Office of National Marine Sanctuaries
National Oceanic and Atmospheric Administration

Going Deep For Lionfish

Designs for Two New Traps for Capturing Lionfish in Deep Water

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Suggested Citation:
Gittings, S.R., A.Q. Fogg, S. Frank, J.V. Hart, A. Clark, B. Clark. S.E. Noakes, and R.L. Fortner. 2017. Going deep for lionfish: designs for two new traps for capturing lionfish in deep water. Marine Sanctuaries Conservation Series ONMS-17-05. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Office of National Marine Sanctuaries, Silver Spring, MD. 9 pp.

Cover Photo: A Dome Trap closing around a lionfish attracted to a fish aggregation device (Credit: Mitchell Tartt/NOAA).

About the Marine Sanctuaries Conservation Series

The Office of National Marine Sanctuaries, part of the National Oceanic and Atmospheric Administration, serves as the trustee for a system of underwater parks encompassing more than 600,000 square miles of ocean and Great Lakes waters. The 13 national marine sanctuaries and two marine national monuments within the National Marine Sanctuary System represent areas of America's ocean and Great Lakes environment that are of special national significance. Within their waters, giant humpback whales breed and calve their young, coral colonies flourish, and shipwrecks tell stories of our maritime history. Habitats include beautiful coral reefs, lush kelp forests, whale migration corridors, spectacular deep-sea canyons, and underwater archaeological sites. These special places also provide homes to thousands of unique or endangered species and are important to America's cultural heritage. Sites range in size from one square mile to almost 583,000 square miles and serve as natural classrooms, cherished recreational spots, and are home to valuable commercial industries.

Because of considerable differences in settings, resources, and threats, each marine sanctuary has a tailored management plan. Conservation, education, research, monitoring and enforcement programs vary accordingly. The integration of these programs is fundamental to marine protected area management. The Marine Sanctuaries Conservation Series reflects and supports this integration by providing a forum for publication and discussion of the complex issues currently facing the sanctuary system. Topics of published reports vary substantially and may include descriptions of educational programs, discussions on resource management issues, and results of scientific research and monitoring projects. The series facilitates integration of natural sciences, socioeconomic and cultural sciences, education, and policy development to accomplish the diverse needs of NOAA's resource protection mandate. All publications are available on the Office of National Marine Sanctuaries website (http://www.sanctuaries.noaa.gov).

Disclaimer

Report Availability

Electronic copies of this report may be downloaded from the Office of National Marine Sanctuaries website at http://sanctuaries.noaa.gov.

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Supply, Demand, and Control

Over the last three decades, lionfish populations have exploded throughout the western Atlantic, Caribbean Sea, and Gulf of Mexico. Their high abundances and gluttonous appetites threaten not only ecosystems like coral reefs, but also important nursery areas, and deep habitats hundreds of feet below diving depths. In some shallow water dive sites, spearfishing has proven an effective way to control populations. For those locations, sustained removals may limit the impacts these fish on the invaded ecosystems.

Numerous novel devices and approaches to harvest lionfish from water depths beyond recreational scuba limits have been considered, but none have yet proven successful. Developing an effective method to target lionfish from these and other remote locations is important. Recent studies have reported the negative effects of lionfish on important prey species of both recreationally and commercially important species in deep water. There may also be trap applications in some shallow water locations, like nurseries, where lionfish control would protect the juveniles of some valuable fished species, and other ecologically important species.

Figure 1. Photo of a 'solution' hole excavated by a Red Grouper at about 250 feet depth on the west Florida shelf. These locations are well beyond recreational scuba limits. (Photo: Coral Ecosystem Connectivity 2014 Expedition)

Coincidently, demand for lionfish in the seafood market has risen, and greatly exceeds supply. Currently, the majority of lionfish in the market come from divers and commercial trap and trawl fishermen capturing lionfish as bycatch.

