

Appendix A

Glossary and Acronyms

Definitions.

- (a) "Alien species" means, with respect to a particular ecosystem, any species, including its seeds, eggs, spores, or other biological material capable of propagating that species, that is not native to that ecosystem. (Executive Order) (EO) 13-112)
- (b) "Aquatic Invasive Species" (AIS), also known as aquatic nuisance species (ANS), is defined as: A nonindigenous species that threatens the diversity or abundance of native species or the ecological stability of infested waters, or commercial, agricultural, aquacultural, or recreational activities dependent upon such waters. (Non-indigenous Aquatic Nuisance Prevention and Control Act (1990))
- (c) "Control" means, as appropriate, eradicating, suppressing, reducing, or managing invasive species populations, preventing spread of invasive species from areas where they are present, and taking steps such as restoration of native species and habitats to reduce the effects of invasive species and to prevent further invasions.(EO 13-112)
- (d) "Early Detection" Early detection: Actions taken to detect incipient invasions and assess the current and potential impact of invasions.(National Invasive Species Council (NISC) 2001)
- (e) "Ecosystem" means the complex of a community of organisms and its environment. (EO 13_112)
- (f) "Eradication" means permanent or long-term elimination of a target aquatic invasive species from a particular wetland or waterbody by killing or physically removing, or introduction of a predator or other biocontrol agent into the target species habitat and proximity. For purposes of this plan, *eradication* need not indicate the total elimination of the target species from the entire wetland or waterbody. Eradication can include elimination of a target species within a more limited segment of a wetland or waterbody as long as the removal is permanent (or long-term), and the project includes a plan to prevent re-infestation.(New York Dept. of Environmental Conservation)
- (g) "Exotic species" – commonly referred to as non-native, alien or invasive species.(Management Policy 2006)
- (h) "Extended Response" Situation in which an infestation cannot be controlled by initial response resources within a reasonable period of time. The infestation usually can be contained by additional resources within a limited time after commencing response action. (Adapted from Fireline Handbook)
- (i) "Federal agency" means an executive department or agency, but does not include independent establishments as defined by 5 U.S.C. 104.(EO 13-112)

(j) "Initial Response" The actions taken by the first resources to arrive at the infestation to protect lives, property, and resources and prevent further extension of the infestations. (Adapted from Fireline Handbook)

(k) "Introduction" means the intentional or unintentional escape, release, dissemination, or placement of a species into an ecosystem as a result of human activity.(EO 13-112)

(l)"Invasive species" means an alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health.(EO 13-112)

(m)"Long term response" Situation in which an infestation cannot be controlled by initial or extended resources. The infestation usually can be contained only by including in routine operations with an undetermined future date. (Adapted from Fireline Handbook)

(n)"Native species" means, with respect to a particular ecosystem, a species that, other than as a result of an introduction, historically occurred or currently occurs in that ecosystem. (EO 13-112)

(o)"Prevention" Prevention: Actions taken to prevent the entry, establishment, dispersal, and dissemination of invasive species. (NISC2001)

(p)Rapid Response" A systematic effort to eradicate, contain, or control a potentially invasive non-native species introduced into an ecosystem while the infestation of that ecosystem is still localized, and to eradicate and/or contain invasive species populations while they are still localized.(NISC2001)

(q) "Species" means a group of organisms all of which have a high degree of physical and genetic similarity, generally interbreed only among themselves, and show persistent differences from members of allied groups of organisms. (EO 13-112)

(r) "Stakeholders" means, but is not limited to, State, tribal, and local government agencies, academic institutions, the scientific community, nongovernmental entities including environmental, agricultural, and conservation organizations, trade groups, commercial interests, and private landowners. (EO 13-112)

(s) "Treatment" means a method for treatment of the contents of a water body to remove or destroy AIS organisms through--

`(A) filtration;

`(B) the application of biocides or ultraviolet light;

`(C) thermal methods; or

`(D) other treatment techniques that meet applicable state or federal standards (adapted from NANPCA 1990)

(t) "Unified command" means a command organization option of ICS where each agency provides an incident commander. These Unified Commanders agree on objectives and priorities, approve strategies and provide the command function of the IMT. (Adapted from the Fireline Handbook).

Title: Lacey Act (1900; amended in 1998)

Authority: 18 USC §42

Department/Agency: U.S. Department of the Interior

Organisms: Species injurious to human beings or resources

Pathways: Intentional introduction and trade

Provisions: Prohibits import of:

- A list of designated species
 - Other vertebrates, mollusks, and crustacea that are "injurious to human beings, to the interests of agriculture, horticulture, forestry, or to wildlife or the wildlife resources of the United States"
- Declares importation or transportation of any live wildlife as injurious and prohibited, except as provided for under the Act

BUT

Allows import of almost all species for scientific, medical, education, exhibition, or propagation purposes

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Title: Non-indigenous Aquatic Nuisance Prevention and Control Act (1990)

Authority: Public Law 101-646 (Nov 29, 1990)

Department/Agency:

- U.S. Department of the Interior, Fish and Wildlife Service
- U.S. Department of Transportation, Coast Guard
- U.S. Environmental Protection Agency
- U.S. Department of Defense, Army Corps of Engineers
- U.S. Department of Commerce, NOAA

Organisms: Aquatic nuisance species

Pathways: Unintentional introductions: ballast water

Provisions: Established Aquatic Nuisance Species Task Force to: identify areas where ballast water does not pose an environmental threat, assess whether aquatic nuisance species threaten the ecological characteristics and economic uses of U.S. waters (other than the Great Lakes), determine the need for controls on vessels entering U.S. waters (other than Great Lakes), identify and evaluate approaches for reducing risk of adverse consequences associated with intentional introduction of aquatic species

Directs Coast Guard to issue regulations to prevent the introduction and spread of aquatic nuisance species into the Great Lakes through ballast water

Directs Corps of Engineers to develop a program of research and technology to control zebra mussels in and around public facilities and make available information on control methods

Acronyms

AIS - Aquatic Invasive Species

ANS - Aquatic Nuisance Species

BLM - Bureau of Land Management

BOR - Bureau of Reclamation

BMP - Best management practices

BRMD - National Park Service Biological Resource Management Division

CESU - Cooperative Ecosystem Study Unit

CFR - Code of Federal Regulation

CUA - Commercial Use Authorization

USDA - Department of Agriculture

DOC - Department of Commerce

DOI - Department of Interior

FWS - U.S. Fish and Wildlife Service

EO - Executive Order

GIS - Geographic Information System

IC - Incident Commander

ICS - Incident Command System

IMT - Incident Management Team

HACCP - Hazard Analysis Critical Control Point

HUC - Hydrological Unit Code

JHA - Job Hazard Analysis

MOU - Memorandum of Understanding

Quagga/Zebra Mussel Infestation Prevention and Response Planning Guide
Appendix A

NEPA - National Environmental Protection Act

NISC - National Invasive Species Council

NRCS - Natural Resource Conservation Service

NRPC - National Park Service Natural Resource Program Center

NRPP NRM - Natural Resource Preservation Program, Natural Resource Management

OFS - Operating Formulation System

PSMFS - Pacific States Marine Fisheries Commission

PMIS - National Park Service Project Management Information System

PPE - Personal Protective Equipment

USACOE - U.S. Army Corps of Engineers

USGS-BRD - U.S. Geological Survey – Biological Research Division

USFS - U.S. Forest Service

WAFWA – Western Association of Fish and Wildlife Association

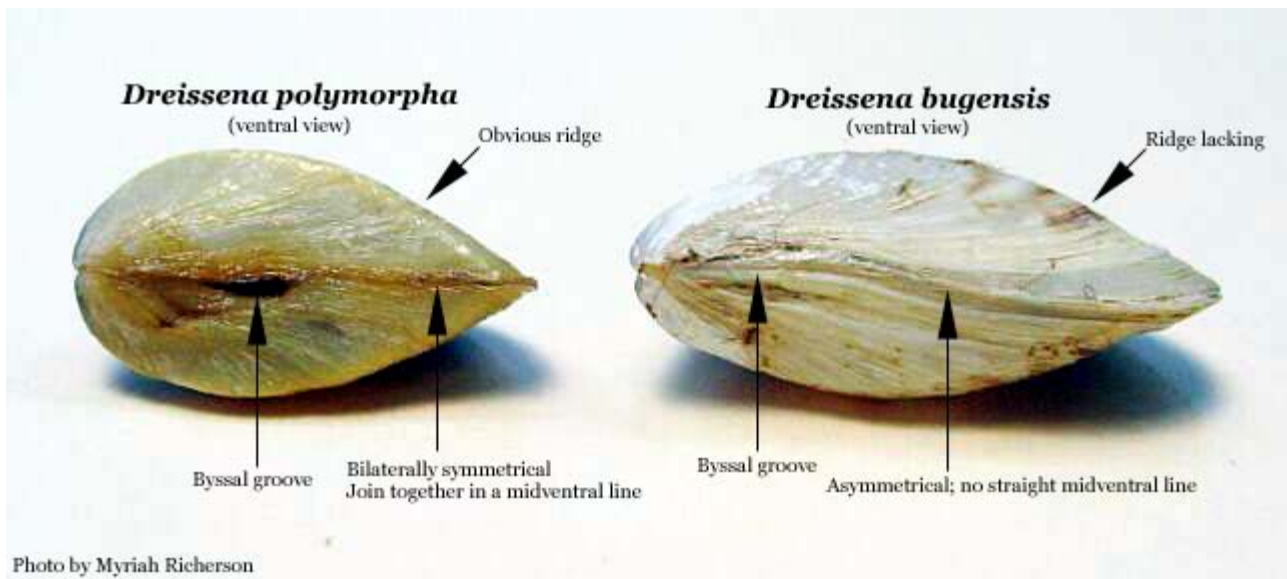
WASO - National Park Service Washington Office

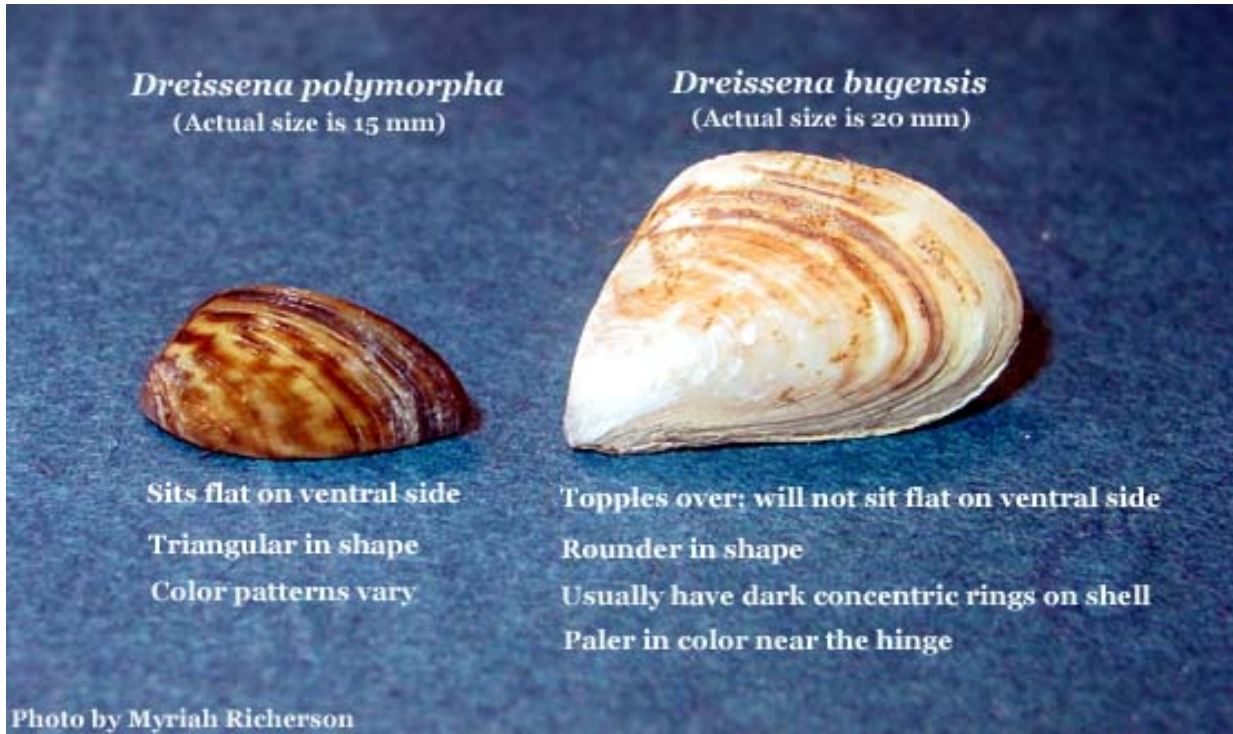
Appendix B


Quagga Mussel Fact Sheet

Dreissena rostriformis bugensis Andrusov, 1897

Common Name: quagga mussel



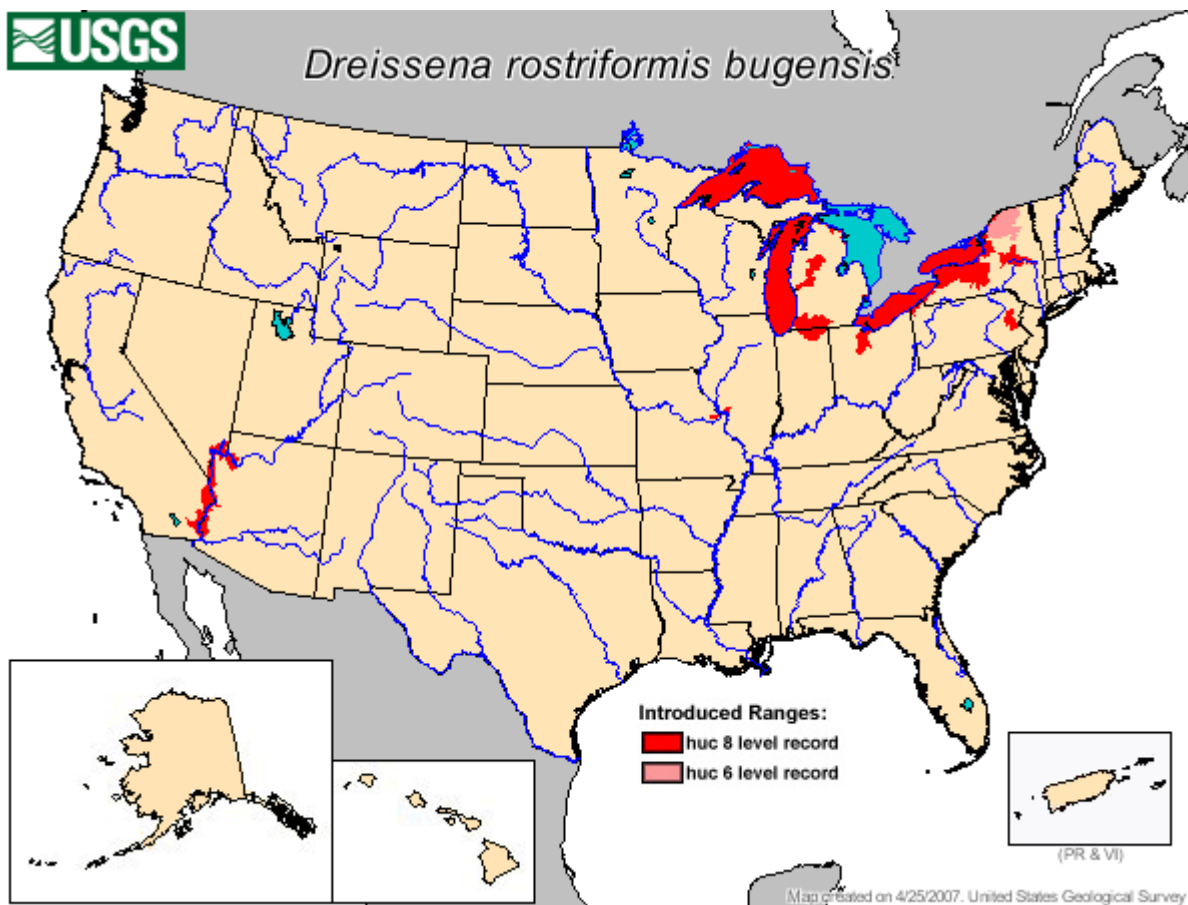


Taxonomy: available through  ITIS

Identification: *Dreissena rostriformis bugensis* is a small freshwater bivalve mollusk that exhibits many different morphs; yet, there are several diagnostic features that aid in identification. The quagga mussel has a rounded angle, or carina, between the ventral and dorsal surfaces (May and Marsden 1992). The quagga also has a convex ventral side that can sometimes be distinguished by placing shells on their ventral side; a quagga mussel will topple over, whereas a zebra mussel will not (Claudi and Mackie 1994). Overall, quaggas are rounder in shape and have a small byssal groove on the ventral side near the hinge (Claudi and Mackie 1994). Color patterns vary widely with black, cream, or white bands; a distinct quagga morph has been found that is pale or completely white in Lake Erie (Marsden et al. 1996). They usually have dark concentric rings on the shell and are paler in color near the hinge. If quaggas are viewed from the front or from the ventral side, the valves are clearly asymmetrical (Domm et al. 1993). Considerable phenotypic plasticity of all morphological characteristics is known in dreissenid species and this may be a result of environmental factors, meaning the same genotype may express different phenotypes in response to environmental conditions (Claxton et al. 1998).

Size: Reaching sizes up to 4 cm

Native Range: *Dreissena rostriformis bugensis* is indigenous to the Dneiper River drainage of Ukraine. It was discovered in the Bug River in 1890 by Andrusov, who named the species in 1897 (Mills et al. 1996).



Interactive maps: [Continental US](#), [Hawaii](#), [Puerto Rico](#)

Nonindigenous Occurrences: Canals built in Europe have allowed range expansion of this species, and it now occurs in almost all Dnieper reservoirs in the eastern and southern regions of Ukraine and deltas of the Dnieper River tributaries (Mills et al. 1996). The quagga mussel was first sighted in the **Great Lakes** in September 1989, when one was found near Port Colborne, Lake Erie, though the recognition of the quagga type as a distinct species was not until 1991 (Mills et al. 1996). In August 1991, a mussel with a different genotype was found in a random zebra mussel sample from the Erie Canal near Palmyra, New York, and after confirmation that this mussel was not a variety of *Dreissena polymorpha*, the new species was named "quagga mussel" after the "quagga", an extinct African relative of the zebra (May and Marsden 1992). The quagga mussel is currently distributed in Lake Michigan, Lake Huron, Lake Erie, Lake Ontario, Lake St. Clair, Saginaw Bay, throughout the St. Lawrence River north to Quebec City, and there are also a few inland occurrences in **New York, Ohio, Michigan, and Pennsylvania.**

The first sighting of the quaggas outside the Great Lakes basin was made in the Mississippi River between St. Louis, **Missouri** and Alton, **Illinois** in 1995 (S. J. Nichols, pers. comm.). A 2002 survey of Lake Superior did not detect quagga mussel specimens, although future colonization is expected (Grigorovich 2003). In fact in 2005, the first quagga mussel was confirmed from Lake Superior in Duluth Superior Harbor (J. Kelly, pers. comm.).

