs associated with containment of dreissenid mussels and the impacts they can have on a wide variety of users, WGFD should seek out partners willing to assist with both the costs and responsibilities of containment. These rapid response plans should be distributed for review to partners and stakeholders associated with each lake or reservoir. In addition, WGFD should reach out to other interests that may be impacted by invasive mussels (e.g., agriculture, dam and hydropower operators, municipal water treatment facilities, etc.).
- With high costs in mind, opportunities should be sought to identify cost-saving measures that could be put in place that don’t sacrifice containment. Prior to or after detection, attempts should be made to track user patterns and optimize times when inspectors can intercept boaters. Risk calculations should be conducted at each status level to determine the advantageous and disadvantages of various practices (e.g., closing waters to night watercraft use).
- These plans do not adequately convey the potential direct impacts that dreissenid mussel containment may have on watercraft users. Public outreach materials should clearly show what a boater may expect and how they may be impacted at each status level. Making that clear early will increase public participation in current practices to keep invasive mussels out of the state and will help manage expectations in the event that they are detected in a Wyoming water.
- These rapid response plans should be reviewed by WGFD employees from Wildlife and Services divisions to look for opportunities to build multi-use infrastructure (e.g., multiple use inspection stations) and to capitalize on the expertise of personnel throughout the agency.

Next Steps

These rapid response plans are final once the Wyoming Game and Fish Commission gives their approval. However, these plans will be living documents that will be updated as

science and technology advances into the future. The next steps moving forward to streamline implementation of these plans if needed will include:

1. Regulation changes to address containment and exit inspections in Wyoming.
2. Working with partners in preparation for implementation of plans by completing:
 - a. Memorandums of Agreement or Understanding
 - b. Federal permits (NEPA and/or NHPA)
 - c. Wyoming Department of Transportation Encroachment Permits
 - d. Wyoming Department of Environmental Quality Pollutant Discharge Elimination System Permits for any proposed chemical applications.
 - e. Coordination with BOR and their managing partners to ensure compliance with 43CFR Part 423.

FUTURE CONTAINMENT PLANNING

As mentioned earlier, rapid response plans are not considered containment plans and are only to be used until a containment plan has been developed for a suspect, positive or infested water. Containment planning will be initiated once the rapid response plan is underway. All key partners and stakeholders will need to be involved with containment plan development. Containment will not be possible without the cooperation of all agencies managing the water body. In addition, all affected parties, including the public, will need to adhere to the plan if it is to be successful.

Containment plans will be written for a minimum of three years (i.e., a suspect water that is delisted after three years of negative monitoring) or into perpetuity (i.e., an infested water that is never delisted). Lessons learned in early stages of the rapid response will help inform the containment plan.

Downstream impacts of a dreissenid mussel infestation should be considered in the containment plan. Such impacts could be to downstream rivers and reservoirs, water treatment and water control structures, etc. This will increase the list of partners and stakeholders originally considered in the rapid response plan, but the expectation should be that mussels can and will migrate downstream of the original detection.

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APPENDIX A. Statewide press release template for a dreissenid mussel detection in Wyoming.

[AIS TYPE] FOUND [WATER]
Discovery means changes for boaters

[LOCATION] — The Wyoming Game and Fish Department has confirmed the presence of the aquatic invasive species [AIS NAME] in [WATER]. This is the first time [AIS NAME] has been discovered in [WYOMING/REGION/WATER]. Boaters and recreationalists should plan for AIS inspection protocol changes at the water.

“The confirmation of [AIS NAME] at [WATER] is very serious and can have catastrophic impacts on the water, fishery and local community. Therefore, Game and Fish is taking steps to prevent the spread of [AIS NAME] from [WATER] and will continue monitoring,” said [QUOTED INDIVIDUAL].

[ABOUT AIS SPECIES DISCOVERED]

The [WATER] is classified as [STATUS] which mean [EXPLAIN]. Under this status, boaters are required to follow more in-depth inspection and launch protocols in efforts to stop the spread to other waters in Wyoming. Those heading to [WATER NAME] with watercraft should be prepared to [CHANGES BASED ON STATUS].

“[QUOTE ABOUT CHANGES, REGIONAL SPECIFIC INFORMATION],” said [QUOTED INDIVIDUAL].

Statewide Game and Fish continues to require AIS inspections on watercraft entering the state. State regulations require all boats transported into Wyoming from March 1 through Nov. 30 to undergo an inspection by an authorized inspector prior to launching in Wyoming’s waters. Any boat that has been in zebra/quagga mussel-infested water in the past 30 days is required to undergo an inspection prior to launching any time of year. Anyone transporting a boat must stop at an open check station on their route of travel, even if they don’t intend to launch their boat in Wyoming.

For ongoing information about AIS and the status of waters, boaters and recreationalists should check the AIS status website.

-WGFD-