The supply shortage has prompted several attempts to develop traps to capture lionfish in deep water. This document presents information on two lionfish-specific traps. These traps have structural components that provide vertical relief to attract lionfish, and low profile frames that remain open during deployment. Because lionfish are so docile, they are not easily agitated or flushed during retrieval when a curtain of net is pulled up to surround them. These two trap designs have several benefits over conventional fish traps:

- High attraction of lionfish
- Limited or no bycatch of non-targeted species
- No mortality resulting associated with containment during the soak period
- No bait required
- If trap is lost, will not "ghost fish" (continue to trap more fish after being lost)
- Traps are stackable, and therefore easily transportable on fishing vessels.

Trap Designs

Below are specifications for two traps that use fish aggregations devices (FADs) to concentrate lionfish, and "jaws" that close over the FADs upon retrieval, capturing the lionfish.

Dome Trap

A Dome Trap (Figure 2), named for its shape when closed, was tested off Pensacola, Florida. It has a stainless steel frame consisting of a circular base (Figure 3), six feet in diameter (shape and size could vary), and two hinged half hoops ("jaws") that pivot from a horizontal to vertical position on hinges (like picnic basket handles) to close when the trap is retrieved (Figure 5). The frame has two cross bars for strength.

The base is covered with polyethylene mesh and the net curtain is #420 knotless nylon netting (7/8 in. sq. mesh; Figure 5). A two-line harness is attached (one line to the apex of each jaw), and an inline float is secured at the apex of the harness. This ensures that the line does not become fouled within the trap during deployment and soak time.

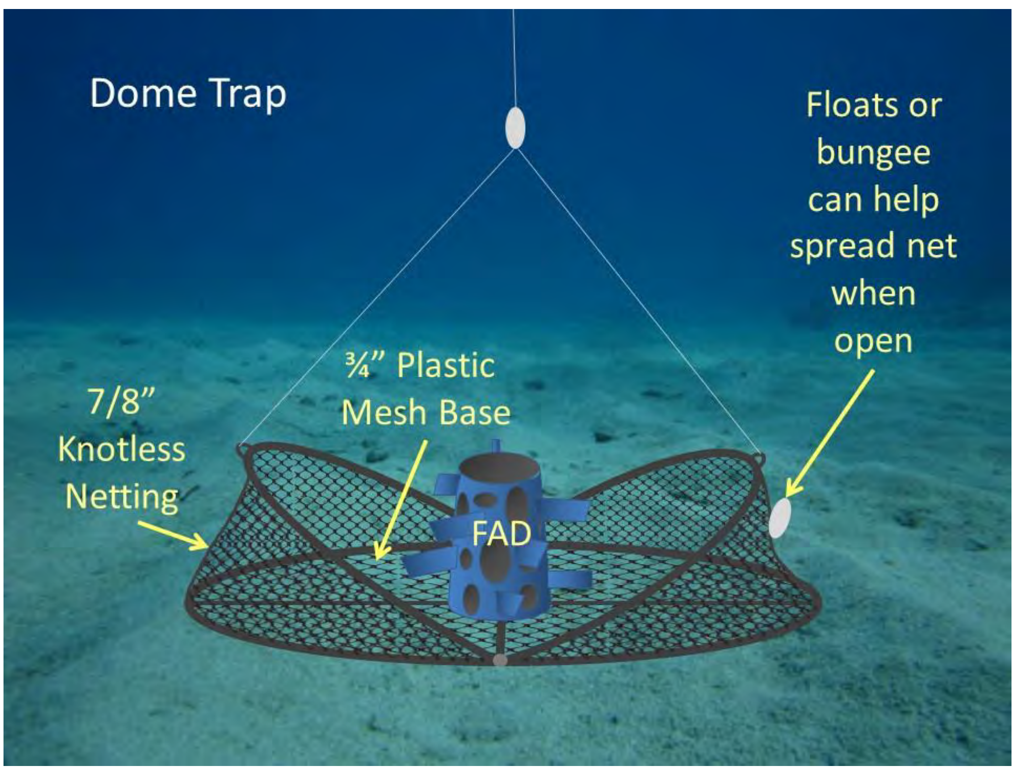

Figure 2. Diagram of partially closed Dome Trap. Small floats were attached to the net during initial tests to keep it away from the FAD when open. (Image: NOAA)