More recently in January 2007, populations of quagga mussels were discovered in Lake Mead

near Boulder City, **Nevada** (W. Baldwin, pers. comm.), and in Lake Havasu and Lake Mohave on the **California/Arizona** border (R. Aikens, pers. comm.). This was an extremely large leap in their range and cause for much concern to limited water supplies and endangered fishes in the southwestern US.

Means of Introduction: The introduction of *D. r. bugensis* into the Great Lakes appears to be the result of ballast water discharge from transoceanic ships that were carrying veligers, juveniles, or adult mussels. The genus *Dreissena* is highly polymorphic and prolific with high potential for rapid adaptation attributing to its rapid expansion and colonization (Mills 1996). Still, there are other factors that can aid in the spread of this species across North American waters, such as, larval drift in river systems or fishing and boating activities that allow for overland transport or movement between water basins.

Status: The quagga mussel must have arrived more recently than the zebra based on differences in size classes of initially discovered populations, and therefore it seems plausible that the quagga is still in the process of expanding its nonindigenous range (May and Marsden 1992, MacIsaac 1994). In the 1990's, the absence of quagga mussels from areas where zebra mussels were present may have been related to the timing and location of introduction rather than physiological tolerances (MacIsaac 1994). The quagga mussel is now well established in the lower Great Lakes. This species is found in all of the Great Lakes, but has not been found in great numbers outside of the Great Lakes. This could be due to a preference for deeper, cooler water found in the Great Lakes region as compared to the zebra mussel (Mills et al. 1996). There is a gradient of dreissenid domination in Lake Erie, with quagga mussels dominating eastern basins and zebra mussels dominating the western basin. The same type of gradient was observed in southern Lake Ontario with quagga mussel dominating the west and zebra dominating the east (Mills et al. 1999). If the native habitat of *D. r. bugensis* is to provide any sort of indicator, the quagga mussel will most likely take over areas where the zebra mussel is now established to become the dominant dreissenid of the Great Lakes (Mills et al. 1996). Indeed, this trend does appear to be occurring in the lower Great Lakes. Mean shell size and biomass increased for both dreissenid species from 1992 and 1995 in southern Lake Ontario (Mills et al. 1999). But the increase was sharper in quagga mussel, and they now dominate in southern Lake Ontario where zebra mussel once did (Mills et al. 1999).

Impact of Introduction: Quaggas are prodigious water filterers, removing substantial amounts of phytoplankton and suspended particulate from the water. As such, their impacts are similar to those of the zebra mussel. By removing the phytoplankton, quaggas in turn decrease the food source for zooplankton, therefore altering the food web. Impacts associated with the filtration of water include increases in water transparency, decreases in mean chlorophyll a concentrations, and accumulation of pseudofeces (Claxton et al. 1998). Water clarity increases light penetration causing a proliferation of aquatic plants that can change species dominance and alter the entire ecosystem. The pseudofeces that is produced from filtering the water accumulates and creates a foul environment. As the waste particles decompose, oxygen is used up, and the pH becomes very acidic and toxic byproducts are produced. In addition, quagga mussels accumulate organic pollutants within their tissues to levels more than 300,000 times greater than concentrations in the environment and these pollutants are found in their pseudofeces, which can be passed up the food chain, therefore increasing wildlife exposure to organic pollutants (Snyder et al. 1997).

Dreissena species ability to rapidly colonize hard surfaces causes serious economic problems. These major biofouling organisms can clog water intake structures, such as pipes and screens, therefore reducing pumping capabilities for power and water treatment plants, costing industries, companies, and communities. Recreation-based industries and activities have also been impacted; docks, breakwalls, buoys, boats, and beaches have all been heavily colonized. Quaggas are able to colonize both hard and soft substrata so their negative impacts on native freshwater mussels, invertebrates, industries and recreation are unclear. Many of the potential impacts of *Dreissena* are unclear due to the limited time scale of North American colonization. Nonetheless, it is clear that the genus *Dreissena* is highly polymorphic and has a high potential for rapid adaptation to extreme environmental conditions by the evolution of allelic frequencies and combinations, possibly leading to significant long-term impacts on North American waters (Mills et al. 1996). *D. r. bugensis* lacks the keeled shape that allows *D. polymorpha* to attach so tenaciously to hard substrata; though, *D. r. bugensis* is able to colonize hard and soft substrata (Mills et al. 1996). The ability to colonize different substratas could suggest that *D. r. bugensis* is not limited to deeper water habitats and that it may inhabit a wider range of water depths where they have been found at depths up to 130 m in the Great Lakes (Mills et al. 1996, Claxton and Mackie 1998).

Remarks: Hybridization between the two species is also a concern. Zebra x quagga mussel hybrids were created by pooling gametes collected after exposure to serotonin in the laboratory, indicating that interspecies fertilization may be feasible (Mills et al. 1996). Although, there is evidence for species-specific sperm attractants suggesting that interspecific fertilization may be rare in nature, and if hybridization does occur, these hybrids will constitute a very small proportion of the dreissenid community (Mills et al. 1996). After years of infestation in Europe and North America, a chemical toxicant for lake-wide control of *Dreissena* has not been developed mainly because it would be deadly to other aquatic life forms. Prechlorination has been the most common treatment for control, but if this method is used to control both zebra and quagga mussels the amount of chlorine used may reach hazardous levels (Grime 1995). Another alternative has been potassium permanganate, especially for drinking water sources, even though chemical controls are not the most environmentally sound solution. Other methods of control include: oxygen deprivation, thermal treatment, exposure and dessication, radiation, manual scraping, high-pressure jetting, mechanical filtration, removable substrates, molluscicides, ozone, antifouling coatings, electric currents, and sonic vibration. Some industries even built their intake structures and piping at depths too low for zebra mussel colonization; however, when the quagga mussels were discovered at lower water depths these new structures became vulnerable to quagga colonization. Biological control so far has proven to be ineffective in controlling *Dreissena* species. Predation by migrating diving ducks, fish species, and crayfish may reduce mussel abundance, though the effects are short-lived (Bially and MacIsaac 2000). Other biological controls being researched are selectively toxic microbes and parasites that may play a role in management of *Dreissena* populations (Molloy 1998). Other prospective approaches to controlling *Dreissena* populations may be to disrupt the reproductive process, by interfering with the synchronization of spawning by males and females in their release of gametes (Snyder et al. 1997). Another approach would be to inhibit the planktonic veliger from settling, since this is the most vulnerable stage in the life cycle (Kennedy. 2002). Researchers are continuously studying these species to learn more about their life cycle, and environmental and physiological

tolerances, with hopes of developing environmentally safe controls that can be used to control *Dreissena* populations.

References

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Other Resources:

[Distinguishing *D. polymorpha* from *D. bugensis*](#)

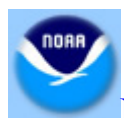
[Dreissena species](#) (ANS Clearinghouse Bibliography)



[NOAA Sea Grant Nonindigenous Species Site \(SGNIS\)](#)

Author: Benson, A. J., M. M. Richerson and E. Maynard

Contributing Agencies:



[NOAA - GLERL](#)

Revision Date: 1/25/2007

Citation for this information:

Benson, A. J., M. M. Richerson and E. Maynard. 2007. *Dreissena rostriformis bugensis*. USGS Nonindigenous Aquatic Species Database, Gainesville, FL.

<<http://nas.er.usgs.gov/queries/FactSheet.asp?speciesID=95>> Revision Date: 1/25/2007

Appendix C

Outreach and Education Resources

Identify Your Audience

Internal

- Fee collectors
- Visitor Centers/contact stations
- Campgrounds
- Web Site
- Roving staff
 - LE Rangers
 - Interp Rangers
 - Maint. Worker
- Non-personal signage locations
 - Overlooks
 - Picnic Areas
 - Trailheads
 - Restrooms
 - Launch Ramps

External

- Contractors
- Tribes
- Concessionaires
 - Marina store
 - Motel
 - Main office
 - Residential Areas
 - Boat Tours
- Agency partners
 - FWS
 - BLM
 - BOR
 - USGS
 - EPA
 - DOE
 - BIA
 - State FG
 - U.S. Army Corp of Engineers
 - Western Association of Fish & Wildlife Agencies
 - Other State agencies
 - Water Authorities
 - Hydroelectric Power Authorities
- Science partners
 - 100th Meridian Initiative
 - Pacific States Marine Fisheries
 - Various Sea Grant organizations

- University science partners
- Western Regional Panel of the ANS Task Force
- Other govt. or private entities
 - Sheriff/police departments
 - Welcome centers
 - Chambers of commerce
 - Tourist bureaus
 - State & local park/museum agencies
 - Conservation organizations
 - University conservation/recreation management programs
 - University leisure programs
 - Boat owners clubs/associations
 - Divers clubs/associations
 - Kayakers clubs/associations
 - Sailboarder clubs/associations
 - Marathon swim/triathlon organizers
 - Diving clubs/associations
 - Water skiing clubs/associations
- Businesses
 - Boat dealers
 - Boat cleaners
 - Boating supply & equipment
 - Boat rentals/charters/excursions
 - Boat repair
 - Boat storage
 - Boat transportation
 - Non-concession marinas
 - Water utilities
 - Water skiing supplies
 - Motorcycle dealers
 - Trailer storage
 - Trailer sales
 - Trailer repair & service
 - Sporting goods shops
 - Divers' equipment & supply
 - Diving instruction schools
 - Swimming instruction schools
 - Canoe & kayak rental & charter
 - Water safety organizations
 - Motels (smaller ones that cater to boaters)
 - Insurance brokers

Interpretive Opportunities

Many opportunities for communication of invasive Quagga mussels exist.

1. Travel Information Stations with special message for boaters or water users.
2. Incorporate invasive mussel message into all formal interpretive programs and activities, including introduction of park film at VC.
3. Develop an invasive or alien species interpretive program including those here now, how to prevent their spread, and how to prevent new invasive species from becoming established.
4. Invasive mussel article in park newspaper.
5. Invasive mussel information on park website
 - Develop a flash module showing how to inspect and decontaminate your boat and equipment.
 - Provide links to 100thMeridian.org, ProtectYourWaters.net and [Sea Grant.noaa.gov](http://SeaGrant.noaa.gov)
 - Provide Invasive Species Hotline for Reporting, 1 (877) STOP-ANS (1-877-786-7267)
6. Develop site bulletin on invasive mussels for general park visitors.
7. Work with Public Affairs Office to provide local media, press release illustrating problem and what boaters and other users need to be aware of and do to prevent spread of mussels to other waters.
8. Develop “Don’t Move a Mussel” bumper sticker to give to boaters as they leave launch areas to help spread the word to others.
9. Add an invasive mussel message to Junior Ranger booklet.
10. Work with WASO Interpretation or whoever maintains the Web Ranger program to add an invasive mussel activity.
11. Add message to Environmental Education programs – i.e. Science to classrooms.
12. Develop on-going employee training on invasive species and specifically quagga mussels.
13. Develop cellular telephone tours.

Key messages:

1. Keep national parks free of mussels. Take care not to spread the mussels. If your vessel has recently been in quagga/zebra mussel infested waters, obtain a boat wash before you launch your vessel in any other lakes.
2. When taking boats and equipment out of the water at any lake:
 - Drain water from the motor, live well, and bilge on land before leaving the immediate area of the lake.
 - Completely inspect your vessel and trailer, removing any visible mussels, but also feel for any rough or gritty spots on the hull. These may be young mussels that can be hard to see.
 - Remove any vegetation and mud attached to the equipment.
 - Air-dry the boat and other equipment for at least five days before launching in any other waterway.
 - Do not reuse bait once it has been in the water and allow all fishing tackle to air dry for at least 5 days before fishing in other lakes and streams.
 - Visit www.100thmeridian.org and www.ProtectYourWaters.net to find more information about zebra mussels and other aquatic nuisance species.
 - Click here to watch a video on how to clean your boat (link to <http://www.100thmeridian.org/Video/Clean.asp>)
3. Report quagga/zebra mussel finds to the park immediately!

Appendix D

Sample “Superintendent’s Compendium” Language

From Glen Canyon’s Compendium:

36 CFR § 3.6 - PROHIBITED OPERATIONS

Vessels that have been used within 30 days in states infested with zebra mussels as identified in park information materials will not be allowed on park waters until completing the prescribed abatement process.

Determination: *If zebra mussels infest Lake Powell, they will foul facilities like docks and ramps, encrust boats, clog engines, and damage the fishery by disrupting the food chain. Additionally, they litter beaches with sharp smelly shells.*

This invasive species from Eastern Europe is spreading at an alarming rate across the US. They are transported to new areas attached to boats or harbored in tiny amounts of water.

Appendix E

Agency Controlled Activities

Effective prevention and early detection actions will always function as the most cost effective means to manage invasive species.

Many agency controlled activities provide distinct avenues to add conditions or specification that can assist parks in the prevention and/or early detection of quagga and zebra mussels as well as other aquatic nuisance species. These activities include (1) Special Use Permitting, (2) General Contracting Specifications, (3) Research Permitting, and (4) Concessions Operations. The simple addition of specific language into contracts or permits to ensure that any vehicle or equipment that comes in contact with water resources within a park are “clean” is one of the strongest means to prevent or contain aquatic nuisance species infestations. Although requirements for inspections and vehicle/equipment decontaminations may not always carry the authority of specific law or regulation, these activities just make common sense and ultimately serve to significantly reduce costs to the American taxpayer.

Specific recommendations for language additions to NPS contracting and permitting activities are provided below. Recommendations provided here should be carefully considered. Anticipated changes to concession operations may require contract or agreement re-negotiations. Such changes should be approved through standard NPS concessions processes. A sample cover letter is provided at the end of this appendix.

Special Use Permitting

Organized water based activities conducted on park waters under special use permits provide an important opportunity to prevent the invasion of aquatic invasive species. The primary mechanism is to put in place standard permit conditions that require cleaning of boats and equipment upon entry and exit from park waters. These permit conditions are particularly relevant for activities such as fishing tournament, sailing regattas, and watersport events. Note that there are opportunities to recover costs of enforcement in the permit fee.

Recommended standard permit condition:

Condition #: To help prevent the spread of aquatic invasive species, it is the tournament/regatta/hauler coordinator's responsibility to assure that all participants receive the following instructions:

All boats, trailers, and equipment that contact water must be cleaned prior to launching on park waters and are subject to inspection by NPS personnel (see attachment for list of boat wash facilities). If boats or trailers have visible plants, mud, mussels, or other signs of contamination, they will not be allowed to enter the water and are subject to enforcement of all applicable state and federal laws.

Upon take-out, while still in the immediate area of the lakeshore, the following tasks must be completed

Drain the water from motors, live wells, and bilges on land

Completely inspect vessels and trailers, removing any grit or debris.

Before leaving the local community, use a commercial boat wash or car wash facility to:

Flush motors and bilges with hot water of at least 104 F.

Wash hulls, equipment, bilges, wells, holds, and any other surface exposed to lake water in hot water of at least 104 F.

clean and wash trailers, vehicles, fishing equipment, or any other items that come into contact with lake water because mussels and microscopic larvae can live in small pockets anywhere water collects.

If feasible, air-dry boats and other equipment for at least five (5) days before launching on any other waterway.

Do not reuse bait once it has been exposed to lake water and dispose of unused bait in garbage cans.

Allow all accessory equipment and fishing tackle to dry completely before reuse.

General Contracting Specifications

Similar to the SUP condition identified above, any contract issued by a park unit should include specifications to prevent the introduction and spread of invasive organisms.

Research Permitting

Water-based research activities have the potential to spread aquatic invasive species on vessels, equipment, scientific instruments, foot wear, and vehicles. Research permit conditions provide an important opportunity to prevent spread via research vectors. Below is a recommended permit condition. Note that the first two sentences can and should be used in every park unit even if there are no known invasive organisms associated with the research activity.

Recommended standard research permit condition:

Condition #: All equipment (instruments, vehicles, boats, footwear, etc) used in the park must be cleaned and dried prior to use and upon exit from the Park. Such equipment must be free of mud, water, or debris that could harbor non-native organisms and all such equipment is subject to inspection by NPS personnel. All permittees are hereby notified that (insert name of water body) are known to harbor (list known aquatic invasive species) that can do substantial harm to uninfested waters. All researchers are required to take all precaution to prevent the spread of these aquatic invasive species. Recommended decontamination procedures are available at (insert good reference website for the species).

Concession Operations

Concession operations involving water-based activities is a risk factor for the establishment of aquatic invasive species. Of special concern are marina concession operations and rafting/boating trip operations.

A. Marinas

Slipped and moored boats are high risk vessels for transport of aquatic invasive organisms between water bodies, because they are often resident in a single water body for sufficient time to realize colonization by adult, reproductive animals or plants. For example, in quagga mussel response at Lake Mead NRA the Science Team suggested focusing on moored/slipped boats and NPS-controlled operations. The reason is that the highest potential for spread is a result of reproductive adult mussels in close proximity to each other, thus releasing gametes in large numbers with an increased probability of fertilization and thus the potential to infest new areas. Slipped and moored boats colonized by mussels provide the mobility to bring reproductive mussels to new environments and thus should be the highest target for containment. Additionally, on Lakes Mead and Mohave all slip and mooring opportunities are associated with marinas that are NPS concessions or government owned docks. There are no private slips, docks, or marinas on Lakes Mead and Mohave. As such there is an opportunity to exercise control over these vessels.

Concessions management in the NPS is a legally complicated arena and there are very limited opportunities to quickly respond at the time of an environmental emergency, such as the detection of an aquatic invasive species. Thus, the ability of the agency to take quick action to contain the spread or treat the outbreak is largely dependent upon the forethought provided in the concessions contract and the annual operations or maintenance plan as well as willingness of the concessioner to cooperate.

