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***125 ASSESSING THE VIABILITY OF ZEBRA AND QUAGGA MUSSELS: LEGAL AND ENFORCEMENT CHALLENGES**

Zebra and quagga mussels entered the United States in the late 1980s and most recently appeared in several Western states. Western states are anxious to stop the spread of these invasive species, which wreak havoc on native ecosystems and water delivery infrastructure. However, variability among state and federal law presents a challenge to stopping the spread of the mussels. This Article examines the issues that arise when laws prohibit only the transport of “live” mussels. Viability standards are one of the most challenging disparities among state and federal laws. The Article concludes that states should preclude both live and dead zebra and quagga mussels to help clarify challenging enforcement questions and give law enforcement officials more certainty in their authority to stop and search watercraft.

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***126 INTRODUCTION**

Originally introduced to the United States in the late 1980s through the discharge of ballast water from container vessels, zebra mussels (*Dreissena polymorpha*) and quagga mussels (*Dreissena bugensis rostriformis*), collectively referred to as “dreissenid mussels,” have quickly spread throughout the Great Lakes basin and connected river systems. Most recently, dreissenid mussels have been discovered in Western waters. In 2007, quagga mussels were found in the Lake Mead National Recreational Area, located along the border of Arizona and Nevada, and in reservoirs located downstream along the Colorado River.¹ Zebra mussels *127 were found a few months later in a reservoir in Central California.² The swift spread of the mussels is widely thought to have been aided by transport via trailered watercraft.³ As trailered watercraft move from water body to water body and from state to state, zebra or quagga mussels may move with them--either attached to the watercraft itself or carried in livewells or ballast tanks.

Dreissenid mussels have negatively impacted native species by removing nutrients from the water and altering water clarity, which allows sunlight to penetrate further into the water and encourages the growth of algal blooms.⁴ In addition, the mussels clog water-intake pipes, debilitating water delivery systems such as irrigation canals and dams.⁵ The infestation of dreissenid mussels in the West may cause billions of dollars in long-term damage.⁶

While many Western states have laws making possession and transport of these invasive species illegal, the laws and enforcement are inconsistent, making it challenging to protect the environment from infestation. One of the most challenging disparities among state and federal laws in the region is the difference in state viability standards. Federal law and some state laws, for example, prohibit only the transport of live zebra or quagga mussels. Others prohibit the transport of any mussel, regardless of whether it is alive or dead. These laws raise some difficult enforcement questions. What does “live” mean? How may an enforcement official who discovers zebra or quagga mussels on a watercraft tell if the organism is “live” or not? How can evidence of viability be documented and preserved? If the viability of the mussel cannot be determined, has there been a

violation of the law?

Further, in states that prohibit only the possession of live mussels, dead mussels might be introduced into water bodies, which could trigger expensive rapid-response actions based on positive environmental DNA (eDNA) results.⁷ The serious implications of such positive results became apparent in 2009 when researchers discovered Asian carp DNA in samples taken from Chicago waterways.⁸ The discovery led management agencies to implement a rapid-response plan that involved the application of the toxin rotenone to a six-mile area.⁹ The resulting fish kill netted only one bighead Asian carp.¹⁰ A second fish kill *128 followed in 2010 that resulted in over 100,000 pounds of dead fish, none of which were Asian carp.¹¹

This Article examines the issues that arise when laws prohibit only the transport of “live” mussels. Part I is a brief look at the scientific definition of viability and an explanation of why viability is so difficult to determine in these species. Part II explores the use of the terms “live,” “living,” or “viable” in reference to aquatic invasive species (AIS) in state and federal laws. Part III looks at how the viability of the organisms might affect enforcement of these laws. Part IV examines the role of eDNA in zebra or quagga mussel detection.

I. DETERMINING VIABILITY

To scientifically determine whether an organism is alive, one can look to see if the organism displays one or more species-specific indicators of life. For mussels, this includes “translocation or foot activity, valve movement, filter-feeding, siphon use, muscle contraction, cilia movement, metabolic respiration, and waste elimination.”¹² It is difficult to observe these characteristics when mussels are attached to trailered watercraft, however, since mussels exposed to air or other harsh conditions often respond by closing their valves.¹³ While dead mussels often gape open, mussels exposed to air for long periods of time may seal their valves shut with dried mucus and can remain closed upon death.¹⁴ Furthermore, different life stages, including larval, newly settled juvenile, or adult, can make it even more difficult to observe these indicators.¹⁵ For example, juvenile mussels can be smaller than a grain of rice. “Dreissenid mussels reach sexual maturity within one year of age and approximately 6-9 mm in length. Newly settled mussels (<1 mm) and individuals smaller than 3-4 mm may be impossible to remove for testing without damaging their valves.”¹⁶ For larvae, observation requires “a microscope and considerable taxonomic expertise.”¹⁷