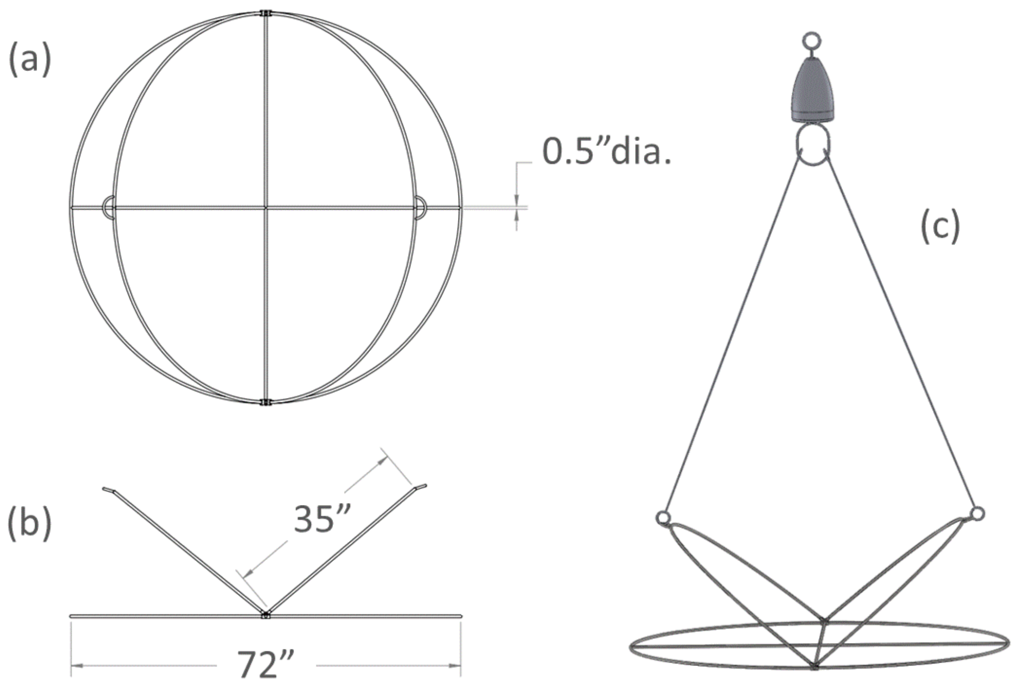

Figure 3. Shop drawings of Dome Trap. (a) top view of partially closed frame, showing one option for lift rings; (b) side view showing base (horizontal) and jaws (angled upward); (c) oblique view, showing another option for lift rings (as in Figure 4 below), and the two-line harness and float attached to the lift rings. (Image: Lewis Fortner, University of Georgia)

Figure 4. Configuration of dual hinge and spring pins holding jaws at end of central crossbar of trap frame. (Photo: Steve Gittings, NOAA)

The FAD used for initial testing consisted of two stacked and connected five-gallon buckets with sixteen 30-inch pieces of garden edging fed through slots cut at four levels in the buckets (Figure 5). A collapsible FAD (Figure 6) may be a better option and will be evaluated in future field operations. Two other collapsible FADs currently being evaluated include floating fabric attached to the frame and a coil of spring steel covered with perforated fabric to make it appear substantial while minimizing the effects of bottom currents.

Figure 5. Trap frame complete with FAD (connected to crossbars) and attached net. Total weight of this frame is approximately 40 pounds in air, and it descends at a rate of about 80 feet per minute. (Photo: Steve Gittings, NOAA)