While it is beyond the scope of this document to prescribe concessions policy, it is desirable to identify ideas that could be used for the protection of park resources. To this end the following recommendations are put forward:

- 1) Parks with marina operations should engage concessioners in the planning and implementation process from the start to help prevent the introduction and spread of aquatic invasive species.
- 2) Parks with marina operations should have boat cleaning services available, such as fixed boat wash stations (preferred) or portable hot water pressure sprayers that drain to a wastewater treatment plan (rather than a storm water drain). Parks should decide whether boat cleaning facilities should be provided and/or operated by the park or concessioner. (See list at the end of this appendix for some boat wash station vendors.)
- 3) Parks should direct concessioners to modify their slip rental agreements to include the following conditions:

Prior to launching and upon exiting, you are required to decontaminate your vessel at a park-approved boat-washing facility and to show proof of decontamination to the marina operator. The vessel is subject to inspection at any time by NPS and marina personnel and contaminated vessels are subject to enforcement of all applicable state and federal laws.

Marina operators should be able to direct vessel owners to identified boat wash facilities that provide proof of decontamination by way of dated receipt. An example of the protocol used at Lake Mead NRA is provided below.

4) Oversize haul permits, generally operated as a Commercial Use Authorization for the launching or retrieval of large vessels, are an important tool to assure that launching and exiting vessels are indeed inspected and decontaminated as recommended. The NPS should assure that adequate permit conditions are in place on both CUA permits and oversize haul permits to link that action to the action prescribed above.

5) Parks should direct concessioners to notify slipped and moored vessel owners of specific invasive species information that should be transmitted to customers, such as via an enclosure in their monthly billing statement. Additionally, Parks should provide or direct concessioners to post signs to alert boat owners of invasive species concerns.

6) Parks should ensure that concessioners are aware of any park policies promulgated (e.g., additions to the Superintendent's Compendium) that may affect concession operations, such as specific procedures to be followed to prevent or eradicate invasive species. Concessioners are required to follow park policies per their contracts, which indicate that they are required to comply with all Applicable Laws.

B. Rafting/Boating Operations

In some cases, concessioner boat operations may serve as a potential vector for the spread of invasive species. For example, river rafters from the Grand Canyon take out at Lake Mead NRA then re-launch at Glen Canyon NRA and raft through the Grand Canyon. As Lake Mead is infested with quagga mussels and Glen Canyon is not, these rafts have the potential to transport mussels to uninfested waters. While each situation is different and it is beyond the scope of this document to prescribe concessions policy, it is desirable to identify ideas that could be used for the protection of park resources. To this end the following recommendations are put forward:

1) Parks with water-related operations (other than marinas) should engage concessioners in the planning and implementation process from the start to help prevent the introduction and spread of aquatic invasive species.

2) Parks should ensure that concessioners are aware of any park policies promulgated (e.g., additions to the Superintendent's Compendium) that may affect concession operations, such as specific procedures to be followed to prevent or eradicate invasive species. Concessioners are required to follow park policies per their contracts, which indicate that they are required to comply with all Applicable Laws.

Lake Mead National Recreation Area

Aquatic Nuisance Species Watercraft Decontamination Guidelines (*version 3/23/07*)

Informed Consent

First, obtain permission from the boat owner to decontaminate the vessel. We recommend that you inform the vessel owner of the following:

- All vessels in contact with waters from Lakes Mead or Mohave have the potential to transport larval or adult quagga mussels. Slipped or moored vessels particularly have a high probability of being infested.
- It is unlawful to transport aquatic nuisance species, including quagga mussels. Infested vessels are subject to inspection and impound by regulatory agencies.
- Cleaning is advised for all vessels exiting Lakes Mead or Mohave destined for other waters; however, cleaning does not preclude regulatory agencies from inspecting any vessel and impounding those found to harbor mussels.
- Even cleaned, there is the potential for mussels to still be present. Mussels can cause the motor to seize, damage the hull, reduce gas mileage, and otherwise affect the normal operation of the vessel.

Containment

Second, find a safe location to clean the vessel and wear personal protective equipment.

- Identify a location in which to do decontamination. Be sure it is not in a drainage channel or where it could do environmental damage.
- If the engine or raw water cooled AC or refrigeration units are flushed, the wash water must be contained for proper disposal. Ideally this should be done in a marine service area with a drain equipped with an oil separator.
- All debris washed from the vessel is collected and properly disposed.

Decontamination

Third, clean the vessel using a pressure sprayer with hot water (>140°F minimum).

- Remove all visible mud, plants, fish or animals from the vessel and contain debris for proper disposal. Use a rubber squeegee or similar non-scratching tools if needed to remove mussels from cracks or crevices. Note that exposure to hot water will kill mussels, but if mussels are left attached the vessel is still subject to impound.
- Drain and dry all live wells and bilges. If there is any oil in the bilge the water must be contained for proper disposal.
- Use high pressure to spray the anchor and all wet lines.
- Use low pressure to flush the gimbal area for at least one minute.
- Use high pressure to spray all surfaces of the vessel and trailer. Pay particular attention to the underside of the vessel as well as trim tabs and other crevices.
- Use high pressure to rinse the vessel's thru hull fittings, compartments, and accessories.
- If you have containment, flush hot water at low pressure through the vessels engine cooling system and heat exchanger with the engine running for at least one minute. If this is not possible, use low pressure hot water to rinse the intake grate or screen and plumbing without running the motor.
- If feasible, drain completely or flush low pressure hot water through any plumbing systems that come into contact with raw water, such as houseboat AC and refrigeration units.
- Finally, check the entire vessel again for any visible mussels and remove any that are found. Thoroughly dry everything by hand or by air.

Example of Draft Letter to include with Contracts and Permit Recipients

Dear Researcher/Contractor/Permittee,

We are sending you this email/notification to inform you of our implementation of new contract/permit conditions to assist us with the prevention and/or early detection of quagga/zebra mussels [or add any other aquatic invasive species] infestations within the water resources at [Park Name].

Non-native aquatic nuisance species represent a significant threat to water resources of the Western United States. The establishment of these invasive species not only adversely impact native ecosystems, but can also negatively affect the recreational activities and infrastructures associated with these waters resources. The recent documentation of quagga mussels to Lake Mead National Recreation Area and Lakes Mohave and Havasu, highlight the potential for exponential spread of aquatic nuisance species throughout the west.

The scope of this issue goes beyond the NPS and [Park Name] alone and will require the assistance of park partners such as you to ensure the greatest chance to prevent the introduction and spread of aquatic nuisance species. Prevention and early detection activities as identified in your contract/permit conditions are essential to the success of this goal.

Please visit the 100th Meridian website (add in web site) or contact [provide Park Contact name and phone] if you would like more information on aquatic nuisance species or if you have any questions.

We thank you and greatly appreciate your participation in protecting park resources from this significant threat!

Sincerely,

Park Superintendent

Appendix F

Boat Inspections

BOAT INSPECTIONS

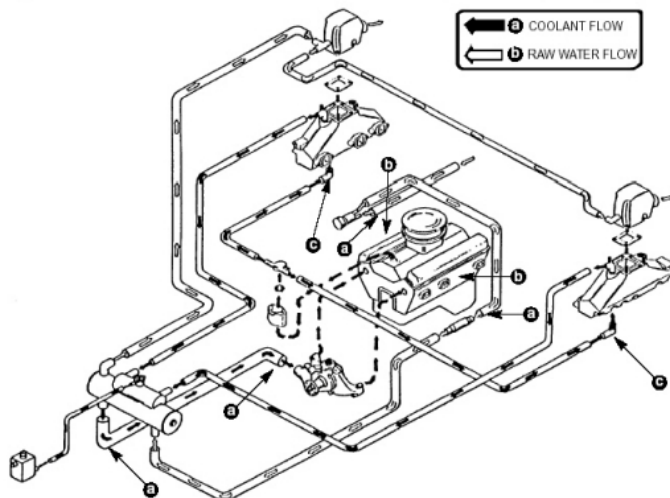
In the process of inspecting a boat to assess its infestation risk, it may be necessary to go beyond the outside surface of the boat's bottom. Following is a description of the different equipment systems in a boat that use raw water for cooling or other purposes. Once it has been established that a boat is infected, it will be necessary to raise the level of inspection to include some or all of the equipment described here.

PROPULSION ENGINES: There are several types;

Outboard Engines. Their cooling systems are simple and all outside of the hull, making it easy to inspect and flush if necessary.

Water Flow Diagrams

Engines With Coolant Flow Thru Exhaust Manifolds



I/O's (Stern Drives), Vee-Drives and IPS'. This group is offered in two versions: Those which use fresh-water and those which use Raw-water for cooling purposes. Components to check are: The stern drive and water intake area, the bellows and the outer-transom plate area. All interior cooling water routing to the pump, heat exchanger, block, exhaust manifold, water-lift or muffler, and the exhaust hose to the exhaust fitting.

water-cooling system include a sea-cock, a strainer or a sea-chest and all the routing elements mentioned for the stern-drives above.

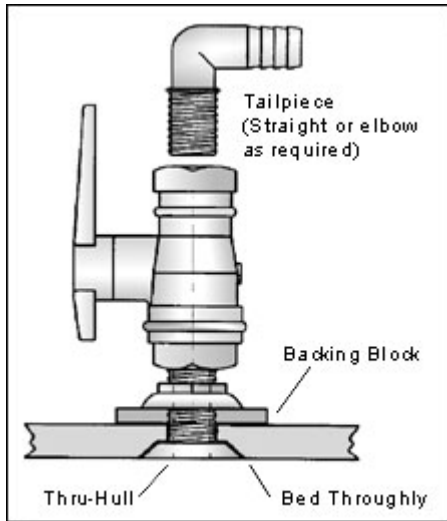
Straight inboard engines with shafting thru-hull. Elements of the

GENERATORS:

Generator cooling system plumbing is very similar to the propulsion engine's one, and include: Sea-cocks, strainers, sea-chest, heat exchangers, raw-water pump, manifold, water-lift and or water separator, including its own water discharge hose and thru-hull fitting.

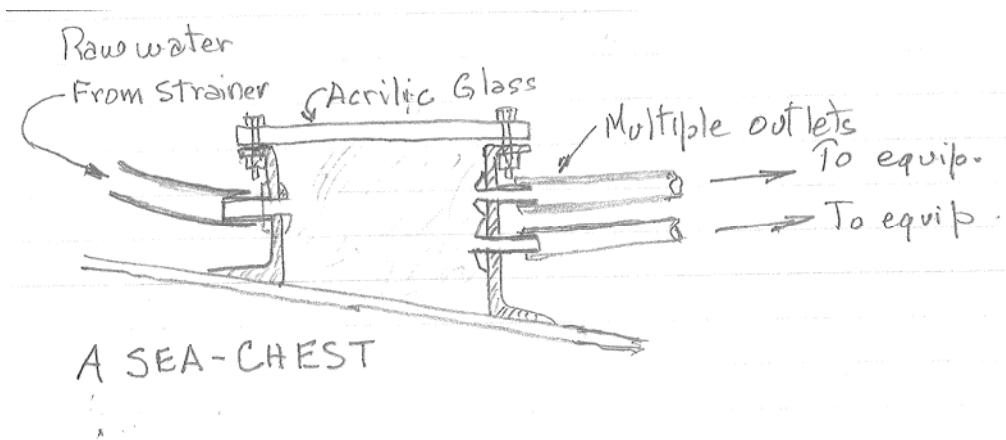
SEA-COCK:

Is a thru-hull fitting with a shut-off valve on the inside and usually feeds water to a sea-chest or directly to an engine or equipment aboard. The intake tube is a mussel harboring spot to look for during inspection of the hull bottom.



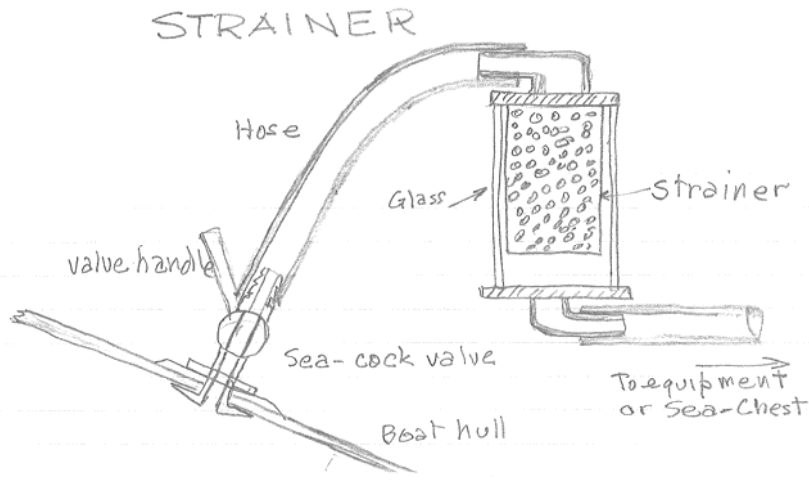
SEA-CHEST:

The sea-chest is a wet box located inside the hull and below the water line. It is used to reduce the amount of thru-hull fittings and sea-cocks necessary to cool other equipment. The sea-chest has one sea-cock, usually large, a strainer which is connected with a hose to the chest. The chest then feeds multiple equipment requiring cooling systems such as air conditioning pumps, refrigeration and others.



STRAINER:

The strainer will get its water from either directly from a sea-cock or from a sea-chest which will then distribute the coolant raw water to multiple equipment without the need for more sea-cocks and thru-hull fittings. The sketches depict both systems.



AIR CONDITION UNITS:

This equipment may have its own sea-cock, or is connected to the sea-chest in order to feed its cooling pump. If it has its own sea-cock then it is also fitted with a strainer.\

REFRIGERATION UNITS:

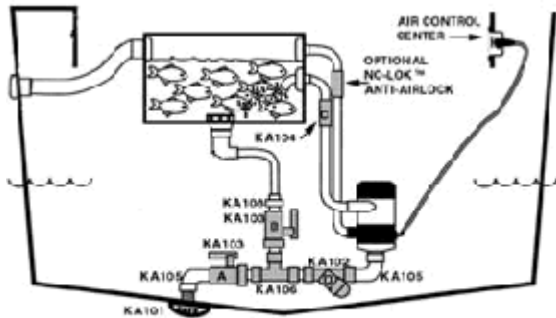
There are several kinds of refrigeration equipment, each with its own cooling requirements:

12 VDC systems. Usually not requiring water cooling, but they could be.

120 VAC systems, which come in both ways, with or without water-cooling. The ones that do, will usually discharge overboard and above the water line. Usually these will feed from the sea-chest, but could have their own sea-cock and strainer.

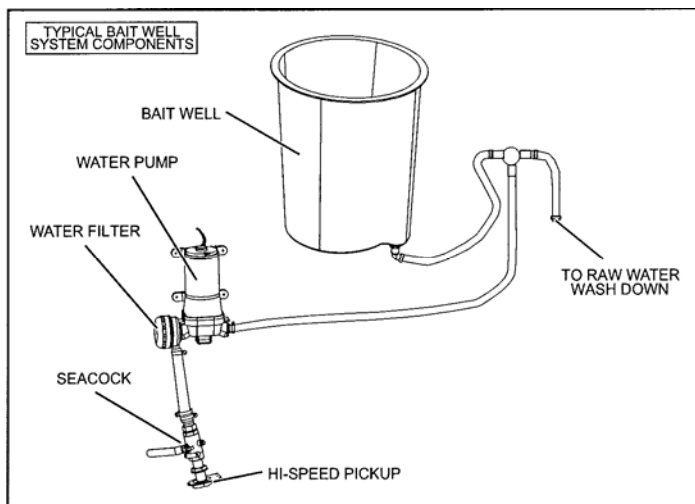
Engine Driven compressor/refrigerator. These are also water cooled and feed from the propulsion engine raw-water pump. This equipment may very well be “out-of-the-way” and difficult to find but it is important because it has its own separate heat exchanger tank. (Full of cool, raw water.

BAIT-WELLS AND LIVE-WELLS:



W/ve "A" opened, "B" closed = outside water flowing thru live well
 W/ve "A" closed, "B" opened = recirculating live/well water only
 W/ve "A" opened, "B" opened = live/well will drain
 W/ve "A" closed, "B" closed = strainer "D" can be cleaned. Check valve "C" prevents back flow

These are inboard tanks with plumbing usually originating at the transom with a thru-hull fitting connected inside to a pump to feed the tanks. The tank will have an overflow and a drain overboard or thru the hull bottom.



Another schematic of a bait-well tank with its plumbing. Notice that even after draining, there will be plenty of water in the system. This should be flushed with a biocide solution in order to properly clean.

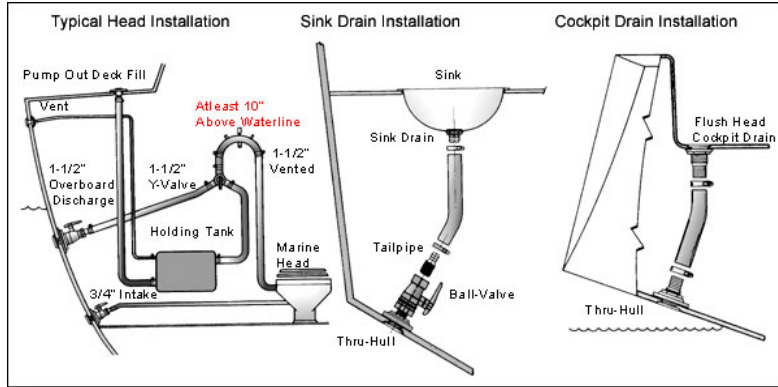
FISH HOLDING TANKS:

Usually below the cockpit sole and do not use water. However since they hold fish, many are fitted with a macerator pump to facilitate the chopping and discharging of tissue, blood, etc. Before leaving the lake these are usually washed with raw water and discharged with the pump.

RAW-WATER WASH DOWN SYSTEMS:

Intake may be isolated or coming from the sea-chest, which is more common. May or may not be fitted with a strainer. This system could be a high risk one since it is not used much and could accumulate raw water.

