

WATER LOG

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Invasive Species



Inside This Issue . . .

Too Little, Too Late: A History of
Invasive Species Laws 3

Protecting Mississippi Waterways
from Aquatic Invasive Species 8

An Overview of Native and Invasive
Crayfish in Mississippi and
Alabama 12

Addressing Invasive Species
Concerns within a Municipal Policy
Framework 13

Cover photograph: Giant Applesnail eggs
Credit: Mississippi Department of Marine Resources

Table of Contents photograph: *Ailanthus altissima*
Credit: John Beetham

• UPCOMING EVENTS •

National Shellfisheries Association Annual Meeting

March 29 - April 2, 2020
Baltimore, MD

<https://www.shellfish.org>

Interagency Conference on Research in the Watersheds

March 30 - April 2, 2020
Tifton, GA

<https://www.icrwatersheds.org>

Alabama Mississippi Water Joint Annual Conference

April 5-8, 2020
Mobile, AL

<https://almswater.com>

Too Little, Too Late: A History of Invasive Species Laws

Kristina Alexander

Background

The history of laws to control invasive species in the United States is a history of laws that came too late. For example, in 1899 the U.S. Congress passed a law funding the removal of water hyacinths, an invasive plant that Congress described as “menacing the safety of any vessel” after finding it growing into dense mats blocking rivers and hiding logs and other hazards. And in 1900 Congress passed the Lacey Act, making it illegal to import starlings, English sparrows, and other “injurious” species not native to the United States,¹ describing the sparrows as the “rat of the air,” that vermin of the atmosphere” because of the harm they already caused. Yet in 2020 these species – water hyacinths, starlings, and English sparrows – are rampant in the United States. In other words, the laws did not work. In fact, in 1960 when amending the Lacey Act regarding injurious species, Congress eliminated references to the sparrow and starling, conceding the loss to the birds: “We believe No feasible means for controlling their numbers or range has been devised.”²

That did not prevent Congress from trying to stop invasives by passing laws to prevent their introduction. However, most laws came *after* significant harm from a non-native species: building a fort after the invasion.

Invasive species, also referred to as exotic, non-native, injurious, or noxious species, are ones that do not naturally occur in the environment, and because they do not have natural enemies, such as insects or larger predators, invasives thrive and outcompete the native species. Invasives come from a different environment, not necessarily a foreign one. For example, the red swamp crayfish is native to Mississippi but is an invasive in California. Once an invasive is established (meaning it reproduces and does not require cultivation) a law prohibiting its introduction will not work. The fact is, at best, laws can limit intentional imports of potential invasives, and then only if enacted prior to the first import and effectively enforced.

However, laws that restrict intentional imports have little effect on species that show up as hitchhikers. Unintentional introductions have produced some of the United States’ biggest invaders. Besides zebra mussels (and their cohort, quagga mussels), other accidental imports include the Asian longhorned beetle, tumbleweed, and hemlock woolly adelgid. A great number of invasives were accidentally introduced after being imported for other purposes (e.g., agriculture, gardens, aquaculture, aquariums, or pets), such as the water hyacinth, the European water chestnut, kudzu, the snakehead fish, Asian carp, Burmese pythons, lionfish, and parrotweed. But the harm from each of those species was identified and addressed in law only after they were established. Sometimes long after they were established. The laws tried to prevent additional imports of an already thriving nuisance.

Ailanthus Trees

Perhaps one of the first invasive species laws was in 1853, within an appropriations act. It includes a line authorizing funds to plant trees on federal property but says “Provided: That no more alanthus [sic] trees be purchased or planted.”³ The restrictions of 1853 came too late. The so-called Tree of Heaven was a beautiful exotic species for gardens, reportedly imported as early as 1784. Like any good invasive, the ailanthus sprang free from its borders and now occurs throughout most of the United States, including sprouting from gutters and sidewalk grates in New York City. When Betty Smith wrote *A Tree Grows in Brooklyn*, she was writing about the resilient ailanthus, which will re-sprout, even when chopped down – a tenacity admirable in humans, but annoying in plants that choke out native species. However heavenly, the tree is an outlaw in the United States. There is [still a law](#) preventing planting ailanthus on public property.

Zebra Mussels

More recently, in 1990 when faced with an invasive mollusk, the zebra mussel, Congress passed the National Aquatic Nuisance Prevention and Control Act (NANPCA). This law set up a task force to study the invasion, and listed the zebra mussel as an injurious species under the Lacey Act.⁴ Congress passed the law after finding that ships' discharge of ballast water led to the "unintentional introduction of nonindigenous species" into the Great Lakes. The zebra mussel was discharged from ballast water gathered in Europe. Zebra mussels clog water pipes, out-compete native mussels, and eat all the edible material from mollusk's food chain. At the time of passing NANPCA, Congress estimated the economic cost of zebra mussels as reaching \$5 billion by 2000, not taking into account the lost biodiversity. [The U.S. State Department](#) anticipated the costs to control zebra mussels from 2000 to 2009 to be \$3.1 billion, and that it would cause the extinction of up to 140 native mussel species.