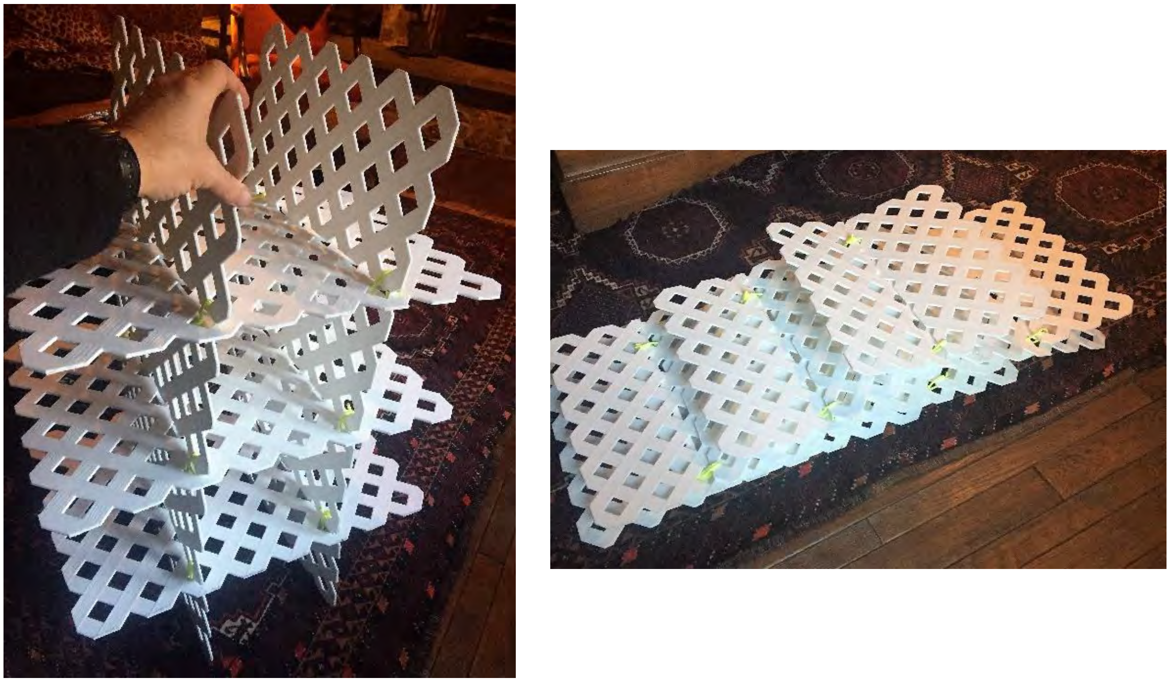

Figure 6. Option for a collapsible Fish Attraction Device (FAD) that could replace hard FAD and allow traps to be stacked on the deck of a fishing vessel. The height of the FAD must be less than the radius of the trap. It was made by slotting and interlocking sheets of vinyl lattice. One vertical sheet would be secured to the axial crossbar of the frame, the other to one of the perpendicular crossbars. The buoyancy of the FAD, about four pounds positive, forces it to open when deployed. (Photo: Steve Gittings, NOAA)

Users are encouraged to try different materials and configurations for frame construction, FADs, netting, and harness lines. Note, however, that certain materials and configurations may be either restricted or required by local regulations or authorities.

On this Dome Trap, one modification will be the addition of a latch to keep the jaws closed during ascent. This is necessary because lionfish gas bladders expand during ascent, causing the fish to become buoyant and potentially floating out if the jaws open even slightly.

Purse Trap

To reduce drag on descent and ascent, a new trap design is being developed that removes the hoop of the Dome Trap, leaving only hinged jaws. This Purse Trap (named because it looks like a change purse when closed) will travel vertically through the water. Deflectors (curved extensions) on the bottom of each jaw force the jaws to open when they hit the bottom. A collapsible FAD opens when the trap does (similar to a pop-up greeting card), and the jaws lay on the bottom in the open position. A two-line harness with float (similar to the Dome Trap) is used to retrieve the trap (a latch may also be needed on this trap to ensure that it stays closed during ascent). A loose net covers the frame, allowing it to billow slightly while closing, surrounding the lionfish within the frame without overcrowding them before closing completely.

This particular model has yet to be field-tested. Figure 7 shows the components of the trap frame, and Figure 8 shows a small mock-up built to test the deflectors and the collapsible FAD. The same net (7/8"knotless nylon netting) used on the Dome Trap could be used on this frame.