MSD OR HEAD SYSTEM:



These come in a large variety of models and most of them will use raw water to rinse and flush (not all). Heads are operated with either an electric or a hand pump that has two cycles. One to intake water into the bowl and the other that flushes while also in-taking water. The discharge may be directly overboard (usually prohibited) or into a holding

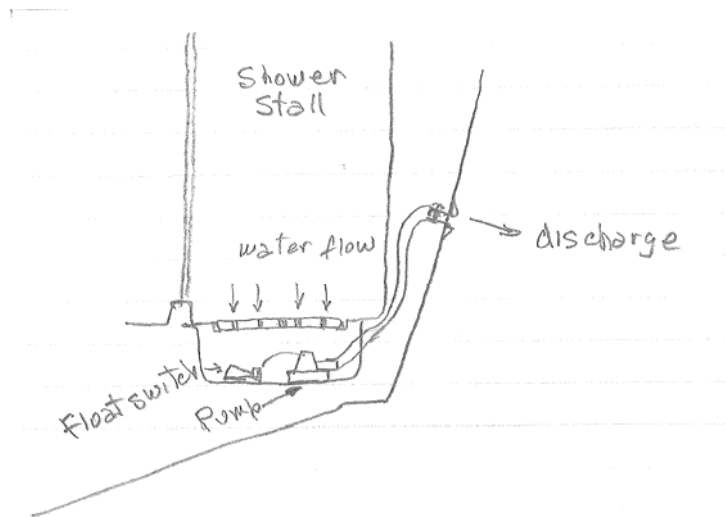
tank with overboard discharge feature. This tank is rich in organic matter and could harbor larvae for some time.

BALLAST TANKS:

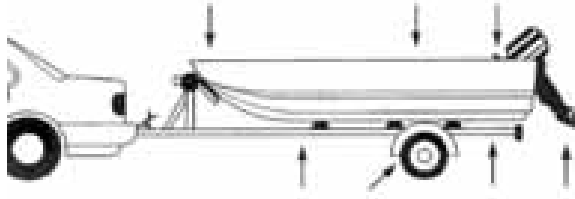
In recent years the use of a ballast tank using raw water has been added to the features on ski-boats and some sail boats. These are used in ski boats to modify the wake pattern in order to do surf boarding. It is a simple pump-in and pump-out system but could harbor larvae. The rare use of them in sailboats, used to increase the righting moment of the vessel, still needs to be checked.

SHOWER STALL SUMP PUMPS:

Most cruisers will have a shower stall with a sump to pump-out the gray water. In many cases where the boat is going to be used on fresh water lakes, the shower pump will feed directly from the lake rather than used fresh water from its tanks, This system will hold water and needs to be decontaminated if infested.



BOAT TRAILER:



Of harmless appearance, the boat trailer could be an important source of contamination, and one that could present problems when decontaminating. Areas to check include: Any organic material attached to the structure, the carpet that covers the bunks could harbor larvae among its fibers, wheel covers and finally the tail-

lights which may or may not be sealed, and consequently a suspect host.

Boat Wash Equipment

Portable boat wash equipment basically consists of a hot water pressure sprayer, which can be acquired from many sources for a few thousand dollars. Ideally, such equipment should be self-contained in the form of a trailer equipped with a water tank and an on-board power source (e.g. diesel fuel). Typically such equipment costs tens of thousands of dollars per unit. As of 2007, there are at least five vendors on GSA Schedule that offer such equipment: Greenfield Industries, Hotsy, Hydro Engineering Inc, Landa Cleaning System, and Sioux Corporation. Recommended specifications for such equipment as purchased at Lake Mead NRA is listed below:

Trailer mounted – tandem axle w/ surge brakes
250 Gallon water tank
140° or higher water temperature (adjustable)
2500 PSI minimum water pressure (adjustable)
4 GPM flow rate
Gas powered pump w/ electric start
Propane heated (diesel is acceptable option)
Hose reel
75” high pressure hose
2 wands – 1 standard, 1 with 90° angle on end
Spray tip assortment (4 minimum)

Permanent boat wash stations are also available on GSA schedule and typically cost in excess of a hundred thousand dollars, but costs vary widely depending on size, specifications, vendor, as well as the availability of water and power at the proposed site. Such systems should be of industrial grade and ideally should be self-contained and provide water recycling for maximum efficiency. If not, the site should be equipped with a drain and treatment system for full containment.

Below are links to some of the vendors for boat wash equipment:

Greenfield Industries <http://www.greenfield-industries.com>

Hotsy <http://www.hotsy.com>

Hydro Engineering, Inc. <http://www.hydroblaster.com>

Landa Cleaning System <http://www.landa.com>

Sioux Corporation <http://www.sioux.com>

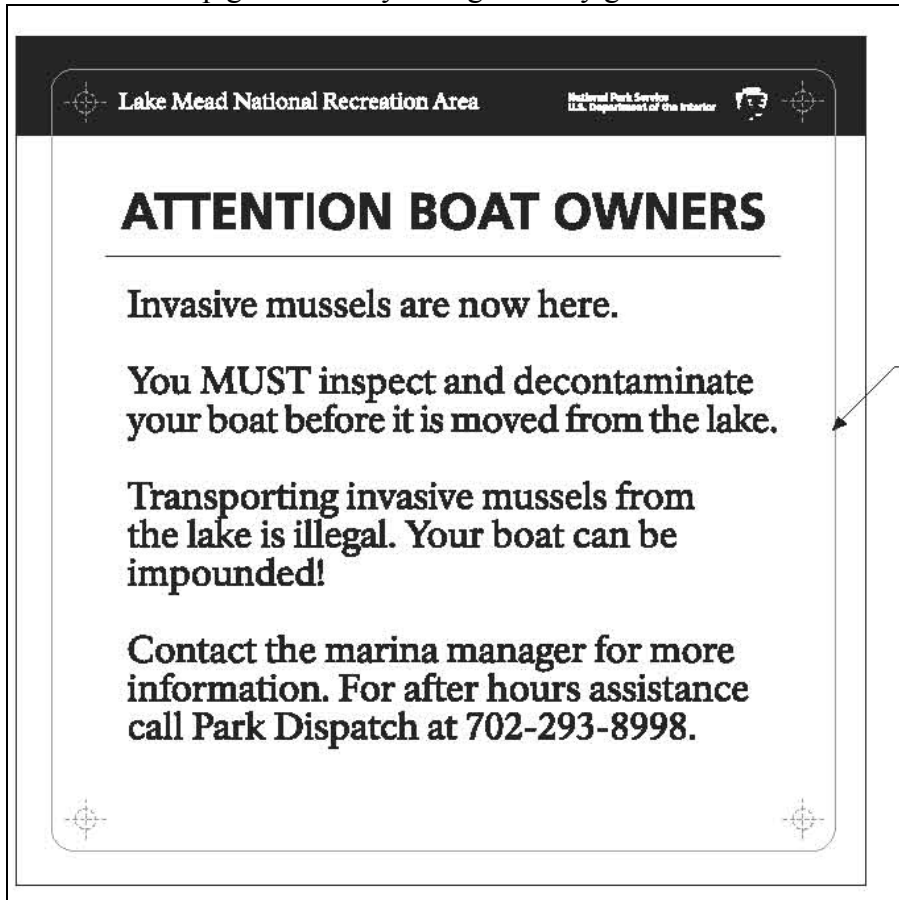
Pre-fix Corporation* <http://www.prefix.com>

April 2007: currently a prototype in development, not on GSA schedule

Appendix G

Sign Samples

Signs posted at all marina slip gates and dry storage facility gates.



Lake Mead Road Signs (all meet NPS sign standards)

Incoming, designed for access roads with 25 mph speed limit
(48'x 24', 3' letters, English)



Incoming, designed for access roads with 25 mph speed limit
(48'x 24', 3' letters, Spanish)

**¡No toque los mejillones!
Sólo lance al agua equipo
que esté limpio y seco**

Outgoing, designed for access roads with 25 mph speed limit
(48'x 24', 3' letters, English)

**DON'T MOVE A MUSSEL!
CLEAN, DRAIN AND DRY
YOUR EQUIPMENT**

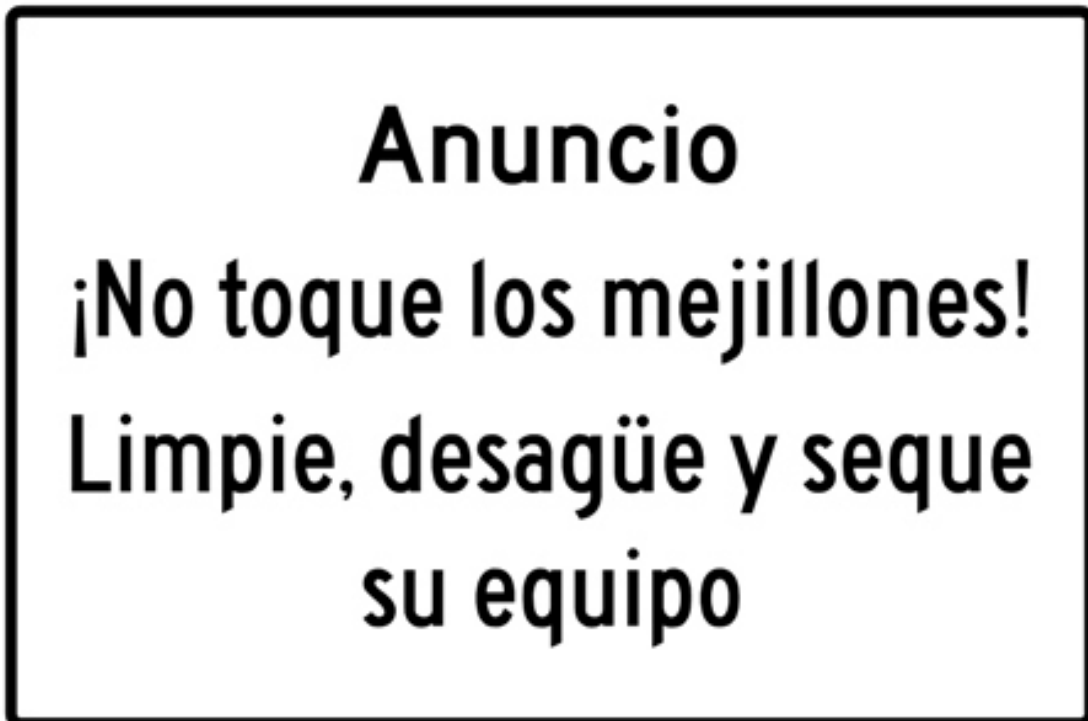
Outgoing, designed for access roads with 25 mph speed limit
(48'x 24', 3' letters, Spanish)

**¡No toque los mejillones!
Limpie, desagüe y seque
su equipo**

Designed for entrance roads with 50 mph speed limit
(72'x48', 5 inch lettering, English)



Designed for entrance roads with 50 mph speed limit
(72'x48', 5 inch lettering, Spanish)



ATTENTION

**VESSEL
CERTIFICATION
INFORMATION
AT LAUNCH
RAMPS**
(Including PWC's)



**STOP AQUATIC
HITCHHIKERS!™**

ATTENTION

STOP HERE

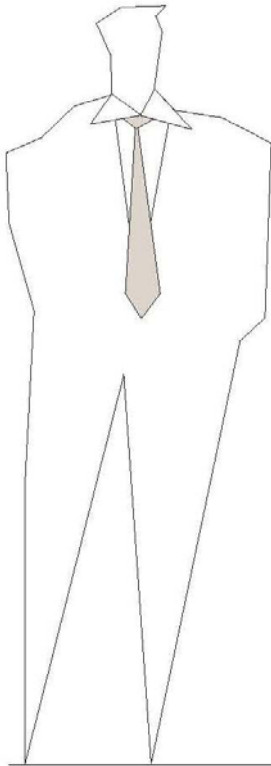
**ZEBRA MUSSEL FREE-ZONE
CERTIFICATION
STATION**



(IN SHADE SHELTER)



**STOP AQUATIC
HITCHHIKERS!™**






STOP AQUATIC HITCHHIKERS!
Prevent the transport of nuisance species.
Clean all recreational equipment.
www.ProtactYourWaters.net

When you leave a body of water:
Remove any visible mud, plants, fish or animals before transporting equipment.
Eliminate water from equipment before transporting.

Clean and dry anything that comes into contact with water (boats, trailers, equipment, clothing, dogs, etc.).
Never release plants, fish or animals into a body of water unless they came out of that body of water.

DON'T MOVE A MUSSEL!
Clean, drain, and dry your equipment.
Prevent the spread of invasive mussels.



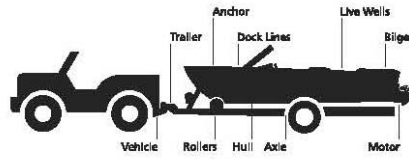


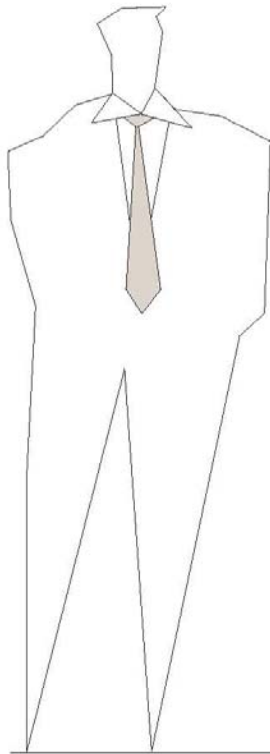
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DON'T MOVE A MUSSEL!
Clean, drain, and dry your equipment.
Prevent the spread of invasive mussels.






¡ALTO! DETÉN LA PLAGA.

No contribuyas al transporte de especies dañinas. Limpia todo tu equipo de recreación.
www.ProtactYourWaters.net

Cuando salgas de una área acuática:
Remueve completamente el lodo, plantas, pescados o animales antes de mover o transportar tu equipo.
Seca tu equipo antes de empaquetarlo o transportarlo.
Limpia y seca cualquier cosa que haya hecho contacto con el agua (lanchas, remolques, equipo, ropa, perros, etc.).
Nunca eches plantas, pescados o animales al agua a menos que hayan salido de ese cuerpo de agua.

¡NO CONTRIBUYAS A LA PLAGA DE MEJILLONES!

Limpia, desagua y seca tu equipo. Evita la propagación de mejillones.



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¡ALTO! DETÉN LA PLAGA.


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Cuando salgas de una área acuática:
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Limpia y seca cualquier cosa que haya hecho contacto con el agua (lanchas, remolques, equipo, ropa, perros, etc.).
Nunca eches plantas, pescados o animales al agua a menos que hayan salido de ese cuerpo de agua.

Rack Cards

Lake Mead

National Park Service
U.S. Department of the Interior



Lake Mead
National Recreation Area



Don't Move a Mussel!

Invasive mussels are here! Quagga mussels, closely related to zebra mussels, have been found in Lakes Mead and Mohave. Mud, plants and animals that may be lurking on your watercraft, trailer, or on your vehicle will cause the spread of invasive mussels. Invasive mussels cause millions of dollars of damage to boat and water systems by clogging pipes and engines. They also impact the native ecosystem and sport fisheries.


CLEAN YOUR BOAT and YOUR EQUIPMENT!

Every time you leave the water:

- Remove any visible mud, plants, fish or animals before transporting equipment;
- Eliminate water from equipment before transporting;
- Clean, drain, and dry anything that comes in contact with water (boats, trailers, vehicles, equipment, clothing, dogs, etc.)

Stop Aquatic Hitchhikers!



Quagga mussel locations


Areas the quagga mussel have been found in the United States.

Prevent the transport of nuisance aquatic species.

Clean, drain, and dry ALL recreational equipment.

www.ProtectYourWaters.net

Glen Canyon



What is the greatest **threat** to **Lake Powell** today?


Zebra Mussels in Lake Powell could:
- Disrupt the food chain and fishing
- Foul facilities like docks and ramps
- Encrust boats and clog engines
- Litter beaches with sharp, small shells

This invasive species from Eastern Europe is spreading at an alarming rate across the US.

They are transported to new areas attached to boats or harbored in tiny amounts of water.

Dead zebra mussels have been found on a boat in Lake Powell.

Zebra mussels have taken over half the country



Zebra mussels have recently been found in Lakes Mead, Mohave, and Havasu



What can you do to help?

1. Don't be the Problem:
- Before Launching... Before Leaving
- Remove ALL plant and animal material from boat, trailer, and other equipment.
- Away from water bodies, drain ALL water from boat and motor!
2. Help raise awareness:
- Find out how many of your friends know about zebra mussels.
- Read this page, then give it away.
- Learn more at:
www.100thMeridian.org



The National Park Service cares for special places saved by the American people so that all may experience our heritage.

Posters

Lake Mead

Lake Mead
National Recreation Area

National Park Service
U.S. Department of the Interior



Don't Move a Mussel!

Invasive mussels are here! Quagga mussels, closely related to zebra mussels, have been found in Lakes Mead and Mohave. Plants and animals that may be lurking on your watercraft, trailer, vehicle, or other equipment will cause the spread of invasive mussels. Invasive mussels cause millions of dollars of damage to boat and water systems by clogging pipes and engines. They also disrupt the native ecosystem.

CLEAN YOUR BOAT and ALL OF YOUR EQUIPMENT!

EVERY time you take them out of the water:
Clean, drain, and dry ALL of your equipment.



Prevent the spread, don't move a Mussel!



Stop Aquatic Hitchhikers!

www.100thmeridian.org

Glen Canyon

Glen Canyon

National Park Service
U.S. Department of the Interior
Glen Canyon National Recreation Area



**IF YOUR BOAT & PWC HAVE
BEEN IN WATERS
OTHER THAN LAKE POWELL
IN THE LAST 30 DAYS
YOU MUST CERTIFY CLEAN
OR
DECONTAMINATE
BEFORE LAUNCHING**



**STOP AQUATIC
HITCHHIKERS!™**

Prevent the transport of nuisance species.
Clean all recreational equipment.
www.ProtectYourWaters.net

When you leave a body of water:

- **Remove any visible mud, plants, fish or animals before transporting equipment**
- **Eliminate water from equipment before transporting**
- **Clean and dry anything that comes in contact with water (boats, trailers, equipment, clothing, dogs, etc.)**

Appendix H

Early Detection Monitoring

Introduction

Early detection maximizes the potential for eradicating mussels from a water body before they have become established and provides a trigger to initiate containment activities to prevent spread to other locations. While measures recommended in the prevention section of this document are intended to prevent an introduction from occurring, it should be recognized that compliance and / or interdiction rates will probably not be 100%. Thus a well designed monitoring program for mussels within a water body provides a necessary second line of defense. The methods identified in this section are intended to serve as starting-points and guidelines not to be prescriptive or provide the best solutions for all possible circumstances. The emphasis is on sampling in the areas where introductions are most likely to occur. These include marinas, boat ramps and other access points, especially areas with high boat traffic. There may be situations where it makes more sense to sample other types of locations such as inflows, outflows and sites where high flow rates may facilitate transport of veliger larvae. Park staff involved with establishing monitoring programs are encouraged to make use of the resources in this document (appendices and reference) and to contact other NPS staff with quagga mussel monitoring experience.