For adult mussels, there are varying methods for viability assessment. The most basic is manual extraction, or the “squish test,” during which a mussel is crushed and “the presence of liquid or wet tissue is used as a proxy for ‘live’ mussels while dry or disintegrated tissue is indicative of death.”¹⁸ If the mussels have “squishy” flesh inside the shell, they are considered live. This test is used by multiple states.¹⁹

*129 Other methods to determine viability may be difficult to perform in the field or may require a good deal of experience with the mussels. For example, states may use a “bucket test” in which mussels are placed in water for observation and checked for movement.²⁰ Utah uses this test, placing fresh-looking mussels in an aquarium and watching their behavior to see if there is walking or siphoning within an hour.²¹ Additionally, the state employs an overnight observation, deeming the mussels alive if they have changed location.²² Yet another test is a “tactile-response test,” which employs a blunt needle to test the clamping reflex of the mussel.²³ In addition, an RNA test may determine if a specimen was alive at the time of collection. During this process, enforcement agents use a preservative at the time of collection and send the specimen to a lab for molecular analysis.²⁴

II. AIS VIABILITY STANDARD IN FEDERAL AND STATE LAW

A. Federal

As challenging as it is to scientifically determine viability, the use of viability standards in law further complicates the issue. Several federal laws use the terms “live,” “living,” or “viable” in reference to aquatic invasive species (AIS). The Lacey Act, the U.S. Coast Guard’s ballast water standards, and the Nonindigenous Aquatic Nuisance Prevention and Control Act, among others acts, mention either a live or viable standard. However, the definition of these terms in the law is unclear.

In 1999, President Clinton signed Executive Order 13112, which aimed to prevent the spread of invasive species and created

the National Invasive Species Council.²⁵ Executive Order 13112 defines “alien species” as “any species, including its seeds, eggs, spores, or other biological material capable of propagating that species, that is not native to that ecosystem.”²⁶ This definition suggests that only a living species can be viable, as most species are only capable of reproduction while they are alive.

The Lacey Act, originally enacted as a conservation law to preserve game and wild birds, is the primary federal law focused on preventing the introduction of non-native species of birds and wildlife into ecosystems. Title 18 of the Lacey Act prohibits the importation or shipment of “injurious” mammals, birds, fish, mollusks, crustaceans, or their offspring or eggs.²⁷ This section of the Act operates by prohibiting only listed injurious ***130** species from transport. “Injurious species” refers to a defined list of species set forth in either the Lacey Act itself or in regulations.²⁸ Congress listed zebra mussels as an injurious species in 1990 in the Nonindigenous Aquatic Nuisance Prevention and Control Act.²⁹ Title 18 prohibits the importation, transportation, or acquisition of “live mollusks, veligers, or viable eggs of zebra mussels, genus *Dreissena*.”³⁰ A Title 18 violation might occur when live zebra mussels attached to a vessel move across state lines. Quagga mussels, live or otherwise, have not been listed.

Title 16 of the Act makes it a violation of federal law to import, export, transport, sell, receive, acquire, purchase in interstate or foreign commerce, or possess any fish, wildlife, or plants in violation of state laws or regulations.³¹ Therefore, under Title 16, if a state law prohibits either dead zebra mussels or quagga mussels that are either live or dead, violation of a state law could also result in a violation of the Lacey Act. For example, if a boater left Utah, where possession of quagga mussels is prohibited in all life stages, with quagga mussels attached to his vessel and traveled across state lines, a Title 16 violation may have occurred.

Ballast water discharges are infamous for introducing invasive species to native ecosystems. Laws and regulations targeting such discharges, therefore, often reference those types of invasive species that are the targets of management actions. For example, the International Maritime Organization (IMO), the specialized United Nations agency that works to prevent marine pollution by ships, developed ballast water management (BWM) guidelines in response to the International Convention for the Control and Management of Ships’ Ballast Water and Sediments.³² The IMO defines viable organisms as “organisms and any life stages thereof that are living.”³³ In March 2012, the U.S. Coast Guard published ballast water standards for the first time. The standards establish the concentration of living organisms that can be discharged from ships in waters of the United States.³⁴ However, the standards do not define the term “living.” In response to public comments asking the Coast Guard to differentiate between living and nonliving organisms, the Coast Guard noted that its standard was different from the IMO discharge standard, which uses the term “viable” instead of “living.” Specifically, the Coast Guard stated,

***131** It is important to note that, while the text of the IMO BWM Convention refers to ‘viable’ organisms, the G8 guidelines define ‘viable’ as ‘living.’ Therefore, the Coast Guard has decided that this issue is best addressed in the BWMS approval process, and will not alter the standard as suggested by these commenters.³⁵

In response to another commenter asking the Coast Guard to consider using the term “viable” rather than “living,” the Coast Guard

decided to use live/dead rather than viable/unviable, because the latter designations would require culturing potentially large numbers of different kinds of organisms to determine whether they were capable of reproduction. This would be made even more problematic by the fact that scientists are not able to culture many of the organisms in question. Finally, it is more conservative, and thus more protective, to base efficacy decision [sic] on the basis of live/dead, rather than viable/unviable.³⁶

Essentially, the IMO appears to define “viable” as simply a live organism, while the Coast Guard may view “viable” as a more stringent “capable of reproduction” standard.