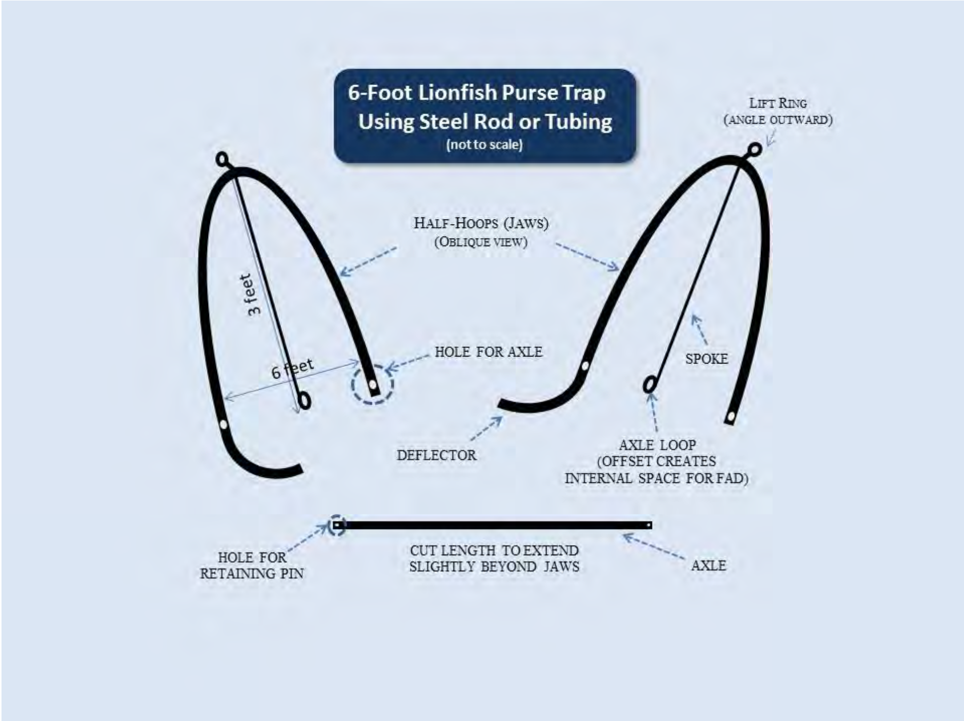

Figure 7. Oblique view of components of a 6-foot Purse Trap design for capturing lionfish. The jaws are two half-hoops, each with a curved extension on one end. The axle feeds through holes on the end of each hoop and the axle loop on the end of each spoke. When assembled, the curved extensions need to be outside the adjacent half-hoop. Lift rings angling away from each other allow the harness to force the jaws closed. (Image: NOAA)

Figure 8. Mock-up Purse Trap and collapsible FAD partially open (left) and fully open (right). Note that the mesh covering this frame is tighter than it should be on an operating trap. A looser net would reduce the likelihood that the closing jaws would agitate fish. (Photo: Steve Gittings, NOAA)

Soak Times

Optimal trap soak time will likely vary by location and the preferences of those fishing the traps. During field trials off Pensacola, Florida, attraction of lionfish occurred with one hour, but some fish remained just outside the perimeter of the trap for at least the first couple of days (Figure 9). The proportion of fish within the trap perimeter, and thus potentially catchable, increased with time, achieving nearly maximum levels (>75%) within about 18 days. More trials are needed, however, to refine estimates for optimal soak time, because no data were collected between 2-day and 18-day soak times during initial trials (see Figure 9).

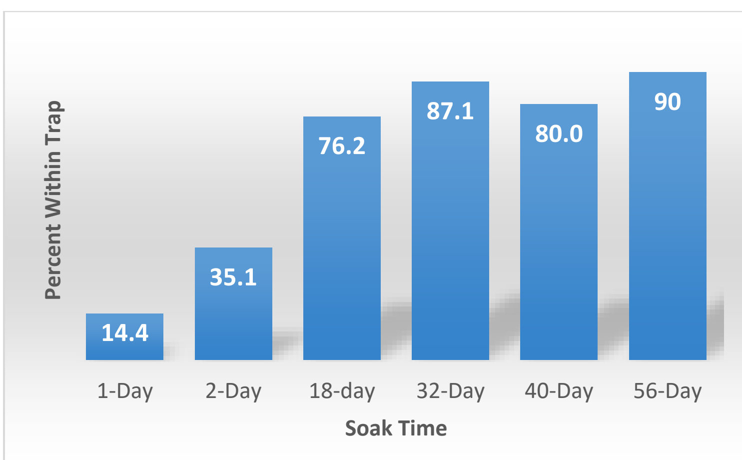

Figure 9. Plot showing an increasing concentration of lionfish in traps with longer soak times. Note, however, the lack of data for soak times between two and 18 days. (Image: NOAA)