Credit: D.Jude, University of Michigan

NANPCA did more than just bar intentional importing of zebra mussels, but it was not a quick response. The law required the Coast Guard to produce regulations within two years for environmentally sound alternative ballast water management or ballast water exchanges in the Great Lakes. The Coast Guard published a final rule in the Federal Register in 1993, "[Ballast Water Management for Vessels](#)

[Entering the Great Lakes.](#)" On December 30, 1994, the Coast Guard published another final rule, "[Ballast Water Management for Vessels Entering the Hudson River.](#)"

During that time, another invasive – the quagga mussel – was first sighted. In 1991 it was identified in New York; in 1992 the quagga was in Ohio; in 1994, Pennsylvania. As of January 2020, according to the U.S. Geological Survey (USGS), [it is found in 17 states](#), including landlocked states Iowa, Kentucky, Nevada, South Dakota and Utah, meaning these species are spreading by hitchhiking on domestic recreational boats and trailers, not just hiding in ballast water.

In 1996 Congress amended the act to require the Coast Guard to issue mandatory regulations to control ballast water, under the National Invasive Species Act (NISA). In 2004 the Coast Guard enacted final regulations to require ballast water exchanges in deep water to prevent carrying the species in. Note that this is 14 years after the initial law identifying zebra mussels as a costly problem. Additionally, in discussing the [regulatory revisions in 2012](#), the Coast Guard found ballast water exchanges (BWE) were not preventing unintentional non-natives from arriving, having an efficacy rate between 50 and 90 percent. According to the Coast Guard "BWE is not well-suited as the basis for the protective [ballast water management] programmatic regimen envisioned by NISA, even though it has been a useful interim management practice and was a logical place to start." In 2018 Congress tried again, this time by amending how ballast water is regulated in the Vessel Incidental Discharge Act ([P.L. 115-282](#), §§ 902-203).

Asian Carp

Not all creatures sneak in. Some species are imported into the United States for an intended purpose. One example is Asian carp (including bighead, silver, black, and grass carp), which in the 1960s were introduced into the United States to control algae in catfish farms and reservoirs in the mid-South. It did not take long for them to escape and spread up the Mississippi River and into 23 states, [according to the USGS](#). They are bigger than native carp and eat everything, reducing resources for native fish. Congress reacted, but decades later.

In 2009 Congress passed the Asian Carp Prevention and Control Act (P.L. 111-307). That act amends the Lacey Act to add bighead carp to the list of injurious species, forbidding their import. Once again, the ban on importing the carp occurred too late, over 30 years after

they were first imported, and long past the date when the greatest risk of carp introductions was due to importing. The law is also too limited, applying only to bighead and silver carp, and not black or grass carp.

At the time the Asian carp law was enacted, the Lacey Act was interpreted as applying not just to imports, but to interstate shipments. Therefore, adding carp to the Lacey Act would limit some potential additional introductions from state to state. However, in 2017 the D.C. Circuit Court of Appeals found that interpretation was not consistent with the plain language of the Lacey Act, and that shipments among the 49 states within North America were not controlled by the act.⁵ Thus, the Asian Carp Prevention and Control Act is interpreted to prevent only the continued import of bighead and silver carp, not the interstate transportation of those fish.

Grass carp, introduced in Arkansas in 1963, are controlled not by import restrictions but by biological ones. Grass carp are very useful to control aquatic vegetation and are still stocked in reservoirs and catfish ponds. But generally, those fish must be triploid, meaning they have an extra set of chromosomes to make them sterile. Mississippi does not have such a restriction on grass carp. While Mississippi prohibits stocking or releasing nonnative aquatic species into a “private or public pond, lake, stream, river or any other water body” it allows the release of grass carp.⁶ Additionally, Mississippi allows aquaculture of “non-native carp species” so long as it is “conducted in a Responsible manner that excludes the possibility of escape,” further stating that screens over drainpipes of a size to prevent the escape of fingerlings was adequate.⁷ In contrast, aquaculture of tilapia in Mississippi (another non-native) requires use of a 1000-micron mesh screen to prevent discharge of water containing eggs or fish; and aquaculture facilities for other non-native species must “prevent the passage of eggs, larvae, juveniles and adults.”⁸

[The State of Alabama prohibits possession, sale, or release](#) of Asian carp, but defining that only to include bighead, silver, and largescale silver, thus excluding black carp and grass carp. However, Alabama has used regulations to help remove invasive species to some extent, by [allowing the harvest of Asian carp](#) at the Gunter Reservoir without gear restrictions. That regulation also prohibits the release of bighead, silver, or black carps back into the reservoir.

Tumbleweed

An invasive species does not have to be aquatic to sneak in and be harmful. In fact, tumbleweed – a symbol of the arid West – is an invasive, thought to have been unintentionally imported in the 1870s in bags of seed.⁹ It took to its new habitat, and took over, scattering 250,000 seeds per plant as it rolls along. It thrives in places where native plants are gone, such as cultivated fields and rights-of-way along roads. In two decades it rolled from South Dakota, where it was first reported, to the Pacific Coast more than 1,000 miles away.



Credit: Jim Choate

In 1939 – sixty years later – Congress passed the Federal Seed Act making it unlawful to transport agricultural seeds unless they are labeled with the origin and percentage by weight of weed seeds (including noxious-weed seeds), the kinds of noxious-weed seeds, and the rate of occurrence of each. This law was amended, and [a form of it](#) requires the U.S. Department of Agriculture to control plant pests and noxious weeds.

While this law may have prevented some additional introductions of invasive plants, it did not prevent the spread of tumbleweed. In 2020 the State of Washington had a [state highway closed](#) for 10 hours due to tumbleweed accumulations of up to 30 feet. Also, a [hybrid tumbleweed](#) blending the genes of two invasive tumbleweeds, one from Russian and China with a species from Australia and South Africa, was first reported in the early 2000s, and grows up to 6-feet tall.



