

Invasive Species of Florida's Coastal Waters: The Red Lionfish (*Pterois volitans*) and Devil Firefish (*P. miles*)¹

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Two species of Indo-Pacific lionfish (*Pterois volitans* and *P. miles*) are the first reported non-native marine fish to become established in the Atlantic Ocean. Genetic studies indicate that lionfish in the Atlantic are likely all descendants of a few individuals, consistent with the widely held belief that lionfish were introduced into the Atlantic as a result of accidental or deliberate release of aquarium pets. Regardless of the method of introduction, the prolific spread of these invasive species in the Atlantic Ocean ecosystem is cause for concern.

Distribution

Currently in the United States, the lionfish is almost continuously distributed in marine waters from the northern Gulf of Mexico to Cape Hatteras, North Carolina. Although the US Geological Survey aquatic invasive species database lists isolated reports of lionfish (*Pterois* spp.) from waters off southeastern Florida in the mid-1980s and early 1990s, these species have since established breeding populations from Florida to North Carolina. Less is known about reproduction of lionfish in the Gulf of Mexico. Lionfish were first reported from the Florida Keys in 2009 and in the northern and eastern Gulf of Mexico in late 2010. Lionfish have been reported from the northeastern United States but do not survive the cold winters in those waters.



Figure 1. The red lionfish (*Pterois volitans*) is spectacular looking but has rapidly invaded marine waters in the Caribbean, off the southeastern United States, and in the Gulf of Mexico. These specimens were collected near Fort Pierce, Florida. Credits: Jeffrey Hill, UF/IFAS Extension

Lionfish expanded eastward to Bermuda (2004), the Bahamas (2005), the Turks and Caicos (2008), and the Cayman Islands (2009). By 2012, they had spread throughout the Greater Caribbean region. Found in several locations on the Atlantic coasts of Venezuela, Colombia, Honduras, Costa Rica, Nicaragua, Belize, Panama, Mexico, and Brazil beginning in December 2008, lionfish quickly adapted to the diverse habitat types of the western Atlantic Ocean.

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Figure 2. Reported lionfish sightings.

Credits: US Geological Survey website, <http://nas2.er.usgs.gov/viewer/omap.aspx?SpeciesID=963>. US Geological Survey. [2013]. Nonindigenous Aquatic Species Database. Gainesville, Florida. Accessed 05/07/2020.

Biology

Lionfish species are members of the scorpionfish family. Approximately 93 percent of lionfish off the eastern United States are *Pterois volitans*, while 7 percent are *P. miles*. Genetic analyses indicate that all lionfish tested from the Bahamas and Gulf of Mexico are *P. volitans*.

Lionfish have venomous spines on their dorsal, pelvic, and anal fins. When these spines penetrate an object, the sheath covering the spine rips, releasing the venom into the wound. The effects of lionfish venom on humans have been well-documented, largely because of the popularity of these fish in the aquarium trade. Aquarium owners are sometimes stung while performing maintenance on their fish tanks containing lionfish. Lionfish stings produce immediate pain, which peaks at 60–90 minutes, but may last for 6–12 hours. Other symptoms of a lionfish sting can include ulceration of the wound site, headaches, nausea, or diarrhea. Initial treatment of the wound involves immersing it in non-scalding hot water. Unlike many types of fish, lionfish do not avoid humans, so swimmers and divers need to take care to avoid lionfish in areas where they are present. While lionfish will not attack divers, they usually do not move out of the way as people approach, so swimmers and divers may accidentally brush against the venomous spines.

Although lionfish have been reported to reach a maximum of 15 inches in native waters, lionfish larger than 15 inches have been caught throughout the Gulf of Mexico, Caribbean, and the southeastern United States. [The largest verified lionfish caught in the Atlantic are more than 18 inches long](#) (myfwc.com 2015).

Lionfish in the Atlantic spawn year-round. They may release eggs as frequently as every four days. They become sexually mature at a small size. Male fish as small as 4 inches (100 mm) may be mature, while females mature at about 7 inches (180 mm). A female lionfish may release over two million eggs in a single year. Eggs are released as

gelatinous floating egg masses, which may increase their early survival rates. Preliminary data suggest that lionfish larvae may settle after approximately 26 days.

