Eye ON Invasives

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In This Issue:

Pathways of Invasion: How Did They Get Here?

They move by air, land and water, in planes, boats, ships and vehicles of all kinds. Their human chauffeurs may be unaware of their traveling companions or intent on moving them. Invasive species introductions and spread can be prevented most effectively if we deal with the pathways, or modes of their transport. Just as with disease transmission, the way an invasive plant or animal is moved on its journey to a new location is known as a "vector." In this issue of *Eye On Invasives* we examine some of the vectors responsible for introducing invasive species that are already in California, as well as vectors that have a high potential for introducing new invasive species in the future.

Did You Know?

The California Department of Food and Agriculture (CDFA) has stopped people at their Border Protection Stations trying to bring in restricted mammals, birds, and reptiles, everything from raccoons and skunks to more exotic animals including a couple of alligators and even a monkey.

For more information on CDFA's Border Protection Stations, see the Partner Spotlight article on page 2.

If a non-native species is introduced into suitable habitat and it reproduces and spreads, it can impact native plants and animals by predation, introduction of new diseases or competition. If discovered after it has become established it can be extremely expensive and difficult, if not impossible, to remove. It should surprise no one, then, that the most effective method of dealing with invasives is to prevent them from ever being introduced to ecosystems outside of their natural range.

Unfortunately, the number of vectors that move through and over California's borders, and the speed and frequency of transportation modes present a relentless tide of potential invasion. For this reason, in addition to their responsibilities to manage existing invasive species outbreaks, California state agencies are keenly interested in stopping new introductions. Understanding the mechanics of vectors is the critical first step to any such prevention effort.

A wide range of vectors can lead to introduction of invasive species into new areas. Some vectors, such as the discharge of marine ballast water, or the importation of cut flowers or horticultural products, have been researched and their risks are fairly well understood. This research has led to the development of policies and programs that can limit the potential for these vectors to disrupt natural ecosystems. Other vectors and the roles they play in the transport of non-native species are not as well understood.

In this issue, we offer steps that the public can take to avoid being a vector and highlight some ongoing efforts to close the information gap on less understood vectors.

Partner Spotlight
Busted By CDFA

Many invasive species are adept hitchhikers, traveling along with produce, plants or vehicles as they are moved by unsuspecting individuals or companies. To protect the agricultural interests of California and its citizens, in the early 1920s the California Department of Food and Agriculture (CDFA) began establishing Border Protection Stations (BPS) to inspect commodities and travelers as they enter the state. The BPS continue to be a major part of CDFA's pest prevention system, and are the first line of defense in California's pest exclusion.

Watercraft (i.e., yachts, boats, jet skis, etc.) used in quagga/zebra mussel infested waters not only pose a significant risk to recreation and the environment, but also to agriculture because they can interfere with the irrigation of crops. Mussels may be moved as adults attached to boat hulls (they may live out of water for several days) or as free-swimming larvae transported with trapped water moved in boat bilges, live wells and other places capable of harboring water while boats are in transit.

CDFA's BPS play an important role in keeping these mussels from being transported into the state and gaining additional footholds in California. Strategically placed along California's border, CDFA's 16 BPS offer the best opportunity to inspect watercraft coming into the state before they are placed in California waters. Inspectors at the BPS have been on the lookout for these mussels since they were first discovered in the United States.

The first interception of a watercraft infested with zebra mussels at a BPS in California occurred at the Needles BPS in 1993. From 1993 to 2006, the number of finds remained relatively low (averaging about five per year). In 2007, as a result of the Colorado River infestation, this trend ended with 109 finds that year. Since 2007, approximately 150,000 watercraft have been inspected each year, and to date over 869 watercraft have been found to be carrying quagga or zebra mussels.

CDFA inspectors talk to the drivers of vehicles towing watercraft through BPS, and solicit their cooperation in the inspection. Because mussels are constantly being found in new waters, all watercraft are inspected regardless of origin. As a result of these inspections, over half a million people towing watercraft have been educated about aquatic invasive species at CDFA's BPS since the discovery of quagga mussel in the Colorado River.

Watercraft are inspected for adult mussels by visually inspecting hulls, propellers, motors, trailers, and other surfaces that would typically be below the waterline when the watercraft is in use.

Additionally, all holds (i.e., live wells, bilges, anchors, etc.) are checked for debris and standing water capable of harboring the microscopic free-swimming larval stages of the mussel. All standing water is drained or pumped from the watercraft before entry into California is allowed.