Credit: Ken Ratcliff

Kudzu

Another example of a non-aquatic nuisance plant, but one found in the South, is kudzu. It was intentionally introduced, and even distributed, by the U.S. Department of Agriculture to southern landowners to fight off erosion caused by poor agricultural practices. An estimated 85 million seedlings were handed out beginning in 1933.¹⁰ Congress even ordered planting it on a military base: “upon the completion of such leveling, draining, and fertilizing, to plant kudzu crowns on such area at the rate of five hundred to the acre.”¹¹ The Alabama Cooperative Extension Service estimates that 7 million acres are infested with kudzu in the Southeast. Getting rid of it is difficult, [according to that group](#): “Eradication, not merely population reduction, is essential for permanent control.”

In 1997 Congress added kudzu to the list of pernicious weeds under the Federal Noxious Weed Act of 1974.¹²

Lionfish

Animals in the pet trade also take a toll on the United States’ natural resources once they get free. For example, lionfish, an eye-catching aquarium fish, were first noticed in the late 1990s along the Atlantic Coast and now plague the Gulf of Mexico, too. They eat small crustaceans, other fish, including fish larvae, but have no predators in U.S. waters because they are native to the Indian and Pacific oceans. One theory of how they came

to the United States’ waters is that aquarium owners released the fish when they got tired of them. Another is that hurricane waters overwhelmed tanks in which they were grown. Thus, legal efforts to prevent the introduction of lionfish would have been effective only if the laws had prevented importing any lionfish in the first place. Releasing aquarium fish into the wild is a violation of state law that people are willing to break and that may be impossible to enforce (both Alabama and Mississippi have such laws, see below).

No federal law or regulation has been found regarding the fish. However, the State of Florida took action, including enacting [regulations](#) in 2018 to prohibit import, breeding, or possession of lionfish eggs or larvae. However, the state still allows the sale of live lionfish if they were harvested from Florida waters or adjacent federal waters. In 2011 Florida began developing regulations to encourage catching lionfish, and in 2014 [eliminated some regulatory obstacles](#) to volunteer divers wishing to harvest the fish. Divers no longer need a recreational saltwater fishing license if using approved or lionfish-specific gear, and the regulations eliminated recreational fishing limits for that fish. In federal waters, a federal permit is still required. While lionfish are said to be delicious if prepared without introducing venom from the spines into the flesh, it seems unlikely that diners can catch up to the 2,000,000 or so eggs laid by mature lionfish each year.

State Efforts in Alabama and Mississippi

Alabama and Mississippi have laws prohibiting the introduction of non-native species into state waters. But the laws only are for intentional introductions. [Mississippi law](#) makes it illegal to “release or cause to be released into any public waters any aquatic species” and also to release any animal not indigenous to the state. [Alabama law](#), for example, makes it a misdemeanor for any person to “introduce[], place[], or cause[] to be introduced or placed, any nonindigenous aquatic plant into any public waters...” But the law continues to say that “the unintentional adherence to a boat or boat trailer of a nonindigenous aquatic plant, and its subsequent unintentional transportation or dispersal in the course of common and ordinary boating activities and practices, does not constitute a violation.”

However, unintentional, careless transportation is exactly how many of these species are spread. Aquatic nuisance plants, for example, common and giant salvinia (sometimes called water spangles, floating fern, or Kariba weed), do not need to be uprooted and replanted to flourish. They can grow from a single shred. The weed is found in 16 counties in Alabama and at least five in Mississippi.¹³ The weed chokes out native plants and also can make waters uninhabitable for fish and waterfowl.

Closing the intrastate transportation gap in the regulatory structure could make a difference by limiting the harm from lake to lake transfers. For example, other states require boaters to rinse their craft and related equipment.¹⁴ [Minnesota](#) requires boaters to clean all visible plants and invasive species from watercraft, trailers, and related equipment before leaving the area; to drain the equipment, including bilge, livewell, and baitwell; keep the drain plugs out while transporting; and to dispose of unwanted bait in the trash, not into the waterbody. [Connecticut](#) requires removing and disposing of any vegetation and aquatic invasive species on boats.

Another, less effective way to reduce the number of invasive carp, would be to open fishing. This could be a program similar to the one Florida has allowing lionfish harvests. Both Alabama and Mississippi could allow recreational harvest of invasive carp without a license, and without limits on gear.

Conclusion

The legal history of trying to control invasive species demonstrates that banning species after they have been

introduced is futile. For intentional imports there could be a requirement that only sterile species may be imported absent an assessment of the potential damage caused by a release. Such a rule could make importing difficult, but there are already noises to require eDNA testing at ports of entry. And the temporary inconvenience of testing could prevent millions of dollars of damages.