Early Detection Monitoring Methods

Passive sampling with artificial substrates

Objective: Early detection of adult mussels within a waterbody.

Rationale: Passive sampling with artificial substrates is a cost effective approach to early detection. Sampling can be conducted by volunteers and other NPS staff with minimal training and equipment.

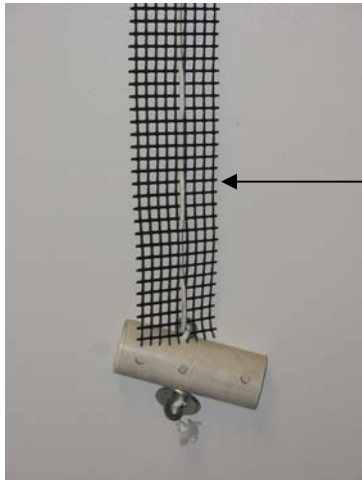
Equipment

Modified Portland Samplers - Portland samplers consist of sections of ABS pipe suspended in the water column at various depths (See Figure 1 and 2). Contact Information for obtaining/purchasing samplers:

Steve Wells

invasivespecies@pdx.edu
Portland State University

Center for Lakes and Reservoirs
PO Box 751
Portland, OR 97207-0751
PH: 503-725-9076
Fax: 503-725-3834



Black netting on the modified sampler is construction mesh that can be found at most home improvement stores. It typically comes in a 4' x 15' roll at a cost of ~\$10. It is cut into a 4-inch wide strip (length will vary depending on the intended sampler depth) with the rope weaved through the mesh.

Fig 1



Fig. 2

Lake Mead Directions for Making a Passive Substrate Sampler (Figures 3-9)

Materials for one unit:

ABS 7 5/8" (6 per unit)

1/2" Washers (6 per unit)

Concrete piece (1 per unit) Broken pieces free at Lowes & Home Depot

Carabineers (3 per unit)

Nylon scrub pad (no soap)(3 per unit)

Rope (length dependent on water depth)

Main Unit:

Cut ABS into 7 5/8" lengths (makes 15 pieces from a 10' length based on 1/8" saw kerf)

Drill 3/8" hole though center of the 7 5/8" ABS section (for rope)

Drill 4 - 1/2" holes at opposing angles through each section (to allow water flow and mussel access into pipe section)

Drill 3/8" hole through center of the piece of concrete.

Thread three ABS pieces onto the rope through the 3/8" hole and a washer below each piece.

Thread the concrete and a washer onto the end of the rope and tie a stopper knot in the end of the rope to keep the washer and concrete from coming off the rope.

Insert scrub pad into one end of each substrate leaving about a 1/3rd sticking out

Replaceable unit:

Cut 3 - 20" pieces of rope

Tie a knot in one end and thread a washer and a ABS section onto line through the 3/8" holes.

Tie a loop in the free end of the rope

Clip a carbineer into the loop

Insert scrub pad into one end of each substrate leaving about a 1/3rd sticking out

Protocols:

Samplers should be deployed during the ice free period in the vicinity of marinas, docks and other public access points. Each sampler should have 2 pipes (~8" long) suspended at depths of 6, 20 and 30 feet below the water surface. Samplers should be inspected for mussels at 4-6 week intervals when water temperatures exceed 10°C. Protocols are subject to modification based on the observations of field personnel and future research.

Checking Frequency: Monthly

Installation

Place samplers at multiple locations, preferably in shaded water

Toward shore

Deeper water

When the water depth at the substrate placement location has been determined, adjust the distance between the ABS sections so that they are evenly placed between the surface and the concrete when the concrete is approximately 5' above the bottom by taking the bottom line and making a half hitch around one end of the substrate (Figs 2, 3, 4). Scrub pads are not shown in the illustrations.



Fig 3



Fig 4



Fig 5

Tie an inline knot (figs 6, 7) above each ABS unit leaving a small loop in the line.



Fig 6



Fig 7

Clip a replaceable substrate into each loop (fig 8)



Fig 8



Fig 9

B. Veliger sampling - Visual Detection

Objective: Determine the presence of veliger larvae in a waterbody during periods when conditions are suitable for spawning.

Rationale: Veliger sampling is more labor intensive and costly than passive sampling for adults. However it provides an excellent tool to determine whether mussels are present and reproducing. It may be useful for detecting presence at remote sites where regular site visits are impractical.

Equipment:

- 63 μ m plankton net w/dolphin bucket
- Calibrated line
- Wash bottle
- Sample jars (125ml)
- Ethanol
- Cooler



Protocols:

Visual detection:

Collection: Slowly lower net into water until you feel slack in the line when the dolphin bucket touches bottom. Do not allow net to rest on the bottom. Read depth and slowly pull net up. Hang net in a shaded area and wash down the sides from the outside starting from top to bottom so as to wash collected samples into the dolphin bucket. Remove the dolphin bucket and wash contents through the screen into a sample jar.

Preserving Sample: Pour enough ethanol into a marked sample jar to make a >50% ethanol mix. Secure top on jar and place in cooler. Record date, time, location, net ring diameter and depth of column sampled.

Checking Sample: Divide sample $\frac{1}{4}$ and $\frac{3}{4}$. Inspect $\frac{1}{4}$ of the sample and send the other $\frac{3}{4}$ to a lab capable of identifying veligers.

Send samples to: Steven Wells sww@pdx.edu Portland State University PO Box 751-ESR Portland, OR 97207-0751 (*note: other parties interested in this sampling should contact lab first*)

C. Collecting Water Samples For *Dreissena* spp. Veliger PCR Analysis

Bureau of Reclamation
Technical Service Center
Denver, Colorado

[Please contact BOR prior to initiation to receive any protocol updates and to establish any analysis contracting needs]

Equipment Needed:

- 63- μ m Plankton Tow Net (Mesh size is critical). (We use custom Wildco plankton net with a 500 mm-diameter opening, flow meter (optional), and a 2-m length.)
- Spray Bottle – 1-L
- Ethanol (lab grade, 200 proof; or from a local liquor store, e.g., Everclear 190 proof = 95% or Rum 151 proof = 75.5%)
- Sample Bottles (1000-mL Nalgene leak-proof poly (HDPE))
- Disposable Diapers
- Plastic electrical tape
- Ziploc Bags – 1-gal.
- Plastic Garbage Bags (large enough to hold 4 sample bottles)
- Waterproof Markers and Labels
- Data Sheet and Waterproof paper
- Ice chest with cubed/crushed ice or frozen “blue ice”
- Decontamination container for sampling net (e.g., $\frac{1}{2}$ plastic barrel with inside diameter greater than plankton net hoop to permit complete submersion)
- White vinegar (from grocer) or 5% acetic acid solution - 12-16 L (i.e., enough to cover plankton net in decontamination container)

Sample Collection Procedures:

1. Introduction - These procedures are designed to collect the veligers or the free-swimming larval form of zebra and quagga mussels (*Dreissena* spp.) as plankton samples for laboratory detection using polymerase chain reaction (PCR). Step-by-step collection procedures are included below. The volumes of water sampled through the plankton net are needed both for sample size standardization and for calculating the number of veliger density by microscopic methods to confirm the PCR results. Collect a minimum of two replicate plankton samples at each location.

Note: If the plankton net has been contaminated with zebra or quagga mussel veligers from previous collection events, it should be decontaminated with acetic acid (vinegar) and rinsed prior to sample collection. Go to Steps 6-8 for this procedure. Save the final water rinsate sample for laboratory analyses to confirm decontamination. Record and label information about the rinsate (Step 5).

2. There are two methods of acquiring the water sample:

Plankton net tow – Lower the net to the desired, measured depth and slowly tow it for a known recorded distance. The volume of water that is sampled can be determined based on the diameter of the net opening and the distance towed. A minimum sample volume of 1,000 L is recommended. Record: Depth and distance of the tow.

(Caution: To assure accuracy of the sample volume, do not let the retrieval speed exceed the filtration rate of the net.) Remember that veligers from spawning zebra and quagga mussels are more commonly found in deeper water so sample accordingly. Go to Step 3.

Pumped source – This may be taken either by a portable pump from a boat or from the raw, untreated water plumbing system of a dam or water treatment plant. Open the flow valve and completely purge the supply line of any stagnant water. If a flow meter is not available on the pipe, use a five gallon bucket and a second timer to determine the flow rate (gallons per minute) through the pipe. Calculate the mean of at least 3 replicate runs for determining the flow rate. Place the plankton tow net under the hose and collect all of the water flowing out of the valve and keep an accurate measure of the volume of water flowing into the net by recording the elapsed time. A minimum of 1,000 L must pass through the net. Record the total volume of filtered water collected per sample and the water depth of the intake of the water source. Go to Step 3.

3. Using water, wash down the net from the outside to concentrate veligers into the collection cup. Carefully unscrew the collection cup and pour the sample into a 1000-mL Nalgene leak-proof poly bottle. Thoroughly rinse the collection cup with spray bottle with minimal volume of water and transfer the rinses into the same sample bottle. Take care to keep the wash and/or rinse water away from the opening of the plankton net and wash only along the outside of the plankton net and cup, so that the filtered volume remains unchanged. MARK THE WATER LEVEL ON

THE SAMPLE BOTTLE WITH PERMANENT INK (Draw a line on the bottle and label “Level 1”).

4. Add an appropriate volume of ethanol to get 25% final concentration in the sample bottle (visually estimate, does not have to be exact). For example, if using lab grade ethanol or 190 proof Everclear, use 3 parts lake water and 1 part etEverclear. Replace bottle cap snugly. (Note: The volume of ethanol will be needed in the calculation of number of veligers per unit volume; therefore be sure that the sample bottle is marked with a second line to indicate total volume (sample + ethanol) so that the lab can also determine the volume of ethanol that was added.) Draw a line on the bottle and label “Level after ETOH”. Tape the secured bottle cap with black electrical tape to cover the seam between the cap and bottle to prevent leakage. Wrap the bottle in a disposable diaper and place in a Ziploc bag (push all air out of bag before closing). Put both the replicates from same location into one single plastic garbage bag. Put on ice in cooler for transport.

5. Labeling sample bottles. Use waterproof Sharpie pens for bottle labels and mechanical pencils for data sheets. Be careful to avoid spillage of ethanol – Sharpie ink will run if contacted with ethanol. For backup, record sample bottle information with a mechanical pencil on a piece of waterproof paper and insert paper into the Ziploc bag along with the sample bottle. Record the following information on both sample bottle and data sheet:

Sample Date

Sample Location (GPS if available, otherwise describe location – i.e. near north shore boat dock, etc.)

Sample depth or intake depth in water column

Volume of water filtered through the plankton net

Mark sample poly bottle with two lines of permanent ink, one for level of sample and one for total level of sample + ethanol

Preservative used (e.g., 25% ethanol)

Name of person collecting sample with contact information (phone number)

6. Veligers easily stick to the walls of the plankton net. Decontamination (and disinfection) is critical to avoid cross contamination from one sample location or event to another and possibly the spread of mussels to new waters. It is recommended that each sampling location (reservoir) has a dedicated collection net. Each time the net is used at a new sample site, the procedure will require a soak treatment in a 5% v/v acetic acid bath. A 5% acetic acid solution may be purchased as white vinegar, or a 5% solution may be prepared with concentrated (glacial) acetic acid and water. These steps will both denature the DNA for the PCR process and dissolve the veliger shells otherwise visible in microscopic observations.

7. The recommended treatment for the plankton net following sample collection is to first rinse the net with clean water to wash as many veligers from the net as possible, and then totally immerse the net in the 5% acetic acid bath. The ideal soak time is overnight; however, if it is necessary to use the net at the next sampling location during the same day, a one hour soak followed up with a rinse prior to the next sampling should be the minimum. The same acetic acid bath may be used repeatedly for all sample sites. Following the acetic acid soak, rinse the net

with a large volume of clean water (e.g., 100 L) allowing the rinse water to drain and collect into the collection cup.

8. Pour the collected rinsate into a sample bottle, preserve with ethanol, and labeled as directed in Steps 4 and 5. The final rinsate from each sample location may be combined at the end of the day and sent as one sample. Ship on ice with the other samples at the address given.

9. Keep samples cool at all times. Samples may be stored under refrigeration for a few days if a delay is necessary to avoid shipping over a weekend.

10. Ship samples using FedEx Overnight Express (AVOID WEEKEND DELIVERIES!) to:

Kevin Kelly/Denise Hosler (86-68220)
U.S. Bureau of Reclamation
Denver Federal Center
Corner of 6th Ave. & Kipling
Bldg 67, Room 152
Denver, CO 80225-0007

Contact information:

Kevin Kelly: kkelly@do.usbr.gov
Denise Hosler: Phone: (303) 445-2195; dhosler@do.usbr.gov
Fred Nibling: Phone: (303) 445-2202; fnibling@do.usbr.gov

Parks in Colorado can use:

Vicki Milano, Fish Pathologist
Colorado Division of Wildlife
122 East Edison
Brush, Colorado 80723
Phone: (970) 842-6308

Also does PCR analyses:

John Wood
Pisces Molecular
5311 Western Avenue, Suite E
Boulder, Colorado 80301
Phone: (303) 546-9300
jwood@pisces-molecular.com

D. Dive surveys:

Objective: Detect adult mussels on boat hulls, structures and facilities.

Rationale: The affinity of mussels for artificial substrates is not well documented or understood. Mussels may attach to other substrates in preference to the passive sampling devices. Visual inspection of submerged surfaces by divers may improve capability for early detection.

Equipment: NPS approved SCUBA equipment for each diver.

Protocols:

Search for mussels on the surfaces of boats, docks, retaining walls and other submerged structures in the vicinity of the marina.

Search for mussels on the substrate surface, under rocks, and in crevices as necessary to document presence / absence.

Appendix I

HACCP Planning for Quaggas

The acronym “HACCP” stands for Hazard Analysis and Critical Control Points. HACCP planning is a proactive tool for developing biosecurity barriers to prevent the introduction of contaminants by analyzing and controlling specific invasion pathways at critical control points.

Originally introduced by Pillsbury to prevent food contamination, HACCP planning was implemented early in its inception by the National Aeronautic and Space Administration (NASA) to keep astronauts healthy during the Apollo missions. HACCP has subsequently been adopted for use in many applications outside the food industry. Currently, the U.S. Fish & Wildlife Service promotes HACCP planning as a biosecurity barrier to prevent the unintentional spread of invasive species.

HACCP planning is not risk assessment, but is an integral tool that allows for proactive risk management for invasive species through the identification of inherent weaknesses in operational procedures and the development of best management practices to address these weaknesses. Attention is focused on critical control points where invasive species can be prevented or removed from a pathway. HACCP plans, which are standardized collections of five related forms, allow documentation of best management practices for future review and modification. These can be used to assure associated partners that appropriate prevention mechanisms have been considered, evaluated, and implemented as part of standard operating procedures.

The best HACCP plans are those that address specific activities and are not general in scope. For example, a HACCP plan developed expressly for transporting fish stocks from a fish hatchery to a target reservoir would likely be more successful in addressing critical control points than would a more general HACCP plan designed to cover all fish hatchery operations. The key distinction between these types of HACCP plans is that the more successful HACCP plans will typically cover a single, specific activity that can be described as a finite, linear sequence of tasks or events. A HACCP plan that attempts to cover a broad range of multiple activities that occur simultaneously is much less likely to achieve the desired results as an effective biosecurity barrier, because such plans are much less likely to identify specific activities at the detail necessary to secure potential invasion pathways.

The U.S. Fish & Wildlife Service recommends that HACCP planning be performed by a team of several individuals, including those who are responsible for carrying out the tasks outlined in the HACCP plan as well as those responsible for managing the activity. The goal is to encourage discussion of potential best management practices and operational feasibility for prescribed solutions to identified problems.

HACCP planning involves five steps:

Step 1: Describe the Activity

Step 2: Identify Potential Hazards

Step 3: Create a Flow Diagram for the Activity

Step 4: Analyze the Hazards for Critical Control Points (CCPs)

Step 5: Address the CCPs and Finalize the HACCP Plan

Several resources are available for HACCP planning. The U.S. Fish & Wildlife Service (USFWS) offers periodic training at the National Conservation Training Center in Shepherdstown, West Virginia (<http://training.fws.gov>). USFWS Aquatic Invasive Species specialists also conduct short training sessions target for specific audience including state agencies, like fish and wildlife departments, and other federal government agencies and bureaus (e.g. National Park Service, U.S. Army Corps of Engineers). A coordination website that also acts as a repository for natural-resource HACCP plans is sponsored by the USFWS and is maintained by the University of Texas at Arlington. This website can be found at <http://HACCP-NRM.org>. The website contains valuable information regarding HACCP planning for natural resource managers, including a HACCP manual that describes the planning process step by step from beginning to end. Also online are blank HACCP forms and a searchable database of completed plans utilized by a variety of natural resource managers throughout the United States. Example HACCP plans developed specifically for the quagga mussel invasion in Lake Mead are included at the end of this section. These plans may be used as templates for the development of additional plans and as a source of existing best management practices that may be incorporated into new plans. One of the most useful tools available online is a HACCP Wizard, a computer program that walks the user through the HACCP planning preprocess, including a decision tree for identifying critical control points. The HACCP Wizard produces an end product in Microsoft Word in a standard format.

As notoriously problematic invaders such as quagga and zebra mussels continue to invade new habitats in North America, many natural resource managers are beginning to recognize that *proactive* strategies are generally more successful and less expensive than *reactive* responses to new invasions, particularly when it is acknowledged that impacts of new invasions are often irreversible. Consequently, the importance of strategic planning cannot be overemphasized. The HACCP concept is an excellent strategic planning tool offering a systematic process for developing biosecurity barriers to future invasions. As such, HACCP planning should be adopted by natural resource managers in all situations where invasion pathways exist.

Below are three example HACCP Plans developed by Lake Mead for quagga mussel activities. These may be adapted for use by other parks.

HAZARD ANALYSIS AND CRITICAL CONTROL POINT PLANS

HACCP Step 1 - Activity Description for NPS SCUBA Operations	
Facility: Lake Mead National Recreation Area	Site: Park Wide, all water bodies
Project Coordinator:	Project Description: SCUBA & Snorkeling Activities
Site Manager: Bill Dickinson	
Address: 601 Nevada Way Boulder City, Nevada 89005	
Phone: 702-293-8920	

Project Description (Who, What, Where, When, How & Why)
All non-recreation diving and snorkeling activities conducted by Federal agencies and their collaborators, cooperators and contractors within the Lake Mead National Recreation Area's management boundary.