If a watercraft is found with attached adult mussels it is cleaned using high pressure hot water. A uniquely numbered band is then placed from the trailer to the watercraft, and the vessel is allowed to proceed to its destination under quarantine. The appropriate DFG quagga/zebra mussel regional scientist is contacted, and they work with the watercraft owner to ensure the watercraft does not pose a threat before it is released from quarantine. Watercraft under CDFA quarantine are not allowed to launch until they are released from quarantine by DFG.

Inspection of this watercraft revealed hundreds of adult mussels clinging to its hull. CDFA file photos.

But mussels don't only arrive at the BPS attached to watercraft. On May 26, 2009, a pickup truck arrived at the Yermo BPS with an assortment of items collected from Lake Mead. The driver thought these items would be great décor for his yard. There were aluminum cans, fishing poles and old anchors, all encrusted with quagga mussels. Because the BPS inspects not just watercraft, but also commodities and travelers, these mussels were intercepted in the course of a routine vehicle stop. Needless to say, the driver was not allowed to take these souvenirs to his home in California, and the CDFA prevented yet another opportunity for the introduction of mussels, thus protecting the agricultural interests of the state.

Horticultural Hitchhikers

Invasive species stow away in a wide variety of nooks and crannies as they hitch a ride to a new location. Retail and/or wholesale imports of potted landscape plants and houseplants (horticulture) and cut flowers (floriculture) too frequently include potentially invasive pest species. Organisms that can be carried by plants include pathogens, insects, worms, amphibians, reptiles, mammals, as well as seeds and rhizomes from other plants. Typically, these pests are physically or cryptically hidden in or under leaves, flowers, pots, soil and shipping crates and containers. These pests cost California millions of dollars each year in damage, loss, inspection, control, eradication and programmatic administration.

The California Department of Food and Agriculture (CDFA) and inspectors from County Agricultural Commissions work diligently to intercept all shipments contaminated by plant pests or pathogens at interstate ports of entry. The U.S. Department of Agriculture inspects at international ports of entry. Although rigorous measures may be taken to treat infested plants prior to shipment, they are not always 100 percent effective. When inspectors encounter contaminated shipments, those shipments are destroyed, returned to their place of origin, re-directed out of California or held under quarantine for treatment at their destination.

One example, the coqui frog (*Eleutherodactylus coqui*), native to Puerto Rico, has been intercepted at California air and marine ports on shipments originating from Hawaii where the "coqui" has become established.

These tiny frogs and their eggs occur with shipments of ornamental tropical plants (e.g., *Dracaena*, palm, bromeliad and some orchid species). If established, the coqui can occur in very high densities. Ten thousand coquis per acre have been reported in Puerto Rico, and even higher densities in Hawaii. Coquis are so named due to the male's loud mating call, a rapid, high-pitched, two-note chirp "ko-kee." Females are silent.

"Ten thousand coquis per acre have been reported in Puerto Rico, and even higher densities in Hawaii."

Noise from the coqui has impacted tourism and real estate industries in Hawaii. The nocturnal call attains nearly 100 decibels at a distance of two feet, reason alone to be considered a pest.

Coqui frogs are typically no larger than a quarter, but their high pitched chirp can be as loud as a lawn mower. Photo by Allen Allison, Ph.D.

Current status of California coqui populations is unknown, but they have been reported from several locations in coastal Southern California and could persist in areas of artificial moisture such as greenhouses or gardens. In Puerto Rico, the coqui occurs in a wide variety of elevations and habitats including agricultural areas, forested areas, riparian zones, wetlands and urban areas. Unlike other frogs, the coqui does not require standing water to reproduce. Adult females deposit their eggs among cuplike vegetation and males guard the eggs and keep them moist. They undergo the tadpole stage inside the egg and emerge after several weeks as fully developed dime-sized froglets.

Citing possible competition with native species in Southern California, the coqui was added to the California Department of Fish and Game's (DFG) Restricted Species List in 2008 per California Code of Regulations Title 14, Natural Resources, Division 1. Dept. of Fish and Game, Section 671. Coquis have a voracious appetite – at risk are native insect prey items including plant pollinators and spiders. Competition with native insectivores such as fish, amphibians, reptiles, birds and small mammals is likewise a risk. In addition, coquis may introduce and/or spread parasites and disease to native amphibians.

Hawaii continues to develop treatments for horticulture and floriculture shipments to prevent coquis from reaching California. But until these treatments are effective, products they are found on will be intercepted in California and will not reach their destination.