To have any impact, laws and regulations must include the authority for removal of species. Even so, as demonstrated by the 1899 law to remove water hyacinth from one river, the results are likely to be temporary. However, while there is no fix, there may be control. That would be accomplished by timely regulations that authorized swift removal/eradication efforts without waiting decades to respond. 🐟

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Endnotes

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3. 10 Stat. 207 (March 3, 1853).
4. 16 U.S.C. §§ 4701 et seq.; 56 Fed. Reg. 56942 (Nov. 7, 1991).
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6. Miss. Admin. Code 40-3:1.1.D.
7. Miss. Admin. Code 2-1-4:11(105.01).
8. Miss. Admin. Code 2-1-4:11(105.02) (tilapia); Miss. Admin. Code 2-1-4:11(105.03) (all other non-native species).
9. DesertUSA, *Tumbleweed: Russian Thistle*.
10. Alabama Cooperative Extension System, *Kudzu in Alabama: History, Uses, and Control* (ANR-65) p. 2.
11. P.L. 81-496, 64 Stat. 96 § 6.
12. P.L. 105-86, 111 Stat. 2079, § 728.
13. Alabama Herbarium Consortium and the University of West Alabama, [Alabama Plant Atlas](#); Mississippi Dep’t of Wildlife Fish and Parks News, *Officials concerned as Giant Salvinia spreads to more lakes* (March 4, 2019). [Introduced in the late 1970s as a garden species.](#)
14. For more information on state regulations requiring removal of species from boats before transport, see Stephanie Showalter Otts, *From Theory to Practice: A Comparison of State Watercraft Inspection and Decontamination Programs to the Model Legal Framework* (Rev’d Dec. 2018).

Protecting Mississippi Waterways from Aquatic Invasive Species

Mike Pursley

It was 2005 in coastal Mississippi when one of the world's most invasive plants, giant salvinia quickly covered an estimated 1,950 acres of the Pascagoula River. The source of the infestation could not be determined, but it is thought to be unwanted plants discarded from an overgrown water garden or aquarium. The outlook for the river was bleak. Giant salvinia, one of the fastest growing plants in the world, was expanding rapidly. Something had to be done and done quickly. The Aquatic Invasive Species Program of the Mississippi Department of Marine Resources (MDMR) was born out of this necessity.

Later that year, Hurricane Katrina (in addition to its terrible destruction) provided some unexpected relief. The storm surge and elevated salinity stranded and killed much of the giant salvinia. Seizing this opportunity, before the surviving population had time to rebound, MDMR with support from the U.S. Geological Survey began a complete inspection of the Lower Pascagoula River system. The objectives were to find, map, and destroy the surviving giant salvinia. The effort was successful in eliminating the visible giant salvinia. However, isolated giant salvinia plants, hidden in the dense vegetation of Pascagoula Marsh, continued to survive and provided a source of re-infestation. Periodic heavy rainfall and high water conditions cause the nearly dormant plants to float out of the confines of the marsh and enter the open waterway where conditions are extremely favorable for reproduction.¹ Over the past 14 years, using a variety of techniques, MDMR's Aquatic Invasive Species Program has been able to suppress the giant salvinia population to a very low, hardly noticeable level. One exception to this success occurred in 2019 when an unusually long period of low salinity allowed giant salvinia to temporarily thrive in a six-acre bayou near the Mississippi Sound.²

What are aquatic invasive species?

Since the appearance of giant salvinia in 2005, other aquatic invasive species unfortunately also have arrived in South Mississippi, and MDMR's Aquatic Invasive Species Program has worked diligently to protect waterways from these harmful introductions as well. Aquatic invasive species (or AIS for short) are water-dependent organisms living outside their native range. They establish quickly and harm natural ecosystems, human health, and the economy. Louisiana and Texas spend millions of dollars every year on aquatic invasive plant control, mostly on giant salvinia. AIS generally have no natural enemies and outcompete native species for nutrients, sunlight, and habitat. They can also reduce native populations by direct predation, parasitism, habitat alteration, and by transmitting disease.

AIS introductions are usually the result of human activity. Ships can carry aquatic organisms attached to their hulls, as part of the cargo, or in their ballast water. Live aquatic animals and plants imported for aquarium, gardening, or food use can escape, get released, or even planted on purpose into new environments.³

Modern global internet-based commerce has greatly accelerated the rate of these biological invasions. Aquatic life from all parts of the globe that were formerly isolated by distance and geography can now arrive anywhere in a just a matter of hours or days. Thankfully, not all these aquatic world travelers have the potential to cause harm. The ones that do however, like giant salvinia, end up causing expensive, sometimes permanent problems.⁴

Mississippi's Most Recent Aquatic Invasive Species: Salvinia

Giant salvinia (*Salvinia molesta*) is a free-floating invasive fern from the Amazon River. It was once a popular water gardening plant, but now its sale is banned as a state and

federal noxious weed. *Salvinia* has small oblong leaves with fine eggbeater shaped hairs on the surface. This extremely fast-growing plant (capable of doubling its population every four days) accumulates and forms dense mats that choke out native aquatic life and impede navigation. *Salvinia* reproduces by fragmentation and can be spread by hitchhiking on watercraft or animals. In 2018 giant *salvinia* had spread to Ross Barnett Reservoir in Jackson and has also been recently spotted in several lakes in North Mississippi.⁵



To combat the Pascagoula River infestation mentioned above, MDMR's AIS crew conducts a year-round program of integrated pest management. Activities include regular surveys of the affected areas by boat and by air. Spot herbicide application is used when necessary in accordance with all applicable laws. Small, isolated clusters of *salvinia* are simply netted and disposed of whenever possible. U.S. Department of Agriculture-approved [bio-control weevils](#) have also helped slow the reproduction of *salvinia*, but it is not clear whether these cryptic tiny weevils have survived recent cold winters.