HACCP Step 2 - Potential Hazard Identification for NPS SCUBA Operations	
Vertebrates:	
Invertebrates: Invasive Mussels	
Plants:	
Other Biologics:	
Others:	

HACCP Step 3 - Flow Diagram for NPS SCUBA Operations

Task # 1	Define project to be undertaken.
	↓
Task # 2	Evaluate project for necessity and potential hazards and concerns.
	↓
Task # 3	Identify equipment necessary to complete project.
	↓
Task # 4	Acquire necessary permissions, permits, etc..
	↓
Task # 5	File a Dive Plan with proper Park Personnel.
	↓
Task # 6	Inspect and test equipment.
	↓
Task # 7	Conduct dive project.
	↓
Task # 8	Inspect, test, clean and store equipment (including platforms and all non-dive related tools utilized underwater).
	↓
Task # 9	Submit Final Dive Report to proper Park Personnel.

HACCP Step 4 - Hazard Analysis for NPS SCUBA Operations					
Task	Hazard	Probable?	Justification	Control Measures	CCP?
Define project to be undertaken.	Invertebrate: Invasive Mussels	No	No contact with water at this stage.		No
Evaluate project for necessity and potential hazards and concerns.	Invertebrate: Invasive Mussels	No	No contact with water at this stage.		No
Identify equipment necessary to complete project.	Invertebrate: Invasive Mussels	No	No contact with water at this stage.		No
Acquire necessary permissions, permits, etc..	Invertebrate: Invasive Mussels	No	No contact with water at this stage.		No
File a Dive Plan with proper Park Personnel.	Invertebrate: Invasive Mussels	No	No contact with water at this stage.		No
Inspect and test equipment.	Invertebrate: Invasive Mussels	Yes	Selected equipment may potentially be contaminated from previous exposure to infested water bodies.	If cannot ensure equipment was previously decontaminated, decontaminate prior to use. Otherwise, DO NOT USE EQUIPMENT.	Yes
Conduct dive project.	Invertebrate: Invasive Mussels	Yes	Equipment utilized during project may come in contact with infested waters.	None.	No
Inspect, test, clean and store equipment (including platforms and all non-dive related tools utilized underwater).	Invertebrate: Invasive Mussels	Yes	Equipment may have come in contact with infested waters.	Visual inspection; decontamination; completely dry equipment and follow with 5 days dry storage.	Yes
Submit Final Dive Report to proper Park Personnel.	Invertebrate: Invasive Mussels	No	No equipment use / contact with water at this stage.		No

HACCP Step 5 - HACCP Plan for NPS SCUBA Operations	
Critical Control Point #1: Task # 6: Inspect and test equipment.	
Significant Hazards: Invertebrate: Invasive Mussels	
Control Measures: If cannot ensure equipment was previously previous decontaminated, decontaminate prior to use. Otherwise, DO NOT USE EQUIPMENT.	
Limits for Control Measures: Decontaminate following options provided in Decontamination SOP.	
Monitoring: What? Whether or not decontamination occurs.	
Monitoring: How? Yes / no	
Monitoring: Frequency? Each time equipment utilized for underwater activities.	
Monitoring: Who? Diver / snorkeler (personal dive equipment); project lead (non-dive related equipment).	
Evaluation & Corrective Actions: Do not use equipment.	
Supporting Documentation: www.protectyourwaters.net; http://el.erdc.usace.army.mil/zmis	
Critical Control Point #2: Task # 8: Inspect, test, clean and store equipment (including platforms and all non-dive related tools utilized underwater).	
Significant Hazards: Invertebrate: Invasive Mussels	
Control Measures: Visual inspection; decontamination; completely dry equipment and follow with 5 days dry storage.	
Limits for Control Measures: Remove and destroy visible mussels; decontaminate following procedures outlined in Decontamination SOP; completely dry equipment and follow with at least 5 days dry storage.	
Monitoring: What? Presence / absence of mussels; decontamination.	
Monitoring: How? Yes / No.	
Monitoring: Frequency? After each use.	
Monitoring: Who? Diver / snorkeler (personal dive equipment); project lead (non-dive equipment).	
Evaluation & Corrective Actions: Label and date equipment that was not decontaminated to inform next user; include information in Final Dive Report.	
Supporting Documentation: www.protectyourwaters.net; http://el.erdc.usace.army.mil/zmis	

HACCP Step 1 - Activity Description for NPS Trailered Boat Operations

HACCP Checklist: for NPS SCUBA Operations	
Facility	Lake Mead National Recreation Area
Site	Park Wide, all water bodies
Coordinator	
Manager	Bill Dickinson
Address	601 Nevada Way, Boulder City, Nevada 89005
<input type="checkbox"/>	Task # 1: Define project to be undertaken.
<input type="checkbox"/>	Task # 2: Evaluate project for necessity and potential hazards and concerns.
<input type="checkbox"/>	Task # 3: Identify equipment necessary to complete project.
<input type="checkbox"/>	Task # 4: Acquire necessary permissions, permits, etc..
<input type="checkbox"/>	Task # 5: File a Dive Plan with proper Park Personnel.
<input type="checkbox"/>	Task # 6: Inspect and test equipment. CRITICAL CONTROL POINT
<input type="checkbox"/>	Hazards were contained Hazards: Invertebrate: Invasive Mussels
<input type="checkbox"/>	Control measures were implemented Control Measures: If cannot ensure previous decontamination, decontaminate prior to use. Otherwise, DO NOT USE EQUIPMENT.
<input type="checkbox"/>	Control limits were maintained Control Limits: Decontaminate following options provided in Decontamination BMP.
<input type="checkbox"/>	Corrective actions were (performed if necessary) Corrective Actions: Do not use equipment.
<input type="checkbox"/>	Task # 7: Conduct dive project.
<input type="checkbox"/>	Task # 8: Inspect, test, clean and store equipment (including platforms and all non-dive related tools utilized underwater). CRITICAL CONTROL POINT
<input type="checkbox"/>	Hazards were contained Hazards: Invertebrate: Invasive Mussels
<input type="checkbox"/>	Control measures were implemented Control Measures: Visual inspection; decontamination; completely dry equipment and follow with 5 days dry storage.
<input type="checkbox"/>	Control limits were maintained Control Limits: Remove and destroy visible mussels; decontaminate following procedures outlined in Decontamination BMP; completely dry equipment and follow with at least 5 days dry storage.
<input type="checkbox"/>	Corrective actions were (performed if necessary) Corrective Actions: Label and date equipment that was not decontaminated to inform next user; include information in Final Dive Report.
<input type="checkbox"/>	Task # 9: Submit Final Dive Report to proper Park Personnel.

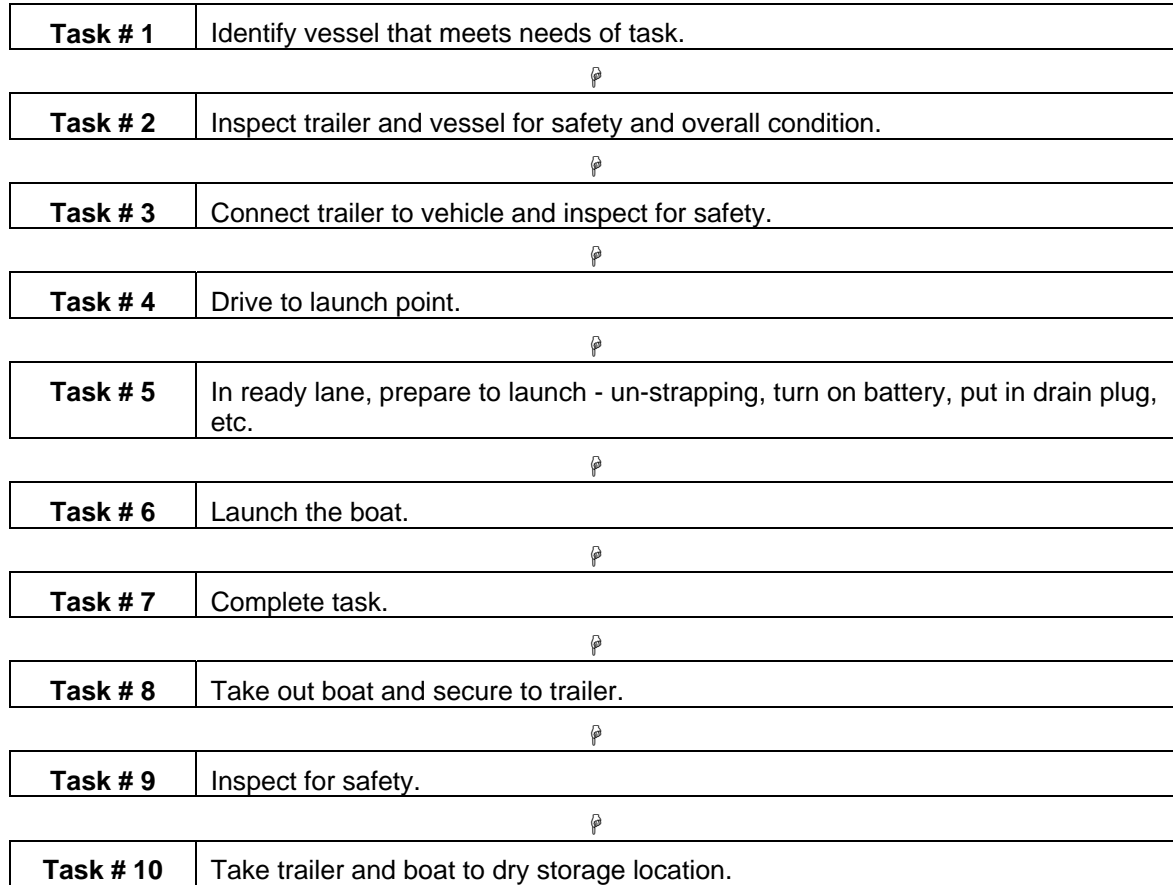
Facility: Lake Mead National Recreation Area	Site: All Lakes
Project Coordinator:	
Site Manager: Bill Dickinson	

Address: 601 Nevada Way Boulder City, Nevada, 89005	
Phone: 702-293-8920	

Project Description (Who, What, Where, When, How & Why)
All park and park cooperators operations using boats that are trailered from site to site, or otherwise not maintained in the water.

HACCP Step 2 - Potential Hazard Identification for NPS Trailered Boat Operations	
Vertebrates:	
Invertebrates:	Invasive Mussels
Plants:	Invasive Aquatic Nuisance Plant
Other Biologics:	
Others:	

HACCP Step 3 - Flow Diagram for NPS Trailered Boat Operations



HACCP Step 4 - Hazard Analysis for NPS Trailered Boat Operations					
Task	Hazard	Probable?	Justification	Control Measures	CCP?
Identify vessel that meets needs of task.	Invertebrate: Invasive Mussels	No	No contact with water at this stage.		No
	Plant: Invasive Aquatic Nuisance Plant	No	No contact with water at this stage.		No
Inspect trailer and vessel for safety and overall condition.	Invertebrate: Invasive Mussels	Yes	The boat and / or trailer may potentially be contaminated from previous contact with infested water bodies.	Decontamination.	Yes
	Plant: Invasive Aquatic Nuisance Plant	Yes	The boat and / or trailer may potentially be contaminated from previous contact with infested water bodies.	Decontamination.	Yes
Connect trailer to vehicle and inspect for safety.	Invertebrate: Invasive Mussels	No	No contact with water at this stage.		No
	Plant: Invasive Aquatic Nuisance Plant	No	No contact with water at this stage.		No
Drive to launch point.	Invertebrate: Invasive Mussels	No	No contact with water at this stage.		No
	Plant: Invasive Aquatic Nuisance Plant	No	No contact with water at this stage.		No
In ready lane, prepare to launch - unstrapping, turn on battery, put in drain plug, etc.	Invertebrate: Invasive Mussels	No	No contact with water at this stage.		No
	Plant: Invasive Aquatic Nuisance Plant	No	No contact with water at this stage.		No
Launch the	Invertebrate:	Yes	Potential for mussels	Ensure decontamination	Yes

boat.	Invasive Mussels		to be present from recent (within 5 days) contact with infested water body.	is completed in Task 2, or DO NOT LAUNCH.	
	Plant: Invasive Aquatic Nuisance Plant	Yes	Potential for mussels to be present from recent contact with infested water body.	Ensure decontamination is completed in Task 2, or DO NOT LAUNCH.	Yes
Complete task.	Invertebrate: Invasive Mussels	Yes	Boat may come in contact with infested water body.	None.	No
	Plant: Invasive Aquatic Nuisance Plant	Yes	Boat may come in contact with infested water body.	None.	No
Take out boat and secure to trailer.	Invertebrate: Invasive Mussels	Yes	Boat, trailer and vehicle may have acquired mussels while in contact with water.	Visually inspect boat, trailer and vehicle once fully removed from water, but prior to leaving launch area.	Yes
	Plant: Invasive Aquatic Nuisance Plant	Yes	Boat, trailer and vehicle potentially acquired nuisance plant species while in contact with water.	Visually inspect boat, trailer and vehicle once fully removed from water, but prior to leaving launch area.	Yes
Inspect for safety.	Invertebrate: Invasive Mussels	No	No potential for the acquisition or transportation of mussels at this stage.		No
	Plant: Invasive Aquatic Nuisance Plant	No	No potential for the acquisition or transportation of mussels at this stage.		No
Take trailer and boat to dry storage location.	Invertebrate: Invasive Mussels	Yes	If mussels are present on boat, trailer or vehicle, mussels may be transported to other locations.	Decontaminate and / or leave out of water at least 5 days.	Yes
	Plant: Invasive Aquatic Nuisance Plant	Yes	If nuisance plant species are present on boat, trailer or vehicle, they may be transported to other	Decontaminate and / or leave out of water.	Yes

			areas.		
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HACCP Step 5 - HACCP Plan for NPS Trailered Boat Operations	
Critical Control Point #1:	
Task # 2: Inspect trailer and vessel for safety and overall condition.	
Significant Hazards:	
Invertebrate: Invasive Mussels	
Control Measures:	
Decontamination.	
Limits for Control Measures:	
Inspection and decontamination.	
Monitoring: What?	
Whether or not decontamination occurs.	
Monitoring: How?	
Yes / No.	
Monitoring: Frequency?	
Each time boat is picked up for use.	
Monitoring: Who?	
Person transporting the boat for use.	
Evaluation & Corrective Actions:	
Do not use boat or trailer.	
Supporting Documentation: www.100thmeridian.org	
Critical Control Point #2:	
Task # 2: Inspect trailer and vessel for safety and overall condition.	
Significant Hazards:	
Plant: Invasive Aquatic Nuisance Plant	
Control Measures:	
Decontamination.	
Limits for Control Measures:	
Inspection and decontamination.	
Monitoring: What?	
Whether or not decontamination occurs.	
Monitoring: How?	
Yes / No.	
Monitoring: Frequency?	
Each time boat is picked up for use.	
Monitoring: Who?	
Person transporting the boat for use.	
Evaluation & Corrective Actions:	
Do not use boat or trailer.	
Supporting Documentation: www.100thmeridian.org	

<p>Critical Control Point #3: Task # 6: Launch the boat.</p>
<p>Significant Hazards: Invertebrate: Invasive Mussels</p>
<p>Control Measures: Ensure decontamination is completed in Task 2, or DO NOT LAUNCH.</p>
<p>Limits for Control Measures: Decontamination.</p>
<p>Monitoring: What? Verification that decontamination has occurred.</p>
<p>Monitoring: How? Yes / No.</p>
<p>Monitoring: Frequency? Every time boat is launched.</p>
<p>Monitoring: Who? Person launching boat.</p>
<p>Evaluation & Corrective Actions: If verification is unsure, complete decontamination step. Otherwise, DO NOT LAUNCH.</p>
<p>Supporting Documentation: www.100thmeridian.org</p>
<p>Critical Control Point #4: Task # 6: Launch the boat.</p>
<p>Significant Hazards: Plant: Invasive Aquatic Nuisance Plant</p>
<p>Control Measures: Ensure decontamination is completed in Task 2, or DO NOT LAUNCH.</p>
<p>Limits for Control Measures: Decontamination.</p>
<p>Monitoring: What? Verification that decontamination has occurred.</p>
<p>Monitoring: How? Yes / No.</p>
<p>Monitoring: Frequency? Every time boat is launched.</p>
<p>Monitoring: Who? Person launching boat.</p>
<p>Evaluation & Corrective Actions: If verification is unsure, complete decontamination step. Otherwise, DO NOT LAUNCH.</p>
<p>Supporting Documentation: www.100thmeridian.org</p>

Critical Control Point #5: Task # 8: Take out boat and secure to trailer.
Significant Hazards: Invertebrate: Invasive Mussels
Control Measures: Visually inspect boat, trailer and vehicle once fully removed from water, but prior to leaving launch area.
Limits for Control Measures: Visual inspection of boat, trailer, and vehicle that have come in contact with water. Specifically inspect all dock lines, anchor, live wells, bilge, rollers, trailer, hull, axle, and motor.
Monitoring: What? Verification of presence / absence of mussels.
Monitoring: How? Visually.
Monitoring: Frequency? Every time boat, trailer and vehicle exit water.
Monitoring: Who? Boat operator.
Evaluation & Corrective Actions: Eliminate all water from boat and equipment before transporting anywhere; clean and dry everything that has come in contact with water; decontamination and / or dry storage for at least 5 days.
Supporting Documentation: www.100thmeridian.org
Critical Control Point #6: Task # 8: Take out boat and secure to trailer.
Significant Hazards: Plant: Invasive Aquatic Nuisance Plant
Control Measures: Visually inspect boat, trailer and vehicle once fully removed from water, but prior to leaving launch area.
Limits for Control Measures: Visual inspection of boat, trailer, and vehicle that have come in contact with water. Specifically inspect all dock lines, anchor, live wells, bilge, rollers, trailer, hull, axle and motor.
Monitoring: What? Verification of presence / absence of plants.
Monitoring: How? Visually.
Monitoring: Frequency? Every time boat, trailer or vehicle exit water.