Spread Fish Stories, Not Invasives

People all around the world love to fish. Whether you enjoy fishing from a boat, hiking into the wilderness or fishing from the river banks, there is something you should know. You may have hitchhikers on board! That's right, invasive hitchhikers. You may pick up and carry these non-native plants and animals to your favorite fishing spots without even knowing it. Some invasive species that you may encounter while fishing include Didymo (rock snot), water hyacinth, New Zealand mudsnail, and quagga and zebra mussels.

How do these hitchhikers get around? These species can attach themselves to your waders, boots, fishing gear, bait buckets, ropes and even pets. Felt soled boots are widely used by fisherman, but are notorious for carrying New Zealand mudsnails and Didymo. The felt soles of these boots may take days to dry and some small aquatic organisms are able to survive under these conditions. If the boots are used again before attached organisms have died, they can be introduced into a new waterbody.

Bob Holland fishing the upper Owens River in the Eastern Sierra of California with his two dogs Bodie and Baxter. Photo by Jeff Weaver, DFG.

Another way these hitchhikers can be transported is through the use of live bait. After a great day of fishing it might seem humane to release the unused bait into the waters where you are fishing. This is a dangerous – and illegal – practice that could have unforeseen consequences by introducing new species. Imported live bait packaging such as seaweed can contain live organisms that if emptied into the body of water can survive and cause harm to the environment. Many such hitchhikers have no natural predators outside of their native habitat, so their populations grow unchecked.

Why should I care about these little hitchhikers? They can have an enormous impact on the entire ecosystem by introducing disease, outcompeting native species and altering food chains. The results can lead to a decline in game fish populations, recreational closures and even the collapse of an entire fishery.

What can I do to prevent invasive species from hitchhiking with me? You can do your part by taking a few simple steps between visiting each body of water:

- Remove mud, dirt, sand and visible plants, fish and animals from ALL equipment and gear. Use a scrub brush to clean small crevices such as boot laces, seams, net corners, etc.
- Eliminate water from all gear and equipment before transporting it anywhere. This includes live wells, buckets, etc. Some invasive species are able to survive with just a little bit of moisture for long periods.
- Clean all gear and equipment using one of the following methods.

  Hot water soak - Immerse gear and equipment in 140 degrees Fahrenheit or hotter water. If necessary, weigh it down to ensure it remains immersed. Soak in 140 degrees Fahrenheit or hotter water for a minimum of ten minutes.

  Dry - Allow gear and equipment to dry thoroughly (i.e., until there is complete absence of moisture), preferably in the sun. Keep dry for a minimum of 48 hours to ensure any organisms are desiccated.
- Clean watercraft - Pressure wash the watercraft and trailer with 140 degrees Fahrenheit water, including all of the boat equipment (i.e. ropes, anchors, etc.) that came into contact with the water. Flush the engine with 140 degrees Fahrenheit water for at least ten minutes and run 140 degrees Fahrenheit water through the live wells, bilges, and all other areas that could contain water.
- Never release plants, fish or animals into a body of water unless they came out of that body of water. If you find yourself with a bucket of live bait at the end of your day, give your bait to another angler, or dispose of it in a nearby trash receptacle.

Research Spotlight
Analyzing Coastal Vectors

Many people are familiar with invasive insects like the Mediterranean fruit fly and plants such as scotch broom that have wreaked extensive damage to the farms and fields of California. However, in our waterways and beneath the surface of our oceans, California's aquatic environment is under similar threat by invasive species.

The San Francisco Bay is widely considered to be an invasive species hot spot. Aquatic Invasive Species (AIS) can upset ecological stability, outcompete native species and impact water quality, affecting commercial and recreational uses of the bay and other waterways.

The economic cost of AIS has been estimated at approximately $9 billion annually in the United States. But AIS management is not just an economic issue – the health of our unique coastal and marine ecosystems is a source of pride and recreation for California's 37 million citizens. If invasive species are allowed to establish themselves in a new area, they can become extremely difficult to eradicate. Therefore, managing the pathways, or vectors, that allow invaders into our waters is the most effective method of protecting against the damaging effects of AIS.

Commercial fishing is one vector being evaluated by the OST. DFG file photo.