A closely related and similar-looking plant, common *salvinia* (*Salvinia minima*), is also found on the Pascagoula and Pearl Rivers. Inoculated with the same bio-control weevils as giant *salvinia*, the slower-growing common *salvinia* has not required as much intervention. Currently common *salvinia* infestations are being monitored so a rapid response can be initiated if populations expand and herbicide application becomes necessary.

Giant Applesnail

Giant Applesnail (*Pomacea maculata*), is also from the Amazon River area. These snails were widely sold as pets until the Mississippi Department of Agriculture learned of the damage they cause and issued an emergency regulation in 2001 to protect the State's rice crop.⁶ In addition to destroying rice fields, infestations of giant applesnail can also strip lakes and marshes of aquatic vegetation. These voracious pests also consume the eggs of native frogs and toads. Giant applesnails can grow to the size of a baseball and can produce 85,000 offspring during their several-year life span. These snails usually remain hidden in the water during daylight hours. Their presence is usually first detected by the clusters of bright pink eggs that they deposit just above the waterline.

The giant applesnail was first discovered in Mississippi in a [Pearl River County lake](#) in 2008. In 2013-2014 two separate infestations were detected in Jackson County: at a constructed [wetland sewage treatment facility](#); and on the [Pascagoula River](#). The constructed wetland treatment facility infestation is thought to have been from snails hitchhiking on aquatic plants purchased for the treatment ponds. The Pascagoula River and Pearl River County infestations are suspected to have started from the release of unwanted pets.

To help prevent damage to critical marsh habitat by these destructive snails, MDMR's AIS program, together with help from [Gulf Corps](#) (a youth environmental conservation training program), have removed a total of 1,100 live snails and destroyed 30,000 egg masses (which equates to 75 million live snails, if those egg masses had all hatched) during weekly Pascagoula River control missions. The Jackson County Utility Authority has been working to contain and control the infestation on their facility. Future MDMR efforts to protect the Pascagoula River marsh include a 2-year, \$836,000 control and monitoring grant in partnership with the Mississippi Department of Environmental Quality awarded through the Gulf Environmental Benefit Fund and the National Fish and Wildlife Foundation.⁷

Beach Vitex

Beach Vitex (*Vitex rotundifolia*) is a fast-growing vine native to the Pacific Rim that is showing up with increasing frequency in Mississippi. It was first brought to the United States in the 1990s as a plant to control dune erosion. This robust and hard to kill woody vine can grow to 60 feet long. Also

known as “Kudzu of the Coast” aggressive infestations engulf dunes hindering sea turtle and shorebird nesting.⁸ The first Mississippi beach vitex sighting was in 2015 on [Deer Island](#). This infestation was successfully eliminated by removing the vine and digging out its roots. Beach vitex was also found growing out of a rock jetty in [Gulfport](#). This infestation is currently under treatment. A report of beach vitex on [Cat Island](#) is being investigated.

Lionfish

Indo Pacific lionfish (*Pterois sp.*) are voracious marine super predators with venomous spines. These popular aquarium fish have caused declines in native reef fish populations of 80% following a single lionfish introduction. Females release up to two million eggs per year. The eggs float freely with ocean current as they develop into hungry little lionfish ready to infest their new location.⁹ Lionfish were first discovered in Mississippi waters in 2012 after [gradual westward movement](#) from the Florida Gulf Coast. Lionfish have no natural predators in the Northern Gulf. Spearfishing is the only known way to remove them. Unfortunately, lionfish can live in deeper waters than recreational divers can reach. Control options are limited.



Asian Tiger Shrimp

Asian tiger shrimp (*Penaeus monodon*) are the world’s most aquacultured shrimp species because of their large size and fast growth. They can reach almost a pound in weight, which seems wonderful, but they are also aggressive predators that could harbor exotic diseases detrimental to

Mississippi’s shrimping industry. These crustaceans are easily identified by their large size and the distinctive dark and light “tiger” striping. Asian tiger shrimp were first reported in Mississippi waters in 2009. The exact source of these shrimp is unknown, but they are thought to have escaped from aquaculture in Central or South America.¹⁰ After a decade of residence in the Mississippi Sound, their reported numbers remain very low and tiger shrimp have not been a significant part of the overall wild shrimp harvest to date. In order to keep an eye on this ongoing situation, MDMR continues to monitor for the presence of Asian tiger shrimp, encourage fishermen to report sightings, and to post all confirmed sightings to the [Nonindigenous Aquatic Species Database](#).

Future Threats: Silver Carp

Silver Carp (*Hypophthalmichthys molitrix*) are native to Asia. Silver carp were first imported into the United States to help manage water quality in ponds. They are plankton feeders that effectively strip the base of the food chain with adverse effects to both game and non-game fish. When startled, these big silver fish leap out of the water, jumping up to ten feet into the air. Many boaters have been seriously injured, and waterskiing is considered hazardous in silver carp infested areas as the fish jump in the boat’s wake.¹¹

These fast-growing, fast-reproducing fish can weigh up to 80 pounds, reaching nearly 12 pounds in their first year. In one study of an infested lake, silver carp made up 42% of the total biomass. In Mississippi they are found in the Tennessee-Tombigbee, Pearl River, Yazoo River, and the Mississippi River. Two large adult fish have been reported in South Mississippi, but so far, no evidence of a reproducing population has been detected in coastal waters.¹² MDMR regularly performs fish sampling in the waters of Coastal Mississippi to monitor native fish populations as well as for the presence of exotic fish like silver carp.