<p>Monitoring: Who? Boat operator.</p>
<p>Evaluation & Corrective Actions: Eliminate all water from boat and equipment before transporting anywhere; clean and dry everything that has come in contact with water; decontamination and / or dry storage.</p>
<p>Supporting Documentation: www.100thmeridian.org</p>
<p>Critical Control Point #7: Task # 10: Take trailer and boat to dry storage location.</p>
<p>Significant Hazards: Invertebrate: Invasive Mussels</p>
<p>Control Measures: Decontaminate and / or leave out of water at least 5 days.</p>
<p>Limits for Control Measures: Inspection and decontamination.</p>
<p>Monitoring: What? Whether or not decontamination occurs.</p>
<p>Monitoring: How? Yes / No.</p>
<p>Monitoring: Frequency? Each time the boat is picked up for use.</p>
<p>Monitoring: Who? Person responsible for picking up the boat and trailer for next use.</p>
<p>Evaluation & Corrective Actions: Leave notification on boat informing next user that boat has not been decontaminated.</p>
<p>Supporting Documentation: www.100thmeridian.org</p>
<p>Critical Control Point #8: Task # 10: Take trailer and boat to dry storage location.</p>
<p>Significant Hazards: Plant: Invasive Aquatic Nuisance Plant</p>
<p>Control Measures: Decontaminate and / or leave out of water.</p>
<p>Limits for Control Measures: Inspection and decontamination.</p>
<p>Monitoring: What? Whether or not decontamination occurs.</p>
<p>Monitoring: How? Yes / No.</p>

Monitoring: Frequency? Each time the boat is picked up for use.	
Monitoring: Who? Person responsible for picking up the boat and trailer for next use.	
Evaluation & Corrective Actions: Leave notification on boat informing next user that boat has not been decontaminated.	
Supporting Documentation: www.100thmeridian.org	
Facility: Lake Mead National Recreation Area	
Activity: Trailer Boat Operations	
Address: 601 Nevada Way Boulder City, Nevada, 89005	
Signature:	Date:

HACCP Checklist for NPS Trailered Boat Operations	
Facility	Lake Mead National Recreation Area
Site	All Lakes
Coordinator	
Manager	Bill Dickinson
Address	601 Nevada Way, Boulder City, Nevada, 89005
<input type="checkbox"/>	Task # 1: Identify vessel that meets needs of task.
<input type="checkbox"/>	Task # 2: Inspect trailer and vessel for safety and overall condition. CRITICAL CONTROL POINT
<input type="checkbox"/>	Hazards were contained Hazards: Invertebrate: Invasive Mussels
<input type="checkbox"/>	Control measures were implemented Control Measures: Decontamination.
<input type="checkbox"/>	Control limits were maintained Control Limits: Inspection and decontamination.
<input type="checkbox"/>	Corrective actions were (performed if necessary) Corrective Actions: Do not use boat or trailer.
<input type="checkbox"/>	Hazards were contained Hazards: Plant: Invasive Aquatic Nuisance Plant
<input type="checkbox"/>	Control measures were implemented Control Measures: Decontamination.
<input type="checkbox"/>	Control limits were maintained Control Limits: Inspection and decontamination.
<input type="checkbox"/>	Corrective actions were (performed if necessary) Corrective Actions: Do not use boat or trailer.
<input type="checkbox"/>	Task # 3: Connect trailer to vehicle and inspect for safety.
<input type="checkbox"/>	Task # 4: Drive to launch point.
<input type="checkbox"/>	Task # 5: In ready lane, prepare to launch - un-strapping, turn on battery, put in drain plug, etc.
<input type="checkbox"/>	Task # 6: Launch the boat. CRITICAL CONTROL POINT
<input type="checkbox"/>	Hazards were contained Hazards: Invertebrate: Invasive Mussels
<input type="checkbox"/>	Control measures were implemented Control Measures: Ensure decontamination is completed in Task 2, or DO NOT LAUNCH.
<input type="checkbox"/>	Control limits were maintained Control Limits: Decontamination.
<input type="checkbox"/>	Corrective actions were (performed if necessary) Corrective Actions: If verification is unsure, complete decontamination step. Otherwise, DO NOT LAUNCH.

<input type="checkbox"/>	Hazards were contained Hazards: Plant: Invasive Aquatic Nuisance Plant
<input type="checkbox"/>	Control measures were implemented Control Measures: Ensure decontamination is completed in Task 2, or DO NOT LAUNCH.
<input type="checkbox"/>	Control limits were maintained Control Limits: Decontamination.
<input type="checkbox"/>	Corrective actions were (performed if necessary) Corrective Actions: If verification is unsure, complete decontamination step. Otherwise, DO NOT LAUNCH.
<input type="checkbox"/>	Task # 7: Complete task.
<input type="checkbox"/>	Task # 8: Take out boat and secure to trailer. CRITICAL CONTROL POINT
<input type="checkbox"/>	Hazards were contained Hazards: Invertebrate: Invasive Mussels
<input type="checkbox"/>	Control measures were implemented Control Measures: Visually inspect boat, trailer and vehicle once fully removed from water, but prior to leaving launch area.
<input type="checkbox"/>	Control limits were maintained Control Limits: Visual inspection of boat, trailer, and vehicle that have come in contact with water. Specifically inspect all dock lines, anchor, live wells, bilge, rollers, trailer, hull, axle, and motor.
<input type="checkbox"/>	Corrective actions were (performed if necessary) Corrective Actions: Eliminate all water from boat and equipment before transporting anywhere; clean and dry everything that has come in contact with water; decontamination and / or dry storage for at least 5 days.
<input type="checkbox"/>	Hazards were contained Hazards: Invertebrate: Invasive Mussels
<input type="checkbox"/>	Control measures were implemented Control Measures: Visually inspect boat, trailer and vehicle once fully removed from water, but prior to leaving launch area.
<input type="checkbox"/>	Control limits were maintained Control Limits: Visual inspection of boat, trailer, and vehicle that have come in contact with water. Specifically inspect all dock lines, anchor, live wells, bilge, rollers, trailer, hull, axle and motor.
<input type="checkbox"/>	Corrective actions were (performed if necessary) Corrective Actions: Eliminate all water from boat and equipment before transporting anywhere; clean and dry everything that has come in contact with water; decontamination and / or dry storage for at least 5 days.
<input type="checkbox"/>	Hazards were contained Hazards: Plant: Invasive Aquatic Nuisance Plant
<input type="checkbox"/>	Control measures were implemented Control Measures: Visually inspect boat, trailer and vehicle once fully removed from water, but prior to leaving launch area.
<input type="checkbox"/>	Control limits were maintained Control Limits: Visual inspection of boat, trailer, and vehicle that have come in contact with water. Specifically inspect all dock lines, anchor, live wells, bilge, rollers, trailer, hull, axle and motor.

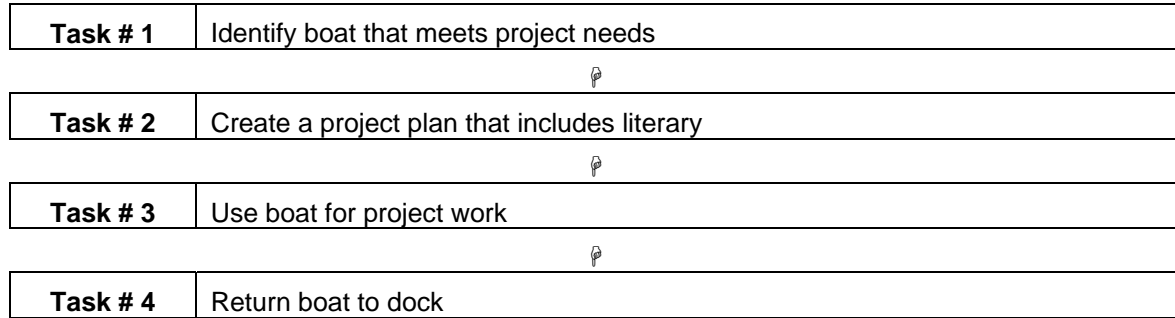
<input type="checkbox"/>	Corrective actions were (performed if necessary) Corrective Actions: Eliminate all water from boat and equipment before transporting anywhere; clean and dry everything that has come in contact with water; decontamination and / or dry storage for at least 5 days.
<input type="checkbox"/>	Task # 9: Inspect for safety.
<input type="checkbox"/>	Task # 10: Take trailer and boat to dry storage location. CRITICAL CONTROL POINT
<input type="checkbox"/>	Hazards were contained Hazards: Invertebrate: Invasive Mussels
<input type="checkbox"/>	Control measures were implemented Control Measures: Decontaminate and / or leave out of water at least 5 days.
<input type="checkbox"/>	Control limits were maintained Control Limits: Inspection and decontamination.
<input type="checkbox"/>	Corrective actions were (performed if necessary) Corrective Actions: Leave notification on boat informing next user that boat has not been decontaminated.
<input type="checkbox"/>	Hazards were contained Hazards: Plant: Invasive Aquatic Nuisance Plant
<input type="checkbox"/>	Control measures were implemented Control Measures: Decontaminate and / or leave out of water.
<input type="checkbox"/>	Control limits were maintained Control Limits: Inspection and decontamination.
<input type="checkbox"/>	Corrective actions were (performed if necessary) Corrective Actions: Leave notification on boat informing next user that boat has not been decontaminated.

HACCP Step 1 - Activity Description for NPS Moored Boat Operations	
Facility: Lake Mead National Recreation Area	Site: Lakes Mead and Mohave
Project Coordinator:	Project Description: Moored boats used for project work
Site Manager: Bill Dickinson	
Address: 601 Nevada Way Boulder City, NV 89005	
Phone: 702-293-8920	

Project Description (Who, What, Where, When, How & Why)
<p>All non-recreation work conducted by Federal agencies and their collaborators, cooperators and contractors that require the use of a boat moored at any of the developed areas within the Lake Mead National Recreation Area's management boundary.</p> <p>Moored boats are boats that are left in the water and for their useful life, and typically only removed for servicing. These boats are used for a variety of projects. These boats are at great risk of contamination by invasive mussels and subsequent spread. Many of the activities that moored boats might be used for all water based park operations. These activities include but are not limited to Law Enforcement, Maintenance, Resource Management, Concessions, and interpretive projects.</p>

HACCP Step 2 - Potential Hazard Identification for NPS Moored Boat Operations	
Vertebrates:	
Invertebrates: Invasive Mussels	
Plants: Aquatic Invasive Plants	
Other Biologics:	
Others:	

HACCP Step 3 - Flow Diagram for NPS Moored Boat Operations



HACCP Step 4 - Hazard Analysis for NPS Moored Boat Operations					
Task	Hazard	Probable?	Justification	Control Measures	CCP?
Identify boat that meets project needs	Invertebrate: Invasive Mussels	Yes	If boat is harbored in known infested areas it could spread mussels to on infested areas.	Decide if decontamination is feasible or necessary	No
	Plant: Aquatic Invasive Plants	Yes	If boat is harbored in known infested areas it could spread plants to on infested areas.	Decide if decontamination is feasible or necessary	No
Use boat for project work	Invertebrate: Invasive Mussels	Yes	If boat is infested using it on project work could spread invasive mussels to uninfected areas	If the boat was not decontaminated prior to use, operations should try to move from areas of no/low infestation towards areas of high infestation	Yes
	Plant: Aquatic Invasive Plants	Yes	If boat is infested using it on project work could spread invasive plants to uninfected areas	If the boat was not decontaminated prior to use, operations should try to move from areas of no/low infestation towards areas of high infestation	Yes
Return boat to dock	Invertebrate: Invasive Mussels	Yes	Mussels may have been picked up while in use	Visually inspect boat for adult mussels, and wipe down and dry all areas on boat where water may collect. If mussels are observed on the boat schedule boat for immediate decontamination.	Yes
	Plant: Aquatic Invasive Plants	Yes	Invasive plants may be picked up during use	Visually inspect boat for plant materials, and wipe down and dry all areas on boat where water may collect. If plants are observed on the boat schedule boat for immediate decontamination.	Yes

HACCP Step 5 - HACCP Plan for NPS Moored Boat Operations	
Critical Control Point #1: Task # 3: Use boat for project work	
Significant Hazards: Invertebrate: Invasive Mussels	
Control Measures: If the boat was not decontaminated prior to use, operations should try to move from areas of no/low infestation towards areas of high infestation	
Limits for Control Measures:	
Monitoring: What? Presence of mussels	
Monitoring: How? Knowledge of known mussel locations	
Monitoring: Frequency? Prior to each project	
Monitoring: Who? Project manager, boat operator	
Evaluation & Corrective Actions: Limit operations to immediate vicinity of marina where boat is stored	
Supporting Documentation: www.100thmeridian.org	
Critical Control Point #2: Task # 3: Use boat for project work	
Significant Hazards: Plant: Aquatic Invasive Plants	
Control Measures: If the boat was not decontaminated prior to use, operations should try to move from areas of no/low infestation towards areas of high infestation	
Limits for Control Measures:	
Monitoring: What? Presence of mussels	
Monitoring: How? Knowledge of known mussel locations	
Monitoring: Frequency? Prior to each project	
Monitoring: Who? Project manager, boat operator	
Evaluation & Corrective Actions: Limit operations to immediate vicinity of marina where boat is stored	
Supporting Documentation: www.100thmeridian.org	
Critical Control Point #3: Task # 4: Return boat to dock	
Significant Hazards: Invertebrate: Invasive Mussels	
Control Measures:	

Visually inspect boat for adult mussels, and wipe down and dry all areas on boat where water may collect. If mussels are observed on the boat schedule boat for immediate decontamination.	
Limits for Control Measures: Remove boat from water and decontaminate	
Monitoring: What? Presence or absence of adult mussels	
Monitoring: How? Visual inspection of hull motor and all parts of the boat where water may collect	
Monitoring: Frequency? Every time the boat is returned to the dock	
Monitoring: Who? Project Manager, Boat Operator	
Evaluation & Corrective Actions: Boat should be scheduled for inspection and decontamination as soon as possible	
Supporting Documentation: WWW.100thmeridian.org, Lake Mead NRA INVASIVE MUSSEL DECONTAMINATION SOP	
Critical Control Point #4: Task # 4: Return boat to dock	
Significant Hazards: Plant: Aquatic Invasive Plants	
Control Measures: Visually inspect boat for plant materials, and wipe down and dry all areas on boat where water may collect. If plants are observed on the boat schedule boat for immediate decontamination.	
Limits for Control Measures: Remove boat from water and decontaminate	
Monitoring: What? Presence or absence of adult mussels	
Monitoring: How? Visual inspection of hull motor and all parts of the boat where water may collect	
Monitoring: Frequency? Every time the boat is returned to the dock	
Monitoring: Who? Project Manager, Boat Operator	
Evaluation & Corrective Actions: Boat should be scheduled for inspection and decontamination as soon as possible	
Supporting Documentation: WWW.100thmeridian.org, Lake Mead NRA INVASIVE MUSSEL DECONTAMINATION SOP	
Facility: Lake Mead National Recreation Area	Activity: Moored boats used for project work
Address: 601 Nevada Way Boulder City, NV 89005	
Signature:	Date:

HACCP Checklist for NPS Moored Boat Operations	
Facility	Lake Mead National Recreation Area
Site	Lakes Mead and Mohave
Coordinator	
Manager	Bill Dickenson
Address	601 Nevada Way, Boulder City, NV 89005
<input type="checkbox"/>	Task # 1: Identify boat that meets project needs
<input type="checkbox"/>	Task # 2: Create a project plan that includes literary
<input type="checkbox"/>	Task # 3: Use boat for project work CRITICAL CONTROL POINT
<input type="checkbox"/>	Hazards were contained Hazards: Invertebrate: Invasive Mussels
<input type="checkbox"/>	Control measures were implemented Control Measures: If the boat was not decontaminated prior to use, operations should try to move from areas of no/low infestation towards areas of high infestation
<input type="checkbox"/>	Control limits were maintained Control Limits:
<input type="checkbox"/>	Corrective actions were (performed if necessary) Corrective Actions: Limit operations to immediate vicinity of marina where boat is stored
<input type="checkbox"/>	Hazards were contained Hazards: Plant: Aquatic Invasive Plants
<input type="checkbox"/>	Control measures were implemented Control Measures: If the boat was not decontaminated prior to use, operations should try to move from areas of no/low infestation towards areas of high infestation
<input type="checkbox"/>	Control limits were maintained Control Limits:
<input type="checkbox"/>	Corrective actions were (performed if necessary) Corrective Actions: Limit operations to immediate vicinity of marina where boat is stored
<input type="checkbox"/>	Task # 4: Return boat to dock CRITICAL CONTROL POINT
<input type="checkbox"/>	Hazards were contained Hazards: Invertebrate: Invasive Mussels
<input type="checkbox"/>	Control measures were implemented Control Measures: Visually inspect boat for adult mussels, and wipe down and dry all areas on boat where water may collect. If mussels are observed on the boat schedule boat for immediate decontamination.
<input type="checkbox"/>	Control limits were maintained Control Limits: Remove boat from water and decontaminate
<input type="checkbox"/>	Corrective actions were (performed if necessary) Corrective Actions: Boat should be scheduled for inspection and decontamination as soon as possible
<input type="checkbox"/>	Hazards were contained Hazards: Plant: Aquatic Invasive Plants
<input type="checkbox"/>	Control measures were implemented Control Measures: Visually inspect boat for plant materials, and wipe down and dry all areas on boat where water may collect. If plants are observed on the boat schedule boat for immediate decontamination.
<input type="checkbox"/>	Control limits were maintained

	Control Limits: Remove boat from water and decontaminate
<input type="checkbox"/>	Corrective actions were (performed if necessary) Corrective Actions: Boat should be scheduled for inspection and decontamination as soon as possible

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Safety Information

<p><u>JOB SAFETY ANALYSIS:</u> Law Enforcement Boat Patrol Operations</p>	<p><u>JOB TITLE:</u> Park Ranger (LE) <u>DEPARTMENT:</u> Protection <u>ANALYSIS BY:</u> David B. Chapman</p>	<p><input type="checkbox"/> NEW December 14, 1999 <input type="checkbox"/> REVISED</p>
<p><u>Required and/or Recommended Personal Protective Equipment:</u> Required- Wearing of Personal Floatation Device (PFD), eye wear and weather protection clothing at all times Recommended-</p>		
<p><u>Sequence of Basic Job Steps</u></p> <p>1. Backing vehicle with trailer</p> <p>2. Boat patrol</p>	<p><u>Potential Hazards</u></p> <p>1a. Jack knifing the trailer 1b. Blind Spots 1c. Locking brakes on trailer</p> <p>2a. Falling overboard 2b. Damaging sides of boats 2c. Pinching hands or feet between boats or docks 2d. Collision with other boats or objects 2e. Limited visibility and area to maneuver 2f. Weather conditions 2g. Tide levels 2h. Fuel spills 2i. Boat fire 3j. Loading & unloading of heavy objects</p>	<p><u>Recommended Action or Procedure</u></p> <p>1a1. Practice backing trailer in wide-open area 1a2. Do not make sharp turns when backing trailer 1b1. Get out of vehicle and look behind vehicle and trailer before backing-up 1b2. Beep horn before backing-up 1b3. Use another person as a spotter 1c1. Place hatch level in "BACK-UP" position before backing-up</p> <p>2a1. Wear PFD at all times when on boat 2a2. Watch your step and watch for waves and wakes 2b1. Approach boats from down stream or down wind 2b2. Approach at a wakeless speed 2b3. Be ready to use reverse 2b4. Put fenders out before approaching boats or docks 2c1. Do not put fingers or feet between boats or docks 2d1. Scan 360 degrees around the boat at all times 2d2. Approach other boats and shore at wakeless speed 2d3. Make sure the other boat operator knows that you are approach be you make the maneuver 2e1. At night or low light condition (including fog) have navigation lights ON 2e2. Operate vessel at limited speed (less than half throttle) 2e3. Do not operate boat at night or limited visibility without radar or gps. If either equipment is out, an observer is required 2f1. Practice boat operations in all weather conditions before an emergency in bad weather. Know and set operator limitations 2g1. Reduce boat speed in unknown waters</p>