The Nonindigenous Aquatic Nuisance Prevention and Control Act (NANPCA) created an interagency task force to address invasive species.³⁷ The Act, as amended by the National Invasive Species Act of 1996, defines “nonindigenous species” as “any species or other viable biological material that enters an ecosystem beyond its historic range, including any such organism transferred from one country to another”³⁸ By using the term “viable biological material,” the Act insinuates that it applies only to living organisms.

Another invasive species law, though not directed at aquatic species, is the Plant Protection Act. The Act contains provisions that seek to protect important plant species, primarily agricultural crops, by preventing the introduction of noxious weeds and pests. The statute defines “plant pest” as “any living stage of any of the following that can directly or indirectly injure, cause damage to, or cause disease in any plant or plant product ... [including] a nonhuman animal”³⁹ Like NANPCA, the Plant Protection Act intimates that it only applies to live species.

B. State

State requirements vary regarding the viability of mussels throughout the West. Some states prohibit live organisms whereas other states do not differentiate between living and dead. Below is a look at several Western states’ laws prohibiting the possession or transportation of invasive species. Of the states highlighted below, California, Idaho, and Utah reference a live/viable standard in their laws; however, it appears that only Idaho ***132** enforces a “live” requirement.⁴⁰ Both Oregon and Nevada have recently amended their rules to remove the “live” requirement.

1. Arizona

The possession, importation, shipment, or transport into or within the state of an aquatic invasive species is prohibited, unless authorized by the Director of the Game and Fish Department.⁴¹ Further, the release of an aquatic invasive species into waters or into any water treatment facility, water supply or water transportation facility, device, or mechanism in the state is prohibited.⁴² Quagga and zebra mussels are listed as restricted wildlife.⁴³ Arizona does not differentiate between live and dead mussels.

2. California

It is illegal to import, transport, or possess certain *live* animals, including all members of the genus *Dreissena*, except under permit issued by the Department of Fish and Game.⁴⁴ Except as authorized, “a person shall not possess, import, ship, or transport in the state, or place, plant, or cause to be placed or planted in any water within the state, dreissenid mussels.”⁴⁵ The California Fish and Game Commission regulations specify the restriction of “live” mussels. The use of the term “live” indicates a viability standard; however, California enforcement officers do not make that distinction in practice.⁴⁶

3. Colorado

It is illegal to “possess, import, export, or transport any aquatic nuisance species.”⁴⁷ Colorado law defines “aquatic nuisance species” as “exotic or nonnative aquatic wildlife or any plant species that have been determined by the commission to pose a significant threat to the aquatic resources or water infrastructure of the state.”⁴⁸ The Department of Natural Resources’ rules specifically list zebra and quagga mussels as aquatic nuisance species.⁴⁹ Colorado does not differentiate between live and dead mussels.

****133 4. Idaho***

The Idaho Invasive Species Act of 2008 prohibits possession of an invasive species with several exceptions, including situations where “the specimen has been lawfully acquired dead and, in the case of plant species, all seeds are removed or are otherwise rendered nonviable.” Also exempted is “herbaria or other preserved specimens, so long as such specimens are rendered nonviable.”⁵⁰ Further, regulations define invasive species as “species not native to Idaho, including their seeds, eggs, spores, larvae or other biological material capable of propagation, that cause economic or environmental harm and are capable of spreading in the state.”⁵¹ Idaho law only applies to live mussels.⁵² Idaho uses several methods to determine viability, as mentioned in Section II above, but also treats mussels as “live” if there is any standing water on the boat.⁵³

5. Montana

Montana defines an invasive species as “a nonnative, aquatic species that has caused, is causing, or is likely to cause harm to the economy, environment, recreational opportunities, or human health.”⁵⁴ Both quagga and zebra mussels are identified by the Department of Fish, Wildlife, and Parks as prohibited species.⁵⁵ The laws do not differentiate between live and dead species.

6. Nevada

In Nevada, it is illegal

for any person at anytime to receive, bring or have brought or shipped into this State, or remove from one stream or body of water in this State to any other, or from one portion of the State to any other, or to any other state, any aquatic life or wildlife, or any spawn, eggs or young of any of them.⁵⁶

Nevada defines “aquatic invasive species” as “an aquatic species that is exotic or not native to this State and which the Commission has determined to be detrimental to aquatic life, water resources or infrastructure for providing water in this State.”⁵⁷ Nevada regulations state that “the importation, transportation or possession of the following species of *live* wildlife or hybrids thereof, including viable embryos or gametes, is prohibited: ... zebra and quagga mussels”⁵⁸ However, Nevada recently promulgated a new regulation classifying ***134** zebra and quagga mussels as aquatic invasive species; the regulation does not distinguish between live or dead mussels.⁵⁹

7. New Mexico

New Mexico defines “aquatic invasive species” as

quagga mussels and zebra mussels and other exotic or nonnative aquatic animals, including invertebrates but excluding those species listed as protected in Chapter 17 NMSA 1978, or any plant or animal species whose introduction into an aquatic ecosystem is determined by the director, after consulting with the secretary of energy, minerals and natural resources and with the concurrence of the director of the New Mexico department of agriculture, to cause or be likely to cause harm to the economy, environment or human health or safety.⁶⁰

The state does not differentiate between live or dead mussels.