Learning Together

Photo: Steve Gittings, NOAA

The designs and ideas presented here are available to anyone interested in building and using lionfish-specific traps. This guide provides a starting point for interested parties to further develop and improve these traps. Changes in trap construction materials, shape, size, mesh choice, opening and closing mechanisms, and FADs are all likely, and can be made without changing the basic operating principles that result in the benefits described here. The guide is not intended to provide instruction on fishing for lionfish. The fishing community will determine the best techniques and times for deployment and retrieval, optimal soak times, the range of acceptable operating conditions, and other matters related to fishing practices.

In addition to the need for further trap testing and improvements, there are other challenges to their use. For example, fish traps are currently prohibited and would require permits in U.S. federal waters of the Gulf of Mexico and South Atlantic and in some other areas. Changing the restrictions will require the collaboration of fishermen, government officials and members of the scientific community to minimize negative effects on ecosystems caused by the traps. The solutions found to regulatory restrictions may be transferrable in some cases, facilitating the use and spread of lionfish-specific traps, and stimulating growth of both control efforts and the fishery.

Transfer of information among users is the most effective way to develop traps that will be effective throughout the invaded range of lionfish. Whether related to improvements, fishing techniques, or regulatory solutions, social media can help communicate the knowledge gained quickly and effectively. **Therefore, groups or individuals testing or improving these lionfish-specific trap designs are asked to report their successes, failures, and lessons learned to** Lionfish University's Facebook page **or by email to** steve.gittings@noaa.gov. All information is valuable, and transparent communication will help us reach our mutual goal faster.

IMPORTANT:

PERSONS INTERESTED IN USING THESE TRAPS SHOULD ENSURE THEY HAVE THE REQUIRED PERMISSIONS AND PERMITS FROM RELEVANT AUTHORITIES. BE AWARE THAT TRAPS CAN DAMAGE BOTTOM HABITATS THROUGH CONTACT, AS WELL AS BY MOVEMENT, IF INADEQUATELY WEIGHTED OR SECURED. SUCH DAMAGE MAY BE PROHIBITED BY FEDERAL, STATE, OR LOCAL REGULATIONS.

To obtain authorizations for the use of these devices in federal waters of the U.S. Gulf of Mexico and South Atlantic, please contact:

NOAA Fisheries
Southeast Regional Office
Sustainable Fisheries Division
263 13th Ave., South
St. Petersburg, FL 33701
727-824-5305

For information about using these traps in U.S. state waters, please contact the respective state fishery management agency.

Acknowledgements

Below are the people who made the development of lionfish traps possible through vessel and field support, trap construction, advisory and technical support, fundraising, permitting, media, or by donating money to the project. Your work and generosity are very much appreciated.

Robin Bateman
Priscilla Bennet
Bryan and Anna Clark
Cayman Islands Department of the Environment
Coast Watch Alliance
Diane Hofbauer Davidson
Captain Gene Ferguson
Florida Fish and Wildlife Conservation Commission
Alex Fogg
Lewis Fortner
Stacy Frank
Charlie Gliwa, Norman's Lionfish
Jack Golbourn
Marsha Graubard
Jim Hart
Peter Hillenbrand
Phil Karp
Valerie Letelier
James Liddle
Lionfish University
Anthony Lombardy
Patsy Massey
Captain Ty McCall
Clare McEachin
Marcus Minges
James Morris
Jeremy Morrison
David Mucci
Keith Neale
Rick Neuman
James Newman
NOAA National Marine Fisheries Service, Southeast Regional Office
NOAA Office of National Marine Sanctuaries
Scott Noakes
OceanGate
Nicholai Pinniakov
Tony Reyer
Stuart Rosenthal
Stockton Rush
Natasha Seery
Allie Sifrit
Brad Tamm
Mitchell Tartt
Randy Terrell
Chris Thomas
Robert Turpin

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