Habitat

From Miami to North Carolina, lionfish are generally found at depths of 100 to 330 feet (30–100 meters). While juvenile lionfish may be found in shallow, nearshore habitats, adult fish tend to be at deeper reef sites. In the Florida Keys and throughout the Caribbean, lionfish have been found in water as shallow as 3 feet (1 meter). In August 2010, a private submarine diving off the Bahamas filmed a lionfish in 1000 feet of water. In the Caribbean, lionfish have been found in a variety of habitats, including seagrass beds, mangroves, patch reefs, and deep reefs. Despite research showing that lionfish can tolerate low salinities for extended periods of time (fish kept in 7 parts per thousand salinity for 28 days showed no ill-effects), there have only been limited reports of lionfish in low-salinity environments. Those reports are from a salt-wedge estuary, where fresh water tends to float on top of the seawater in a layer that gradually thins as it moves seaward, so the lionfish could easily retreat down into higher-salinity water.

Lionfish are able to tolerate water temperatures as low as 50°F (10°C), which probably allows them to survive winters along the southeastern US continental shelf south of Cape Hatteras. They have been found in waters off the northeastern United States. It is believed that larvae are transported to this area by the Gulf Stream, but cannot survive the winter temperatures there.

Impacts

In the wake of their rapid and successful establishment in coastal waters of the southeast United States and greater Caribbean region, there is concern that lionfish compete with and eat ecologically and commercially important native fish. Researchers found that when lionfish were introduced to Bahamian patch reefs, recruitment of native fish was reduced by almost 80 percent over five weeks when compared to similar reefs without lionfish.

While smaller lionfish prey more on shrimp and other small crustaceans, stomach content analysis indicates that larger lionfish diets in the Bahamas are comprised largely of bony fishes (78 percent by volume) and crustaceans. Lionfish also have larger impacts on native fishes than some similarly sized native predators such as small groupers. Capable of consuming prey that are almost half their size, lionfish are targeting gobies, basslets, wrasses,

and blennies—all common prey items for commercially important species such as groupers and snappers.

The explosive nature of the lionfish invasion in the Atlantic Ocean means that environmental, economic, and social impacts of this invasion have largely not been measured, so there is great concern about potential negative impacts. Many natural resource management agencies in the region have been prompted to move forward with management actions and discussion of management alternatives.

In 2017, [an ulcerative skin disease was reported on lionfish from the northern Gulf of Mexico](#). At this time, little is known about the cause or impact of this disease.

In 2013, the Florida Fish and Wildlife Conservation Commission instated a rule which waives the bag limit for lionfish as well as the requirement to have a recreational fishing permit when catching lionfish (as long as lionfish-specific harvesting gear are used). The Florida Keys National Marine Sanctuary has issued special permits which allow the removal of lionfish from “no harvest” zones within the Sanctuary. In 2015, the Invasive Lionfish Control Ad-Hoc Committee of the Aquatic Nuisance Species Task Force finalized a lionfish management plan for US waters.

Why are lionfish so successful?

Lionfish are presently more successful in their introduced range of the tropical western Atlantic than they are in their native range. In fact, some researchers have reported densities of over 390 lionfish per hectare in the Bahamas. (A hectare covers an area 100 m x 100 m and equals 2.47 acres.) This is more than eight times higher than densities reported from the lionfish's native range in the Red Sea. More common densities in the Atlantic are 5–21 lionfish per hectare. It is likely that lionfish are so abundant because the environment is suitable, food is abundant, and reproduction is highly successful. Additionally, natural enemies have limited, if any, impact on the abundance of lionfish.

Lionfish have an unusual feeding behavior that appears to confuse many native Atlantic species and allows for efficient capture of small fishes. As they slowly approach their prey, lionfish produce a jet of water that is directed towards the smaller fish. This causes the fish to turn toward the predator, into the direction of the water flow, which may make it easier for the lionfish to swallow it.

Frequent production of large numbers of eggs provides numerous juveniles able to settle into a variety of habitats over a wide geographic range. While there is an instance

of predation on lionfish in the Indo-Pacific region by a cornetfish, few Atlantic fish seem willing to feed on lionfish. Apart from a few reports of groupers that were found to have lionfish in their stomachs, it seems that many predatory fish avoid lionfish. It may be that native predators, though capable of eating lionfish, do not recognize them as prey. Reports from divers indicate that sharks, groupers, and moray eels may take and eventually learn to steal lionfish from divers in popular spear-fishing locations. Feeding speared lionfish to native fish is not recommended because it could be dangerous for the divers. Unfortunately, large groupers and other potential predators of lionfish are over-fished, resulting in low abundance in many regions.