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<p>3. Changing propellers while boat is in the water</p>	<p>3a. Falling overboard 3b. Cutting or injuring self with propeller 3c. Dropping tools or parts in water</p>	<p>2h1. Only refuel vessel on calm waters or at USCG approved fuel dock 2h2. Clean up all fuel spills immediately 2h3. Do not overfill the fuel tanks on vessels and only put four and one half gallons of fuel in a five gallon container 2i1. NO smoking on any patrol boat 2i2. Have easy access to fire extinguisher on the boat 2i3. Have fire extinguisher tested once a year and check their serviceability each time you launch the boat 2i4. Only start outboard motor with the spark arrestor on and the engine cover in place 2j1. Do not lift any object or equipment over 45 pounds without assistants from another person 2j2. Use proper lifting techniques (use the legs not the back) 3a1. Wear PFD at all times when on boats 3a2. Know how to swim 3a3. Practice getting into boat from the water 3a4. Watch for waves and wakes 3b1. Turn motor off and remove the keys 3b2. Turn battery disconnect to OFF 3b3. Wear gloves and eye protection 3c1. Carry extra parts on the boat 3c2. Tie lanyard to tools and self or boat 3c3. Watch for waves and wakes</p>
<p>4. Charging or replacing batteries</p>	<p>4a. Battery acid spill or splash 4b. Fire 4c. Back injury</p>	<p>4a1. Do not move battery without cover plates in place 4a2. Have running water available for eye and body flushing 4a3. Do not overfill or over charge a battery 4a4. Wear eye protection around batteries 4b1. No smoking around batteries 4b2. Do not use or store oils or other flammables around batteries 4b3. Have a serviceable fire extinguisher available 4c1. Use proper lifting techniques</p>
<p>5. Environmental hazards</p>	<p>5a. Heat, Sun, Cold, Ice, Rain, Wind, Snow, and Water</p>	<p>5a1. Cover exposed skin with clothing and hats 5a2. Wear sunscreens at all times 5a3. Be aware of the environmental hazard with the weather. Check the forecast daily 5a4. Have bi-annual screening for skin cancer</p>
<p>6. Getting on and off patrol boat</p>	<p>6a. Wet, slippery or sharp rocks and decks</p>	<p>6a1. Wear proper foot wear at all times 6a2. Do not jump out of boat or rock to rock</p>

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<p>7. Launching & recovering boats</p>	<p>6b. Distant between deck of boat and shore/ground/other boat</p> <p>7a. Winching boat on to trailer 7b. Back injury 7c. Trapping body between the boat and the trailer or shore</p>	<p>6a3. Wear PFD when in and around the boat 6a4. Walk slowly and test the shore/ground 6b1. Do not jump out of boat – step down or step out of boat 6b2. Do not use your body or any body part to block the boat from the shore/rock/other boat</p> <p>7a1. Wear gloves to protect hands from the winch cable 7a2. Do not slide hand down/up the winch cable 7a3. Do not force boat on to the trailer with the winch 7a4. Do not put your hands between the boat and the winch assembly 7b1. Do not use your back to push the boat off or on to the trailer 7c1. Do not use your body or any body part to block the boat from the trailer</p>
<p>8. Loading & unloading heavy objects</p>	<p>8a. Back or other body injury</p>	<p>8a1. Use proper lifting techniques (use legs not your back) 8a2. Do not lift over 45 pounds</p>
<p>9. Outboard motor maintenance</p>	<p>9a. Long term exposure to oils, fuels and cleaners 9b. Splashing or spilling of oils, fuels and cleaners 9c. Back injury</p>	<p>9a1. Wear protective clothing and eye wear 9a2. Remove soiled clothing as soon as possible 9a3. Wash hand and body with soap and water as soon as possible 9a4. Be screened by a doctor for cancer at least bi-annually 9b1. Wear protective clothing and eye wear 9b2. Have running water available for eye and body flushing 9c1. Use proper lifting techniques 9c2. Do not lift over 45 pounds</p>
<p>10. Refilling oil and fuel containers</p>	<p>10a. Splashing or spilling of oil or fuel 10b. Fire</p>	<p>10a1. Wear protective clothing and eye wear 10a2. Do not overfill containers 10a3. Have rags out for rapid spill clean-up before you fill containers 10a4. Have running water available for eye and body flushing 10b1. Have containers properly grounded 10b2. No smoking around the refilling or storage area 10b3. Have serviceable fire extinguisher available 10b4. Store fuel containers in approved flammable storage locker</p>
<p>11. Refueling of boats</p>	<p>11a. Splashing or spilling of fuel 11b. Fire</p>	<p>11a1. Wear protective clothing and eye wear 11a2. Do not overfill the fuel tanks 11a3. Clean-up any spill immediately</p>

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Appendix J

<p>12. Shallow water operation</p>	<p>11c. Inhalation of fuel vapors</p> <p>12a. Hitting objects just below and on the surface of the water</p> <p>12b. Fouling propeller</p>	<p>11b1. No smoking in refueling area</p> <p>11b2. Have serviceable fire extinguisher available</p> <p>11b3. Turn all electrical equipment off and turn the battery disconnect switches to OFF</p> <p>11b4. Make sure the filling nozzle is in contact with the edge of the fueling receptacle (Proper ground)</p> <p>11c1. Refuel boat only in open air areas</p> <p>11c2. Store fuel containers in approved flammable storage locker</p> <p>12a1. Reduce speed in unknown areas or in areas of known floating debris</p> <p>12a2. Do not lock down the outboard motor on skiff when making beach landings</p> <p>12a3. Constantly watch for objects in the water</p> <p>12a4. Review navigation charts for the area you patrol</p> <p>12b1. To clean fouled propeller – turn motor off, remove key from the ignition, tilt motor up, use boot hook or hand to pull/cut objects off the propeller, tilt motor down into water, insert key, restart motor</p> <p>12b2. Watch for floating debris</p>
<p>13. Starting patrol boat</p>	<p>13a. Fire</p> <p>13b. Fuel leaks</p> <p>13c. Electrical short</p> <p>13d. Propeller injury</p> <p>13e. Boats starts in forward or reverse</p>	<p>13a1. Have at least one serviceable fire extinguisher on board</p> <p>13a2. Use the starter for no more than 5 seconds, then wait 10 or more seconds before turning the engine over again</p> <p>13a3. Start motor only with engine cover and spark arrester in place</p> <p>13a4. Do not idle motors more than 2000 rpm</p> <p>13a5. No smoking on board vessel</p> <p>13a6. Use aerator for at least 2 minutes before starting motors</p> <p>13b1. Visually check for fuel leaks before starting motors</p> <p>13b2. Annually check all fuel lines for cracks or wear (replace as needed)</p> <p>13b3. Clean-up any fuel leaks/spills before starting motors</p> <p>13c1. Annually check motors and boat wiring for cracks, burns, wear or other damage (repair as needed)</p> <p>13c2. Do not operate boat if there are any known shorts or electrical problems</p> <p>13d1. Do not start motors if lower unit is out of the water</p> <p>13d2. Look to make sure no one is in the water near the motor or rear of the boat</p> <p>13d3. Check the depth of the water before starting the motor</p>

<p><u>JOB SAFETY ANALYSIS:</u></p> <p>SUBMERGED CULTURAL RESOURCES (SCR) PROGRAM</p>	<p><u>JOB TITLE:</u> SCR DIVER</p> <p><u>DEPARTMENT:</u> CULTURAL RESOURCE</p> <p><u>ANALYSIS BY:</u> STOLTZ/MINAS</p>	<p><input type="checkbox"/> NEW</p> <p><input type="checkbox"/> REVISED</p>
<p><u>Required and/or Recommended Personal Protective Equipment:</u></p> <p>Required- SCUBA Equipment Recommended-</p>		
<p><u>Sequence of Basic Job Steps</u></p> <p>1. Pre-dive Plan</p> <p>2. Dive</p> <p>3. Post-dive</p> <p>4. Submerged Cultural Resource Specific Activity (underwater datum installation)</p>	<p><u>Potential Hazards</u></p> <p>1. Lack of recognition of inadequate equipment, diver skills and adverse environmental conditions.</p> <p>2. Diving is a strenuous activity in an adverse marine environment. Muscle & back strains, swimming in currents, drowning, decompression illness, embolism, hypothermia, interaction with a variety of potentially hazardous marine animals, and traumatic injuries (contusions and lacerations) from unexpected contact with foreign objects.</p> <p>3. Decompression illness, hypothermia, equipment malfunction and injury from strenuous exercise, marine animal, or contact with foreign objects.</p> <p>4. Hearing loss due to operation of high db pneumatic hammer drill without effective hearing protection.</p>	<p><u>Recommended Action or Procedure</u></p> <p>1. The dive plan must include the following:</p> <ol style="list-style-type: none"> designation of the lead diver objective of dive, # of dives, location, estimated depth & time and repetitive dive table check method used—SCUBA, surface supply, or rebreather adverse environmental or special hazards surface and underwater conditions breathing gas supply repetitive dive tables and decompression diving equipment and systems physical and mental fitness of divers coordination of dive activities with potential hazards, boat dive, traffic, shore dive, pier dive etc. <p>2. Divers are trained to recognize and accept those potential hazards. Divers are responsible for their own safety and may refuse or abort a dive they feel is unsafe. RM #4, Chapter 3 D.1.</p> <p>3. After each completed dive, divers will report any physical problem or injury, symptoms of decompression illness, or equipment malfunction</p> <p>4. Rotate divers frequently to minimize exposure to high dbs.</p>

Appendix K

NATIONAL PARK SERVICE • Incident Management Program • INCIDENT COMPLEXITY GUIDE

FACTOR	TYPE 3	TYPE 2	TYPE 1
Incident objectives	<ul style="list-style-type: none"> objectives cannot be met by the initial response 	<ul style="list-style-type: none"> objectives cannot be met by a type 3 incident organization 	<ul style="list-style-type: none"> objectives cannot be met by a type 2 incident organization
Resources	<ul style="list-style-type: none"> mostly local resources small to moderate number used to working together variety of resources not of issue local resources qualified and experienced at the extended response level 	<ul style="list-style-type: none"> moderate number many resources arrived pre-organized moderate variety of different kinds of resources some ordering difficulties lack of qualified incident personnel 	<ul style="list-style-type: none"> large number large number of single resources that need to be organized there may be span of control issues to be resolved wide variety of different kinds of resources serious/severe ordering difficulties
Political sensitivity/ visibility and consequences	<ul style="list-style-type: none"> local significance 	<ul style="list-style-type: none"> high local/regional significance 	<ul style="list-style-type: none"> national/ international significance
Variety of activities involved in incident	<ul style="list-style-type: none"> encompasses a small to moderate variety of activities activities are generally standard for local operations 	<ul style="list-style-type: none"> encompasses a moderate variety of activities 	<ul style="list-style-type: none"> encompasses a wide variety of activities
Costs/source of money	<ul style="list-style-type: none"> uses well established funding mechanisms 	<ul style="list-style-type: none"> WASO budget office may be involved possibility of needing supplemental appropriation home unit has inadequate incident funding capability 	<ul style="list-style-type: none"> WASO budget office is involved there is a probability of needing supplemental appropriation
Number of agencies and organizations involved	<ul style="list-style-type: none"> small to moderate number 	<ul style="list-style-type: none"> moderate number 	<ul style="list-style-type: none"> large number
Scope of agreements and contracts	<ul style="list-style-type: none"> agreements and contracts are in place and useable, or are not needed incident operations are well within local capabilities 	<ul style="list-style-type: none"> some or most agreements and contracts exists and are useable a small number may need to be written 	<ul style="list-style-type: none"> large number of agreements and contracts need to be developed and implemented very large contracts may need to be developed (Level IV Warrant)
Logistic difficulties	<ul style="list-style-type: none"> within local capabilities or can be easily solved 	<ul style="list-style-type: none"> problems can be resolved through normal procedures and channels incident activities may be dispersed over a wide geographic area 	<ul style="list-style-type: none"> special interventions with outside organizations may be needed to solve logistics problems logistics may need to be branched
Safety complexity	<ul style="list-style-type: none"> most identified risks can be mitigated by standard procedures 	<ul style="list-style-type: none"> most identified risks can be mitigated by standard procedures 	<ul style="list-style-type: none"> significant research may be needed to identify risks or appropriate mitigations large number of assistant safety officers required
Media interest / complexity	<ul style="list-style-type: none"> low to moderate local or regional significance 	<ul style="list-style-type: none"> high local/regional significance most information is straight forward 	<ul style="list-style-type: none"> national / international significance potential for highly sensitive information or circumstances
Size of area involved	<ul style="list-style-type: none"> incident facilities and operational work sites are relatively close together 	<ul style="list-style-type: none"> moderate number of scattered incident facilities and or operational work sites. 	<ul style="list-style-type: none"> large number of widely scattered incident facilities and operational work sites.
Duration/impacts to unit operations	<ul style="list-style-type: none"> short duration or disruption to normal operations is minimal or of short duration 	<ul style="list-style-type: none"> normal operations/unit activities may be disrupted for a prolonged period of time 	<ul style="list-style-type: none"> local unit cannot resume normal operations because of the duration and/or severity of the incident
Air operations	<ul style="list-style-type: none"> the local agency is prepared to properly manage the air resources needed to manage the incident 	<ul style="list-style-type: none"> the local agency is not prepared to manage the air resources needed 	<ul style="list-style-type: none"> the local agency is not prepared to manage the air resources needed aviation complexity may require OAS or FAA intervention to resolve issues

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NATIONAL PARK SERVICE • Incident Management Program

INCIDENT COMPLEXITY GUIDE, Instructions and Definitions

INSTRUCTIONS FOR USING THIS GUIDE

1. Gather as many facts about the incident as possible, using the “factors” column to help identify the information needed.
2. Contact your regional emergency coordinator and discuss the situation with her or him. Include type 2 or type 1 incident commanders in the decision process, as appropriate.
3. Looking at the typical characteristics of each factor, decide which of the characteristics listed under the “type” columns best describes your incident. Remember, usually no one incident will have all of the factors fall under just one of the “type” columns.
4. Determine the complexity based upon the column under which the preponderance of factor characteristics fall. For example, if most of the characteristics are best described by the type 2 column, then the incident is probably of type 2 complexity. But, also consider mitigating as well as aggravating circumstances. For example, an analysis of agency participation in the 2002 Olympics in Salt Lake City seemed to have a number of type 1 characteristics, such as international significance and worldwide media attention. However, further inspection of these factors showed that they were NOT an agency responsibility and should not force the incident to type 1. Conversely, the President’s three week vacation in Grand Teton National Park meant high-level political involvement with significant media attention over an extended period, driving an otherwise type 2 incident to type 1.
5. Order incident resources, including an Incident Management Team, if needed, accordingly. Remember, one of the benefits of the Incident Command System is that if you were wrong, or if the situation changes, you can always transition to a more complex or lower complex management structure as needed.

INFORMATION REGARDING INCIDENT TYPES

Type 5 incidents are relatively simple incidents that are usually handled by one resource. Examples:

- motor vehicle accident with no injuries investigated by a single police officer
- small grass fire extinguished by a single engine.

Type 4 incidents are those normally encountered by an agency or jurisdiction and are normally managed by the initial responding resources. Examples:

- multi-vehicle accident with injuries, handled by multiple resources.
- single-alarm working building fire.

Type 3 incidents are incidents that may require more resources in addition to those that initially responded and/or the timeframes for managing the incident are extended. (Some large parks may maintain organized type 3 Incident Management Teams.) Examples:

- lost person search extending over several operational periods.
- one-day dignitary visit.
- multiple alarm structural fire.

Type 2 incidents are incidents of significant complexity exhibiting characteristics shown by the factors listed on the reverse side of this sheet. These incidents are usually managed by regionally organized type 2 Incident Management Teams. Examples:

- impacts from moderate to large disaster, such as a hurricane, flood, tornado or earthquake.
- large special event or ceremony.

Type 1 incidents are the most complex incidents, often involving multiple kinds of activities, a large area of operation or significant political involvement. These incidents are usually managed by a nationally organized type 1 Incident Management Team. Examples:

- impacts from a large disaster, such as a hurricane, flood, tornado or earthquake.
- large special event or ceremony with national or international significance.

Appendix L

**National Park Service
U.S. Department of the Interior**



**Integrated Pest Management Program
Biological Resource Management Division**

**11 Step Process to Developing and Implementing an
Integrated Pest
Management Strategy
August 7, 2006**

1. Describe your site management objectives and establish short and long term priorities.
2. Build consensus with stakeholders-occupants, decision makers and technical experts (ongoing).
3. Document decisions and maintain records.
4. Know your resource (site description and ecology).
5. Know your pest. Identify potential pest species, understand their biology, and conditions conducive to support the pest(s) (air, water, food, shelter, temperature, and light).
6. Monitor pests, pathways, and human and environmental factors, including population levels and phenological data.
7. Establish "action thresholds," the point at which no additional damage or pest presence can be tolerated.
8. Review available tools and best management practices. Develop a management strategy specific to your site and the identified pest(s). Tools can include: 1) no action, 2) physical, 3) mechanical, 4) cultural, 5) biological, and 6) chemical management strategies.
9. Define responsibilities and implement the lowest risk, most effective pest management strategy, in accordance with applicable laws, regulations, and policies.
10. Evaluate results; determine if objectives have been achieved; modify strategy if necessary (adaptive management).
11. Education and outreach. Continue the learning cycle, return to Step 1.