Hydrilla

Hydrilla (*Hydrilla verticillata*) [exists in nearby areas](#) but has not been found in South Mississippi’s natural waterways, yet. Imported from India in the 1950s as an aquarium plant, this rooted submerged noxious weed forms dense accumulations up to 25 feet deep and is considered one of the world’s most invasive weeds. This plant can crowd out


native plant species, reduce the habitat available to fish and interfere with navigation. Hydrilla spreads by plant fragmentation and by its root bulbs. The most common method of spread is by boats.¹³ MDMR's AIS program actively monitors boat ramps and other high-risk areas for early detection and rapid response to any outbreaks of hydrilla.



Credit: David J. Moorhead,
University of Georgia, Bugwood.org

You can help

Everyone can help in the fight against aquatic invasive species. A great way to start is by learning how to identify these harmful invaders. A link to a downloadable invasive species poster can be found on the [MDMR website](#). Another important way is not releasing or dumping aquarium pets or plants outside. Instead, they must be put in sealed plastic bags and put in the trash. The two most problematic invasive species in South Mississippi, giant salvinia and giant applesnail, were likely the result of careless mistakes. To help stop the spread of AIS by watercraft, before leaving the water's access, boaters should clean their boat, trailer, and gear of all plant or animal life, and drain the bilge, livewell, and other water-holding areas. Boaters should let the craft dry before entering another body of water.¹⁴

If you find an aquatic invasive species in South Mississippi, please report it by email with a picture and description of the location to MDMR (report.invasive@dmr.ms.gov) or by phone at (228) 374-5000. If wishing to report an invasive species in some other area, please contact your local fish and game or environmental quality agency. 

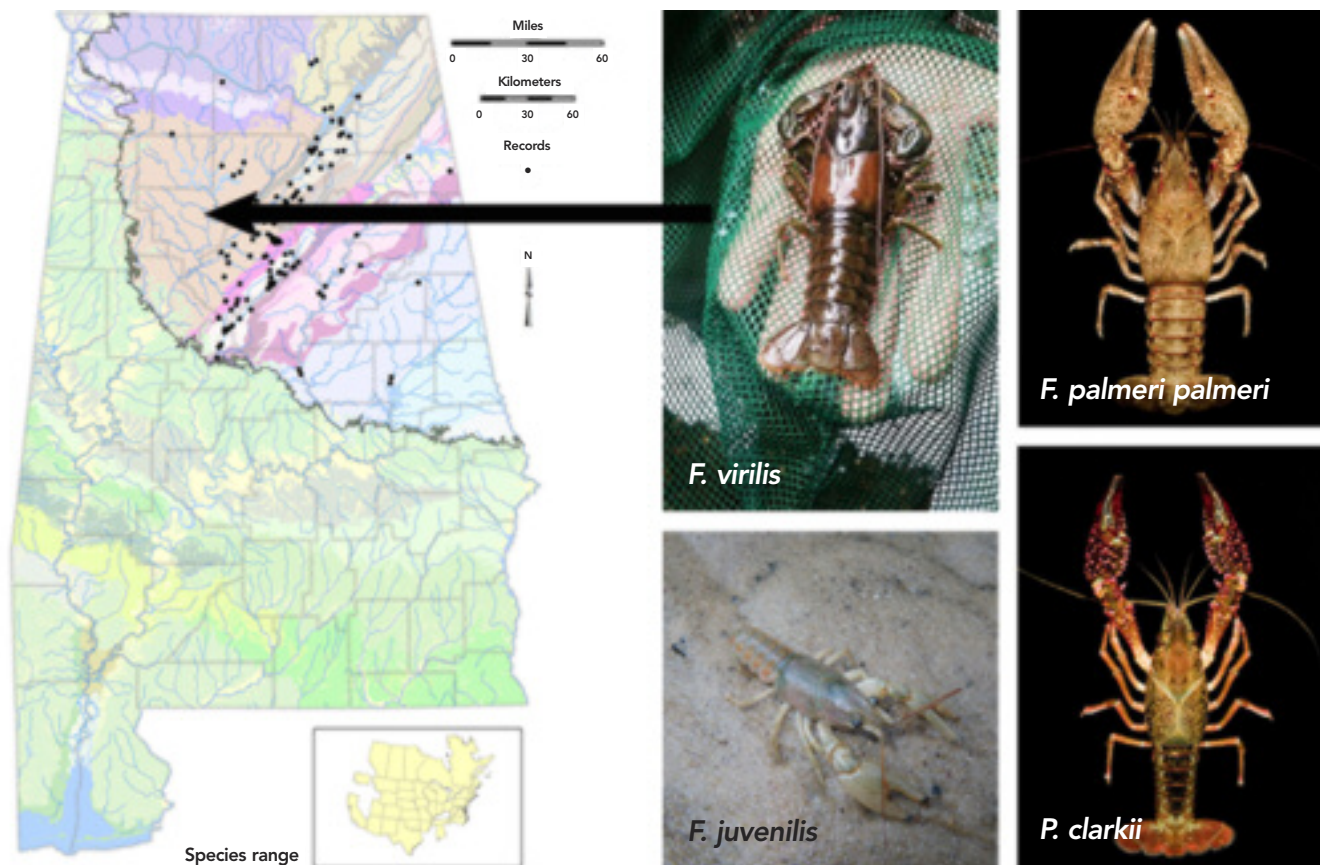
Mike Pursley is the Coastal Preserves Invasive Species Program Manager for the Mississippi Department of Marine Resources. He also serves on the Gulf and South Atlantic Regional Panel on Aquatic Invasive Species and as the Coordinator for the Mississippi Aquatic Invasive Species Council.