Non-native species with novel traits such as new and unusual behavior, appearance, size, or other attributes often do well in their introduced range and may cause negative impacts. Overall, lionfish are novel in many ways compared to native Atlantic species. From the venomous spines and their showy fins to their unusual behavior, lionfish are like no other fish in the western Atlantic. All these factors contribute to their success.

What can you do?

People are asked to report lionfish that have lesions on the Florida Fish and Wildlife Conservation Commission's fish disease and fish kill hotline (MyFWC.com/fishkill).

Efforts to control lionfish have had mixed results at best. The prevailing strategy in shallow-water areas in the Caribbean and Florida Keys is to try to prevent infestation by early detection and rapid removal of lionfish using teams of trained divers. The Reef Environmental Education Foundation, or REEF, has been actively working in the Caribbean and Florida Keys for the past several years to train divers to identify and safely catch and handle lionfish. To date, the best method for capturing lionfish has been found to be by divers using spears or nets with plastic sides. In partnership with local governments, REEF sponsors [lionfish rodeos](#) (MyFWC.com), which can result in the capture of over 1000 lionfish in a single day. Lionfish are being marketed as a food fish in several locations. People who plan to eat lionfish from some areas of the Caribbean should be aware that, like many other top predatory reef fish, lionfish can accumulate ciguatera toxin, which can cause ciguatera poisoning. Local fisheries officials should be able to advise about the safety of consuming lionfish or other reef predators such as grouper, snapper, and barracuda from particular locations.

Lobsterers in Bermuda and the Florida Keys often find lionfish in their traps. Studies are underway to see if

trapping might be an effective method for capturing lionfish (NOAA.gov). Lionfish have occasionally been caught by anglers using live shrimp as bait. However, no studies have been published that investigate the use of different bait types to catch lionfish with hook-and-line. In aquaria, lionfish will initially only feed on live prey. They can be converted to frozen or dead food, but this can take some time and effort. This aversion to eating dead prey will likely present a challenge if trying to develop a hook-and-line fishery for lionfish.

Preliminary research into the effectiveness of diver removal efforts indicates that eradication is not possible. Modeling studies suggest that a high proportion of the adult lionfish, anywhere from 27% to 65%, must be removed each year to cause a meaningful decline in lionfish abundance. A continual effort is needed to maintain low lionfish abundance. In addition to reducing local abundance, targeted removal efforts can result in the removal of the larger lionfish, further reducing predation impacts on native fish. Removals are likely most effective when targeted to protect highly vulnerable areas such as marine reserves.

Additional Information Sources

Gulf and Caribbean Fisheries Institute. 2012. *Invasive Lionfish: A Guide to Control and Management*. http://lionfish.gcfi.org/manual/InvasiveLionfishGuide_GCFI_SpecialPublicationSeries_Number1_2012.pdf (Accessed May 2020)

Invasive Lionfish Control Ad-Hoc Committee of the Aquatic Nuisance Species Task Force. *National Invasive Lionfish Prevention and Management Plan*. 2015. https://www.anstaskforce.gov/Documents/Lionfish_Plan-Final_Approved.pdf (Accessed May 2020)

NOAA <http://oceanservice.noaa.gov/education/stories/lionfish/welcome.html> (June 25, 2018)

US Geological Survey. "Nonindigenous Aquatic Species Database." <https://www.usgs.gov/centers/wetland-and-aquatic-research-center-war/science-topics/nonindigenous-aquatic-species> (Accessed May 2020)

References

MyFWC.com. 2015. "Florida Lionfish State Records." Accessed May 2020. <https://myfwc.com/fishing/saltwater/recreational/lionfish/records/>

MyFWC.com. 2017. "Lionfish Derby and Event Calendar." Accessed May 2020. <http://myfwc.com/fishing/saltwater/recreational/lionfish/events/>

NOAA.gov. nd. "Going Deep For Lionfish: Designs for Two New Traps for Capturing Lionfish in Deep Water." Accessed March 8, 2017. <https://sanctuaries.noaa.gov/science/conservation/lionfish-trap-guide.html>