8. Oregon

The Oregon Aquatic Nuisance Species Management Plan addresses aquatic invasive species.⁶¹ Oregon Department of Fish and Wildlife rules define “aquatic invasive species” as “any species of wildlife, fish (excluding game fish) or freshwater or marine invertebrates that are listed in the ‘United States Geological Service list of Aquatic Nonindigenous species in Oregon’ dated June 4, 2009 or that is listed as a mollusk or crustacean in OAR 635-056-0050 as a Prohibited Species.”⁶² The rules list species that “may not be imported, possessed, sold, purchased, exchanged or transported in the state.”⁶³ To aid enforcement officers, Oregon recently amended its rules to include “live or dead” zebra and quagga mussels.⁶⁴

9. Texas

Texas prohibits the possession of exotic shellfish. “Exotic shellfish is defined as a nonindigenous shellfish that is not normally found in the public water of this state.”⁶⁵ All species of *Dreissena* mussel are listed as exotic shellfish.⁶⁶ The state does not make a distinction between live and dead shellfish.

***135 10. Utah**

Except as authorized, it is illegal to

(a) possess, import, export, ship, or transport a Dreissena mussel;

(b) release, place, plant, or cause to be released, placed, or planted a Dreissena mussel in a water body, facility, or water supply system; or

(c) transport a conveyance or equipment that has been in an infested water within the previous 30 days without decontaminating the conveyance or equipment.⁶⁷

“Dreissena mussel” is defined as “a mussel of the genus Dreissena at any life stage, including a zebra mussel, a quagga mussel, and Conrad’s false mussel.”⁶⁸ While the rule defines Dreissena to be “at any life stage,” which might suggest a viability standard, Utah does not employ one, and enforcement officers issue citations and make arrests for possession, even if mussels are dead.⁶⁹

11. Washington

The state makes it illegal to possess or import into the state aquatic nuisance species, which include both zebra and quagga mussels. “A person is guilty of unlawful use of a prohibited aquatic animal species if he or she possesses, imports, purchases, sells, propagates, transports, or releases a prohibited aquatic animal species within the state, except as provided in this section.”⁷⁰ The state does not make a distinction between live and dead organisms.

12. Wyoming

Possession of aquatic invasive species is prohibited.⁷¹ Wyoming defines “aquatic invasive species” as “exotic or non-native organisms that have been determined by the commission to pose a significant threat to the aquatic resources, water supplies or water infrastructure of the state.”⁷² Zebra mussels are specifically identified as a “priority aquatic invasive species,” which are species that are not present in Wyoming but are a threat to the state.⁷³ The state does not make a distinction between live and dead mussels.

***136 III. ENFORCEMENT**

Most Western states authorize law enforcement officers to inspect conveyances for aquatic invasive species and take action when vessels are contaminated. Generally, many of the Western states have roadside inspection stations at their borders where boaters are required to stop and allow agents to inspect watercraft for any invasive species. A few states have mobile inspection teams where boaters are required to stop for inspection. Inspection agents look for any signs of zebra or quagga mussels. If mussels are found, the vessel may be decontaminated through a “hotwash,” a process that uses 140°F water to kill the mussels. Agents may also assess fines or issue penalties.⁷⁴

When taking these actions, does it matter if the organisms are alive or dead? In states prohibiting only “live” organisms, law enforcement may have a difficult time proving that mussels were alive and the vessel owners were, therefore, in violation of state laws. Below are examples of how states might manage this viability issue, as well as a look at how it might be addressed under federal law.

A. State Law

In states that do not distinguish between live and dead mussels, enforcement actions would likely apply to both. For example, the Washington Department of Fish and Wildlife (WDFW) Aquatic Nuisance Species Unit is tasked with preventing the introduction of aquatic invasive species (AIS) into the state. The WDFW is authorized to require recreational and commercial watercraft to stop at check stations.⁷⁵ Owners of watercraft used in designated AIS states or contaminated with AIS “must

bear the expense for any necessary impoundment, transportation, cleaning, and decontamination of the watercraft.”⁷⁶ Boaters found to have zebra or quagga mussels, either dead or alive, may face penalties. The “unlawful use of a prohibited aquatic animal species” is a gross misdemeanor, with harsher penalties for subsequent violations.⁷⁷

In Western states with a “live” requirement, viability may come into play. For example, Idaho authorizes law enforcement authorities to require a driver to stop and submit to an inspection of the exterior of any conveyance upon reasonable suspicion of infestation with quagga mussels or zebra mussels.⁷⁸ State law defines invasive species as “species not native to Idaho, including their seeds, eggs, spores, larvae or other biological material capable of propagation, that cause economic or environmental harm and are capable of spreading in *137 the state.”⁷⁹ Therefore, in Idaho, a violation would occur only when mussels are alive or capable of reproduction.