In 2008, the California Ocean Protection Council (OPC) reached out to the California Ocean Science Trust (OST) to coordinate risk assessments for pathways of introduction of AIS into California's coastal and estuarine waters. The OST was chosen for this project because of its expertise in presenting scientific research in a manner that is useful for ocean management. The OST also has processes in place to coordinate scientific studies so that managers know that the information they ultimately receive is unbiased, accurate and up to date.

Some routes of AIS introduction into new areas – such as the unintentional transport of species in the ballast water of freight ships – are relatively well understood. The goal of this project is to learn more about lesser-known vectors that pose a significant risk of introducing invasive species to California. These include commercial fishing, recreational boating, live bait, live imported seafood, aquariums, aquascaping and aquaculture.

The marine alga *Caulerpa taxifolia*, a common aquarium plant, invaded native eelgrass beds in San Diego. Photo by Rachel Woodfield, Merkel & Associates.

The OST recruited three highly qualified teams of AIS scientists from across the country. The teams are using a combination of literature and database review, augmented with direct sampling and interviews, where appropriate, to provide the state with an assessment of the risks posed by each vector. The OST is working to ensure a consistent approach across the project teams so that each vector can also become part of a wider analysis.

When finished, the report will be a comprehensive study that clearly lays out the relative risk posed by each of these potential introduction routes. The OST will also work with a team of scientific and socioeconomic experts to develop specific recommendations about the costs and opportunities for management options for controlling key pathways of AIS into California.

Managing AIS is one of the many issues that our state must address that requires the most reliable, advanced scientific information to guide decision making. As an organization that fluently converses with both California policy makers and the scientific community, the OST can ensure a productive dialogue and positive outcomes.

For more information on this project please visit the Ocean Science Trust's Aquatic Invasive Species web page.

DO YOU KNOW THIS IS INVASIVE?

American Bullfrog – *Lithobates (Rana) catesbeiana*

Most Californians are familiar with the low-pitched bellow of the bullfrog, but many don't know that bullfrogs are not native to California. American bullfrogs originated from the eastern U.S. and were originally introduced to California in the 1890s as a food source. Not long after, they were abundant in the wild and are now found in a range of habitats throughout the state. American bullfrogs reach uninfested waterbodies by escaping or being released by medical laboratories, research facilities and pet owners. Once released, bullfrogs can move about on their own from waterbody to waterbody.

American bullfrogs, the largest frog species in the U.S., can weigh more than a pound and be as long as eight inches. They are typically green to olive-green in color with darker spots or blotches on the top of their bodies. Their bellies tend to be white, cream or yellow in color. American bullfrogs have a fold of skin that extends from their eye to their ear; however, the rest of their skin tends to be smooth. They also have visible eardrums that are the same size or larger than their eyes.

Bullfrogs are found in freshwater lakes, ponds, streams, swamps and other types of slow, warm water. They prefer waters with plenty of aquatic vegetation and do quite well in human-modified habitats, like golf course ponds.

Photo by Carl D. Howe

American bullfrogs will eat anything they can swallow, including birds, rodents, frogs, snakes, turtles, lizards, fishes and bats. As a result, they both outcompete and prey upon native species. They also are a known carrier of chytrid fungus, which causes a serious skin disease in some amphibians and has been attributed to the decline of many native amphibian species worldwide, including some here in California.

Efforts to reduce or eliminate bullfrog populations include the ability to take an unlimited number of bullfrogs with a California sport fishing license, and various local bullfrog eradication projects where sensitive native species occur.

To protect California's native species from predation and disease, don't move bullfrogs, and don't release pets.

Quagga and Zebra Mussel Laws Extended

Fish and Game Code Section 2301 has been extended. Gov. Jerry Brown signed into law Senate Bill 215 (Huff) on Sept. 26, 2011. This bill extends the Jan. 1, 2012 sunset date specified in FGC 2301 by five years. With this bill DFG will continue to have authority to inspect and quarantine conveyances that may carry dreissenid mussels, as well as require containment plans for infested reservoirs.

Level Two Watercraft Interception Training

The Pacific States Marine Fisheries Commission (PSMFC) and its 100th Meridian Partners will be sponsoring the following Level Two Trainings in the spring of 2012 at Lake Mead:

Feb. 7-8, Feb. 28-29 and April 3-4

This two-day, intensive, hands-on training is provided free of charge and registration is on a first-come first-served basis. The course is designed for those individuals who are or will become active in setting up or implementing watercraft inspection and decontamination programs.

For more information or to register, contact Bill Zook with PSMFC at bjzook2@msn.com or at (360) 427-7676

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