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3. U.S. Fish and Wildlife Service, *Fish and Aquatic Conservation, Aquatic Invasive Species, Overview*.
4. John E. Havel, et al., *Aquatic Invasive Species: Challenges for the Future*, Hydrobiologia, 750(1), 147-170 (Jan. 2015).
5. Nikki Rowell, *PRV/WSO Continues to Battle Invasive Plant*, Northside Sun (Dec. 6, 2019) (noting that the Pearl River Valley Water Supply District spent more than \$250,000 in 2019 in salvinia control).
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An Overview of Native and Invasive Crayfish in Mississippi and Alabama

Susan B. Adams



Photos by SB Adams, except *F. virilis* photo by ZC Barnett (USFS).
Map credit: Schuster et al., In press.

Mississippi has approximately 63 crayfish species and no known invasive crayfish. Whereas Alabama has about 97 species, including at least three non-natives: the Kentucky River crayfish (*Faxonius juvenilis*), the gray-speckled crayfish (*F. palmeri palmeri*), and the virile crayfish (*F. virilis*). In addition, the red swamp crayfish (*Procambarus clarkii*) is probably native on Alabama's Gulf Coastal Plain but introduced elsewhere in the state.

Often the source of an introduction is unknown, but documented pathways of crayfish introductions include escapes or intentional releases from fishing bait, aquaculture, food trade, and biology classrooms. Some biologists also suspect introductions have occurred by crayfish "hitchhiking" during fish stocking.

The virile crayfish was the first known non-native crayfish in Alabama (Guenter A. Schuster et al., Crayfishes of Alabama Univ. of Ala. Press (forthcoming)) and is now widely established above the Fall Line (see map: black dots indicate virile crayfish recorded sightings). The species becomes quite large in some locations and appears to negatively affect some native crayfish species, although little research has been done on the ecological effects of any of these invasives in Alabama. 🦞

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Addressing Invasive Species Concerns within a Municipal Policy Framework

Stephen Deal

Environmental resilience at the local level begins with good stewardship. The term stewardship is defined simply as the “careful and responsible management of something entrusted to one’s care.”¹ Cities and towns cannot maintain a high level of respect and appreciation for the environment if they do not first promote the proper conservation of land under their direct supervision and care. Although cities are primarily perceived as engines of economic wealth and opportunity, many cities also serve as primary landholders by creating parks and recreation facilities for local citizens to enjoy. As a major landholder, a city has a responsibility to steward those resources in a way that best benefits the public while also maintaining the integrity of the natural environment.

One critical, but easily overlooked, aspect of good natural stewardship is invasive species management. An ecosystem cannot be considered healthy or functional if it is overrun by an invasive species. If left unchecked, an invasive species can destroy the delicate balance within an ecosystem and undermine the capacity of a natural system to buffer itself from other natural stressors such as drought or temperature change. So while invasive species may not be a core concern for city policymakers, good stewardship necessitates that cities develop basic strategies to curb the presence of invasive species in order to maintain a high level of environmental performance within the public spaces managed by city governments.

Invasive Species in Park Management

As the urban footprint continues to expand into sensitive natural areas, many cities have embraced a more active role in land conservation by opting to acquire additional parkland. For example, the largest city park in America, South Mountain Preserve in Phoenix, totals 16,094 acres, which would rival many state parks in its scope and scale.² Also, a 2011 survey conducted by the Trust for Public

Land determined that America’s 100 largest cities manage more than 1.5 million acres of land in total. Such numbers show that municipal governments are key stakeholders in developing better stewardship practices. A key factor in developing better stewardship practices is the removal of invasive species. Estimates from the U.S. Fish and Wildlife indicate that invasive species cost the United States more than \$120 billion in damages each year.³

Realizing the important role cities have in local conservation, in March 2019 the Natural Areas Conservancy, of New York City, conducted a survey of urban forest managers to determine what the primary areas of concern were in their day-to-day decision-making.⁴ One of the biggest areas of concern cited by urban forest managers was invasive species. Conservation of native species ranked as the top factor in urban forestry decision-making as 61% of respondents said that it was one of the top three factors they consider. Conversely many of the management techniques used within urban parks and forests were devoted to the removal of invasive species or planting and encouraging the growth of native species. Of forest managers surveyed, 66% said that they engaged in invasive understory species removal on an annual basis and it ranked as the most frequently used practice in municipal park management. 50% of survey respondents also noted that they engaged in invasive tree removal on an annual basis.

One basic strategy city governments can engage in is developing basic guidelines for invasive species management in city parklands. One city that has done this is Madison, Wisconsin, which posts their invasive species management techniques to the city parks website.⁵ In Alabama, the City of Auburn’s Urban Forestry program maintains an invasive species removal webpage, which lists plant species of concern in the city and notifies residents of city projects that prevent the spread of non-native plants.

Visitors to the webpage can also learn about how to volunteer for invasive species removal and can visit other websites such as Alabama Cooperative Extension to learn more about invasive species affecting the region.