Both Oregon and Nevada recently amended their rules to encompass both live and dead mussels. Oregon amended its rules to include “live or dead” dreissenid mussels, thereby removing the limitation on enforcement of its laws to only live mussels. In its analysis of the rule change, the Oregon Department of Fish and Wildlife stated:

One of the shortcomings of the Wildlife Integrity Rules for quagga/zebra mussel before the Temporary rule went in to [sic] effect on August 31, 2012 was that the current rule only made it illegal to transport live mussels. The [in]ability to prove viability of a mussel just by looking at it made it impossible for law enforcement to have probable cause to stop watercraft that had or was suspected of having mussels attached to any part of the vessel. The temporary rules ... gave law enforcement a much needed tool to allow them to stop a vessel for probable cause if they see or suspect a vessel of having mussels without having to first prove the viability of the mussel.⁸⁰

The Department’s explanation of the rule change points out the enforcement issues that may arise in states that have a live mussel requirement. Oregon law enforcement officers felt they did not have probable cause to stop watercraft for potential violations. Generally, law enforcement officers may perform warrantless searches on watercraft if there is consent, individualized suspicion, or an authorized administrative search.⁸¹

Individualized suspicion may exist with either reasonable suspicion or probable cause.⁸² Probable cause exists where law enforcement officers “reasonably believe the person, place, or thing to be searched has evidence of a crime.”⁸³ In a state with a live requirement that requires probable cause, enforcement officers are required to have a reasonable belief that the watercraft contained live mussels. Mussels attached to the boat would give evidence of illegal possession, but unless they were wet, officers might not have probable cause that they are alive.

“Reasonable suspicion is a less demanding standard than probable cause”⁸⁴ Reasonable suspicion may be based on “specific reasonable inferences which [the officer] is entitled to draw from the facts in light of his experience.”⁸⁵ Law enforcement officers may *138 temporarily stop individuals to investigate suspicions.⁸⁶ Idaho has its own reasonable suspicion standard for dreissenid mussels. “[U]pon reasonable suspicion that a conveyance is infested with quagga mussels or zebra mussels, [law enforcement officers] may require a driver of a vehicle to stop and submit to an inspection of the exterior of any conveyance(s) in plain view.”⁸⁷ Reasonable suspicion that a watercraft is transporting dreissenid mussels may be based on “observations of the boater’s actions while leaving a water body, the visible presence of aquatic plants, or tips from officials in other states.”⁸⁸ It seems as though the reasonable suspicion standard is low enough that law enforcement could at least stop and perform a temporary search of a watercraft, whether or not the mussels on the boat were live or dead.

B. Federal Law

Since live zebra mussels are listed as an injurious species under Title 18 of the Lacey Act,⁸⁹ transport of live mussels would be a violation of federal law. The transport of dead mussels would not be a violation of Title 18. Title 16 of the Lacey Act, however, makes it a violation of federal law to import, export, transport, sell, receive, acquire, purchase in interstate or foreign commerce, or possess any fish, wildlife, or plants possessed in violation of state laws or regulations.⁹⁰ Transport of zebra or quagga mussels that are live or dead could violate Title 16 in states that prohibit both live and dead mussels.

C. Case Study: The Fiesta Queen

In April 2012, authorities intercepted the *Fiesta Queen*, a 100-foot paddle-wheeled boat, as it traveled throughout several Western states en route to Canada.⁹¹ The *Fiesta Queen* had operated for several years in the Laughlin, Nevada, area on the Colorado River, an area known to be infested with quagga mussels. After receiving information that the boat would pass through Utah, the Utah Division of Wildlife Resources (UDWR) discovered the boat just inside state lines. A preliminary inspection revealed encrusted quagga mussels both inside and outside of the boat. Many of the mussels were still alive. The UDWR seized and quarantined the boat. The *Fiesta Queen* was quarantined for a total of twenty-nine days while it underwent measures to kill and remove the encrusted quagga mussels. The UDWR estimated that the total decontamination cost was a minimum of \$12,500, not including administrative costs or the owner's costs.

***139** Utah law defines "Dreissena mussel" as "a mussel of the genus *Dreissena* at any life stage, including a zebra mussel, a quagga mussel, and Conrad's false mussel."⁹² In Utah, the UDWR may "temporarily stop, detain, and inspect a conveyance or equipment that the division reasonably believes is in violation" of the state's dreissenid mussel laws.⁹³ Law enforcement officers would therefore be required to have a reasonable belief that the watercraft contained mussels.

In this instance, UDWR had information that for several years the *Fiesta Queen* had been in a highly infested area and was coming through the state. This information was enough to meet the probable cause requirement that law enforcement have a reasonable belief that mussels were on the vessel. If Utah enforced a "live" requirement, law enforcement would have to reasonably believe that live mussels were on the vessel. Adult mussels can live out of water up to five days in dry environments and for several weeks in areas such as damp bait wells, shaded crevices, indentations found on boat hulls and thru-hull fittings, and intake pipes for boat motors.⁹⁴ It is thus reasonable to believe that a boat such as the *Fiesta Queen*, with a complicated design and structure, may contain live mussels.

D. Law Enforcement Case

What would the role of viability play in a law enforcement case? Admittedly, this is a theoretical question, as--at the time this Article was written--there are no cases on point in which a prosecution has hinged on whether a zebra or quagga mussel was alive at the time of the inspection. States often do not proceed with criminal prosecution when a boater cooperates with state directives, and instead focus more on outreach and education.⁹⁵ In fact, the U.S. Fish and Wildlife Service noted that it "would not prosecute a quagga mussel enforcement case unless state law enforcement prosecutes first under state AIS law, the case shows mussel viability, and the state requests federal assistance."⁹⁶

Idaho prohibits the transportation of live quagga mussels.⁹⁷ If an inspection of a boat in Idaho revealed encrusted quagga mussels, an officer could order the boat impounded and issue a hold order. A violation could result in a fine of no more than \$3000, a prison sentence of no more than twelve months, or both.⁹⁸ However, whether this would be a prosecutable enforcement case relies on several factors, including whether the mussels were ***140** in fact alive at the time of the stop. What proof of live mussels would a court require? As mentioned above, Idaho uses a squish test to determine if a mussel is alive. The state also treats boats with standing water as having live mussels. Testimony from the officer explaining the consistency of the mussels at the time of inspection or the existence of standing water could offer evidence that the mussels were alive. However, the accuracy of this test may be questionable. For example, would a hot-wash decontamination rewet tissue and affect the results of such a test? Other tests, such as RNA, may offer more accuracy.

IV. EDNA

A fairly new method of testing for invasive species in waterbodies is eDNA, or environmental DNA.⁹⁹ Using this method, researchers collect water samples and extract DNA from solids in the water, such as fish scales or feces. Researchers can then identify genetic markers unique to a particular species. The problem with this method is that the eDNA results do not show whether the cells come from live or dead organisms.

As mentioned in the introduction, this occurred in 2010 when researchers discovered Asian carp DNA in samples taken from Chicago waterways. The discovery led the state to order a massive fish kill that resulted in over 100,000 pounds of dead fish, none of which were Asian carp.¹⁰⁰ A similar scenario could occur in states that do not prohibit both live and dead mussels. For example, eDNA shed from dead encrusted mussels on a boat in Idaho could give a false positive for infestation of a waterway. Evidence of quagga mussel DNA in the waterway would mean that the water body would be managed as an

infested water body. If the state prohibited both live and dead mussels, perhaps dead mussels would not enter the waterway, triggering the eDNA and resulting in unnecessary fish kills.

CONCLUSION

Determining viability of dreissenid mussels is difficult due to their small size and other physical characteristics. Further, the tests needed to determine viability often require training and may not be practical to perform in the field. If states do not already prohibit both live and dead mussels, they should consider amending rules to preclude both. Prohibiting both would help clarify challenging enforcement questions and give law enforcement officials more certainty in their authority to stop and search watercraft. Further, by prohibiting dead mussels, states would avoid unnecessary and ecologically harmful measures taken following positive eDNA results.