Regulatory Oversight to Address Invasive Species

In addition to managing public parks, cities also employ development regulations that govern the natural appearance of private developments and the public realm. A number of cities have developed new landscape regulations and oversight to curb the spread of invasive plants. One notable example of this is the City of Fayetteville, Arkansas. In 2015 Fayetteville passed a city ordinance that established a list of 18 invasive plants that could not be used in new construction and development.⁶ The city's website identifies the 18 invasive plants in question and recommends appropriate plant selections for trees, shrubs or ground cover. In Alabama, the City of Orange Beach modified its beach and dune preservation ordinance to discourage invasive plants species within the protected dune area. Orange Beach prohibits the installation of any vegetation in the primary dune system with the exception of a few plant species explicitly mentioned within the ordinance.⁷ These actions ensure that critical coastal habitats remain ecologically sound and viable.

One interesting regulatory approach that local governments have employed to tackle aquatic invasive species is developing an Aquatic Invasive Species (AIS) Prevention Plan. This type of planning initiative has been spearheaded by state and local government agencies in Minnesota where there are 692 waterways that are infested by at least one invasive species.⁸ In response to this policy dilemma, the 2014 Minnesota legislature set aside \$10 million for counties to spend to combat invasive species and another \$4 million is available through the nonprofit Initiative Foundation. In light of this new legislative initiative, local government officials in St. Louis County partnered with Minnesota Sea Grant to develop a plan to regulate and manage aquatic invasives. The plan is twofold: first, it will define actions that may be employed to prevent the spread of invasive species and second, it will guide the prevention response developed by St. Louis County for aquatic invasives.⁹ The 45-page plan is structured around seven broad action items.¹⁰ These seven action items serve as the backbone of a comprehensive action table which lists all the local projects and policy actions the county will pursue with regards to aquatic invasives.

In addition to the action table and list, the plan also has comprehensive descriptions of the 23 different aquatic invasive species found in the county.

Since the passage of the plan, the county has developed a multi-pronged approach of adaptation projects, research, and educational outreach. In 2017 St. Louis County awarded funds to an invasive species research project to determine what boat gear is most likely to spread the spiny water flea, an invasive species found in 24 lakes in St. Louis County.¹¹

Invasive Species Management in Aquatic Environments

The problems associated with invasive species though are not simply confined to terrestrial habitats; marine environments can easily be disrupted by the presence of invasive species as well. In some respects invasive marine species may be more problematic than those found on land as there aren't as many barriers to disrupt the movement of marine organisms across different aquatic ecosystems.

Consider the case of the lionfish, which has become a major problem in the Gulf of Mexico. Originally native to the Indo-Pacific Oceans, the lionfish is a popular species with saltwater aquarium owners due to its striking appearance.¹² However, when a number of lionfish escaped their artificial confines and entered the Gulf of Mexico it didn't take long for lionfish to establish itself at the expense of other species. Lionfish eat "a belly full of baby sport fish and lobster" in just a few minutes, making it a threat to the livelihood of charter boat captains and shrimpers.¹³ Thankfully a number of organizations have developed novel and creative ideas aimed at containing the spread of lionfish.

Orange Beach has hosted numerous tournaments and awareness events aimed at reducing the impact of the lionfish. In 2019 the Coastal Conservation Association of Alabama and the Poarch Band of Creek Indians sponsored two lionfish spearfishing tournaments and each provided prizes of \$10,000 to be awarded based on pounds of fish. The biggest haul was 279 pounds.¹⁴

In the case of lionfish there is one additional weapon people can deploy to stop the spread of this species and that is their stomach. Lionfish are edible and safe for human consumption, which is why the Alabama Seafood Marketing Commission has marketed the fish for table fare. Chefs in Orange Beach created a group to focus on edible, but underutilized, flora and fauna within the Gulf fishery.¹⁵ The group, Nuisance, Underutilized, Invasive, Sustainable,

Available, through Noble Culinary Endeavors (NUISANCE) hopes to expand the Gulf seafood palette to include edible invasives such as lionfish.

Conclusion

The difficulty with invasive species is that it is a multifaceted problem requiring many different stakeholders and management techniques. Different invasive species often require different approaches to removal or containment, so it is important that cities develop a set of strategies that are appropriately tailored to the different invasive species encountered within a given area. Conversely cities must also develop ordinances that prevent the further spread of invasive species and discourage the introduction of exotic flora and fauna that may become invasive in the future. By incorporating these strategies into local planning procedures and the development review process, cities can not only curb the negative spillover effects associated with invasive species they can also become better stewards of the natural assets they preside over. 🐟

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IN SUM.

A Summation of the Facts and Figures of Interest in this Edition

★	Number of native species expected to be destroyed by zebra mussels:	140
★	Amount of grant to control giant applesnails in the Pascagoula River Marsh:	\$836,000
★	Number of eggs from a mature lionfish annually:	2,000,000
★	Pounds of lionfish caught by winner of 2019 Orange Beach lionfish derby:	279
★	Number of days for giant salvinia to double its mass:	4



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To subscribe to **WATER LOG** free of charge, go to <http://masglp.olemiss.edu/subscribe>. For all other inquiries, contact us by mail at Mississippi-Alabama Sea Grant Legal Program, 258 Kinard Hall, Wing E, P. O. Box 1848, University, MS, 38677-1848, by phone: (662) 915-7697, or by e-mail at: bdbarne1@olemiss.edu. We welcome suggestions for topics you would like to see covered in **WATER LOG**.

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