Footnotes

- ^{a1} J.D., University of Mississippi School of Law; Senior Research Counsel at the National Sea Grant Law Center.
- ¹ Erik Stokstad, *Feared Quagga Mussel Turns Up in Western United States*, 315 SCIENCE 453 (2007).
- ² *Zebra Mussel and Quagga Mussel Information Resource Page*, U.S. GEOLOGICAL SURVEY, <http://nas.er.usgs.gov/taxgroup/mollusks/zebramussel/> (last updated July 8, 2011).
- ³ W. REG'L PANEL ON AQUATIC NUISANCE SPECIES, QUAGGA-ZEBRA MUSSEL ACTION PLAN FOR WESTERN U.S. WATERS 2 (2010), available at http://anastaskforce.gov/QZAP/QZAP_FINAL_Feb2010.pdf [hereinafter QUAGGA-ZEBRA MUSSEL ACTION PLAN].
- ⁴ S.N. Higgins & M.J. Vander Zanden, *What a Difference a Species Makes: A Meta-analysis of Dreissenid Mussel Impacts on Freshwater Ecosystems*, 80 ECOLOGICAL MONOGRAPHS 179, 188 (2010).
- ⁵ QUAGGA-ZEBRA MUSSEL ACTION PLAN, *supra* note 3, at 1.
- ⁶ *Id.* at 25.
- ⁷ Pierre Taberlet et al., *Environmental DNA*, 21 MOLECULAR ECOLOGY 1789 (2012) (“Environmental DNA refers to DNA that can be extracted from environmental samples (such as soil, water or air), without first isolating any target organisms.”).
- ⁸ Joel Hood, *Catch of the Day: Only 1 Asian Carp*, CHI. TRIB., Dec. 4, 2009, at C5.
- ⁹ *Id.*
- ¹⁰ *Id.*
- ¹¹ Joel Hood, *Fish Kill Nets No Asian Carp*, CHI. TRIB., May 26, 2010, at C8.
- ¹² ROBYN DRAHEIM, DETERMINING VIABILITY OF DREISSENID MUSSELS INTERCEPTED ON RECREATIONAL BOATS AND OTHER IN-WATER EQUIPMENT (forthcoming 2013) (manuscript at 3) (on file with author).

- 13 *Id.*
- 14 *Id.*
- 15 *Id.* (manuscript at 4).
- 16 *Id.*
- 17 *Id.*
- 18 *Id.*
- 19 E-mail from Amy Ferriter, Idaho Invasive Species Coordinator, Idaho State Dep't of Agric., to Terra Bowling, Senior Research Counsel, Nat'l Sea Grant Law Ctr. (Dec. 20, 2012) (on file with author).
- 20 DRAHEIM, *supra* note 12 (manuscript at 6).
- 21 E-mail from Larry Dalton, Aquatic Invasive Species Coordinator, Utah Div. of Wildlife Res., to Terra Bowling, Senior Research Counsel, Nat'l Sea Grant Law Ctr. (Dec. 20, 2012) (on file with author).
- 22 *Id.*
- 23 DRAHEIM, *supra* note 12 (manuscript at 5). This test is likely not used in the field by any of the states, as it would probably be impossible to employ in the field and would require a good deal of expertise to perform. *Id.*
- 24 *Id.* (manuscript at 7).
- 25 Exec. Order No. 13112, 64 Fed. Reg. 6183 (Feb. 3, 1999).
- 26 *Id.*
- 27 18 U.S.C. § 42 (2012).
- 28 *Id.*; 50 C.F.R. § 16 (2013).
- 29 16 U.S.C. § 4701 (2012).
- 30 50 C.F.R. § 16.13(a)(2)(iii) (emphasis added).
- 31 16 U.S.C. § 3372.
- 32 *BWM Guidelines, INT'L MAR. ORG.,* <http://www.imo.org/OurWork/Environment/BallastWaterManagement/Pages/BWMGuidelines.aspx> (last visited Jan. 9, 2013).

33 Marine Env't Prot. Comm., *Guidelines for Approval of Ballast Water Management Systems (G8)*, at ¶ 3.12, Annex 4 Res. MEPC.174(58), MEPC Doc. 58/23 (Oct. 10, 2008), available at <http://globallast.imo.org/2012/Individual%20Guidelines%CC20for%CEreferenceG8.pdf>.

34 Standards for Living Organisms in Ships' Ballast Water Discharged in U.S. Waters, 77 Fed. Reg. 17,254-01 (Mar. 23, 2012) (codified at 33 C.F.R. § 151.1511 (2012)).

35 *Id.* at 17,266.

36 *Id.* at 17,274.

37 16 U.S.C. § 4701 (2012).

38 *Id.* § 4702(11).

39 7 U.S.C. § 7702(14) (2012).

40 Oregon recently amended its rules to include “live or dead” zebra/quagga mussels, thereby removing the enforcement of its laws to only “live” mussels. OR. ADMIN. R. 635-056-0050 (2013).

41 ARIZ. ADMIN. CODE § R12-4-1102(A) (2012).

42 *Id.*

43 *Id.* § R12-4-406(M)(3).

44 CAL. CODE REGS. tit. 14, § 671(c)(10) (2013).

45 CAL. FISH & GAME CODE § 2301(a)(1) (West 2012).

46 Telephone Interview with Marth Volkoff, Senior Envtl. Scientist, Cal. Dep't of Fish & Game (Jan. 9, 2012).

47 COLO. REV. STAT. § 33-10.5-105(1)(a) (2012).

48 *Id.* § 33-10.5-102(1).

49 COLO. CODE REGS. § 405-1:800 (2013).

50 IDAHO CODE ANN. § 22-1905 (2012).

51 *Id.* § 22-1904; IDAHO ADMIN. CODE r. 02.06.09.010 (2012).

52 E-mail from Amy Ferriter, *supra* note 19.

53 *Id.*

54 MONT. CODE. ANN. § 80-7-1003(2) (2012).

55 MONT. ADMIN. R. 12.6.2215 (2013).

56 NEV. REV. STAT. § 503.597(1) (2011).

57 *Id.* § 488.035(1) (2011).

58 NEV. ADMIN. CODE § 503.110(1)(g) (2012) (emphasis added).

59 184 Nev. Reg. Admin. Regs. R152-12 (Dec. 20, 2012).

60 N.M. STAT. ANN. § 17-4-35(M)(1) (2012).

61 ERIK HANSON & MARK SYTSMA, OREGON AQUATIC NUISANCE SPECIES MANAGEMENT PLAN 1 (2001), *available*
at http://www.clr.pdx.edu/docs/OR_ANS_Plan.pdf.

62 OR. ADMIN. R. 635-059-0000(2) (2012).

63 *Id.* 635-056-0050(1).

64 *Id.* 635-056-0050(1)(f)(A)(ii).

65 TEX. PARKS & WILD. CODE ANN. § 66.007(e)(2) (West 2011).

66 TEX. ADMIN. CODE § 57.111(17)(C) (2013).

67 UTAH CODE ANN. § 23-27-201 (West 2012).

68 *Id.* § 23-27-102(6) (emphasis added).

69 E-mail from Larry Dalton, *supra* note 21.

70 WASH. REV. CODE § 77.15.253(1) (2012).

71 WYO. STAT. ANN. § 23-4-202(a)(2) (2012).

72 *Id.* § 23-4-201.

73 040-020-062 WYO. CODE R. § 4 (LexisNexis 2012).

74 *See* Emi Kondo et al., *Are State Watercraft Inspections Constitutionally Permissible Searches?*, 3 ARIZ. J. ENVTL. L. & POL'Y
105, 108 (2013).

75 WASH. REV. CODE § 77.12.879 (2013).

76 *Id.*

77 *Id.* § 77.15.253. However, a person in violation of the law is exempt from criminal penalties if that person complies with
department directives for decontamination. *Id.* § 77.12.879.

78 IDAHO CODE ANN. § 22-1910 (2012).

79 *Id.* § 22-1904(3).

80 OR. DEP'T OF FISH & WILDLIFE, EXHIBIT B: WILDLIFE INTEGRITY RULES FOR SPECIES CLASSIFICATION OF
TIGER MUSKIE, ASIAN CARP AND QUAGGA/ZEBRA MUSSELS, ATTACHMENT 1 AGENDA ITEM SUMMARY 4
(2012), *available at* [http:// www.dfw.state.or.us/agency/commission/minutes/12/12_dec/ExhibitB_Attachment1_](http://www.dfw.state.or.us/agency/commission/minutes/12/12_dec/ExhibitB_Attachment1_AgendaItemSummary.pdf)
AgendaItemSummary.pdf (document author likely intended to use the word “inability” in second sentence).

81 *See* Kondo, *supra* note 74, at 108-116.

82 THOMAS CLANCY, THE FOURTH AMENDMENT: ITS HISTORY AND INTERPRETATION 475-76 (2008).

83 *Id.*

84 *Alabama v. White*, 496 U.S. 325, 330 (1990).

85 *Terry v. Ohio*, 392 U.S. 1, 27 (1968).

86 Kondo, *supra* note 74, at 113.

87 IDAHO CODE ANN. § 22-1910 (2012).

88 Kondo, *supra* note 74, at 112.

89 50 C.F.R. § 16.13(a)(2)(iii) (2013).

90 16 U.S.C. § 3372(a) (2012).

91 Mike Fowlks, *Case Study: Fiesta Queen: Interdiction, Decontamination, Costs & Enforcement*, OR. SEA GRANT (Aug. 22,
2012), [http:// seagrant.oregonstate.edu/node/678/](http://seagrant.oregonstate.edu/node/678/).

92 UTAH CODE ANN. § 23-27-102(6) (West 2012) (emphasis added).

93 *Id.* § 23-27-301.

94 DRAHEIM, *supra* note 12 (manuscript at 2).

95 LARRY LECLAIR ET AL., AQUATIC INVASIVE SPECIES PREVENTION AND ENFORCEMENT PROGRAMS 37 (2012),
available at <http://wdfw.wa.gov/publications/01392/wdfw01392.pdf>.

96 Memorandum from Jim Ruff, Raquel Crosier, & Amy Ferriter to Members of the Fish & Wildlife Comm. of the Nw. Power &
Conservation Council (June 28, 2012), *available at* <http://www.nwcouncil.org/news/2012/07/f7.pdf>.

97 IDAHO CODE ANN. § 22-1905 (2012).

98 *Id.* § 22-1913.

99 *See, e.g.*, Michigan v. U.S. Army Corps of Eng'rs, No. 10-CV-4457, 2010 WL 5018559, at *6 (N.D. Ill. 2010), *aff'd on other*
grounds, 667 F.3d 765 (7th Cir. 2011).

100 Hood, *supra* note 11.