Request for Exempted Fishing Permit:

Strengthening the Supply Chain for Lionfish to Promote Fishing and Protect Native Species

Date of Application:

October 26, 2021

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Thomas Matthew, Emily Hutchinson, Sam, Hagedorn
Florida Fish and Wildlife Conservation Commission, Marathon, FL

Request for Exempted Fishing Permit

The following outlines our request for an exempted fishing permit to exempt from 50 CFR 622.9(c) (use or possession of a fish trap) to conduct research and field-testing activities on board a research and commercial vessels within the United States Exclusive Economic Zone. This project will observe recruitment behavior and biology of invasive marine fish *Pterois volitans/miles* (collectively, "lionfish") on mesophotic reef systems in the Florida Keys National Marine Sanctuary. The requested exemption is for use of the non-containment trap (NC trap) designed by NOAA Office of National Marine Sanctuaries (ONMS) Chief Scientist Dr. Steve Gittings. NC traps will be used to harvest lionfish at depths beyond limits of open water SCUBA diving. We intend to use the same NC trap concept for which an LOA for research was granted to NOAA ONMS Dr. Gittings – LOA F/SER25:FH – on June 13, 2017, LOA F/SER24KO – on March 20, 2019, to University of Florida Holden Harris – LOA F/SER24:KO – March 26, 2018 (amended May 23, 2018), University of Florida Dr. Will Patterson – LOA F/SER24:KO – September 5, 2018, and to REEF Dr. Alli Candelmo – LOA F/SER24:KO – October 23, 2020 although a slightly different model will be used to reduce entanglement risks. The research will be conducted under the auspices of the Principal Investigator and partner's home institutions – namely Reef Environmental Education Foundation and Florida Fish and Wildlife Conservation Commission. Primary research funding is provided by the NOAA Saltonstall-Kennedy Program. The intent of this application is to permit Reef Environmental Education Foundation (REEF) to design and test modifications to a non-containment (NC) trap to make them more effective as a lionfish trap while also reducing bycatch. The intent is not only to use research vessels, but to also contract commercial vessels to test the use of these traps and for the commercial fishermen to be able to sell the catch harvested. The contracted commercial fishermen will be permitted to sell landed species that they have appropriate permits for and meet requirements for being legally harvestable. Commercial fishermen will not be allowed to sell any species harvested in the traps that are undersized or out of season per state or federal regulations. REEF requests this exemption for a time-period of 2 years with sampling occurring year-round. Only lionfish catch will be permitted for sale outside of lobster season. From 100 deployments of the NC trap in a study in Gulf of Mexico near natural reefs, the following species were captured as bycatch; stripped burrfish, *Chilomycterus schoepfi* (1), jacknife fish, *Equetus lanceolatus* (1), tattler bass, *Serranus phoebe* (1) therefore bycatch is expected to be minimal.

Scope of Research

Project Impact: Indo-Pacific lionfish (*Pterois volitans/miles*) are the first non-native marine fish to become established in the Atlantic. Lionfish pose a significant threat to Atlantic, Caribbean and Gulf of Mexico ecosystems due to widespread predation on native species, prolific reproduction and lack of controlling predators. Lionfish have been identified as one of the top 15 threats to global biodiversity (Sutherland et al. 2010) and evidence show that lionfish are causing dramatic declines in native marine life (Green et al. 2012). While current lionfish control efforts are proving successful in heavily dived locations (Morris 2012, Green et al. 2017), much of the invaded territory lies beyond the access of recreational divers.

Demand for invasive lionfish is not matched by supply. Because lionfish are currently targeted primarily by shallow-water spearfishing, supply is limited and inconsistent, preventing penetration into the seafood market and secondary supply chains (e.g. lionfish jewelry market). Deepwater lionfish populations, however, are documented in higher densities (Reed et al. 2015), are under-exploited, and are negatively impacting communities and fisheries (Ballew et al. 2016). Deepwater populations of lionfish are shown to be disruptive to the mesophotic food web processes (Lesser and Slattery 2011), are comprised of larger more reproductively capable individuals (Andradi-Brown et al. 2017) and provide a population source for shallow reefs (Johnston and Purkis 2015); therefore undermining current control efforts (Andradi-Brown et al. 2017a, b). Currently lionfish in mesophotic reefs are primarily removed as bycatch in local fisheries; hook and line (Akins 2012), bycatch in lobster traps (Morris and Whitfield 2009, Akins et al. 2012), and commercial shrimping (Switzer et al. 2015) at catch rates too low to exert control over deepwater populations (Arias-González et al. 2011).

Lionfish specific traps are being developed to help meet market demand through the targeted capture of lionfish in water beyond recreational scuba diving depths. Over the past several years, design and testing of innovative, lionfish traps that are baitless and use a Fish Attracting Device (FAD) instead has yielded encouraging results. The traps have been tested and/or observed by several research and volunteer organizations, with consultation from Dr. Steve Gittings (NOAA), who designed the non-containment (NC) trap that is to be the central focus of this project. The completion of a 2018 Programmatic Environmental Assessment for lionfish trap testing in the Gulf of Mexico revealed the potential for the trap design to remove lionfish from high density source reefs with minimal bycatch compared to other traps (lobster traps and fish pots) (Ahrens et al. 2019, Harris et al. 2020, NOAA 2018). The proposed project would allow for the finalization of trap design modifications, assessment of lionfish capture and reductions in on source populations and field observations of lionfish traps with commercial trap fishermen in South Florida.

This work specifically seeks to test the efficacy of these traps in the Florida Keys National Marine Sanctuary which will support Objective 4.2 of the National Marine Sanctuary strategic plan to "develop and implement plans to control invasive species in sanctuaries" (Johnston et al. 2015). The development of technologies to remove invasive lionfish will result in numerous returns locally (Florida) and regionally. Not only do reef fish fisheries contribute a large percentage of state fishery landings and associated revenue from both recreational and commercial fisheries, but non-extractive reef activities, such as ecotourism and diving, also contribute greatly to Florida's economy. Results of this work will provide decision makers with much needed information pertaining to strategies for minimizing the lionfish threat. In addition to creating new economic opportunities for fishing communities, widespread trap use may significantly reduce the impacts of lionfish on native deep-water fish and invertebrate communities, including those of commercial interest.

Our goal is to conduct a study assessing the recruitment of lionfish to a non-containment trap (NC) in mesophotic habitats in the Florida Keys with the objective of providing important information to management agencies and lobster trap and other fishers. Included within the scope of the project, is strong collaboration with the professional fishing community to improve catch rates by using their knowledge and participation for successful NC trap deployment, retrieval, and site selection.

Project objectives:

(1) Test different designs and deployment strategies of the non-containment (NC) lionfish trap to eliminate risk of non-target species entanglement, increase success of deployment and ability to land on a target site. It is essential to engage professional fishers in developing gear for lionfish fishery. Commercial fishing may involve setting the traps individually or in trawls (lines of connected traps). The knowledge and participation of commercial spiny lobster trap fishermen will be used to determine appropriate weight, line and float configurations, as well as protocols for fishing the traps. Different NC trap designs and fishing techniques will be tested to compare deployment success (opens successfully and is near target), deployment speed and accuracy, and movement of traps post-deployment.

(2) Determine the efficacy of the NC trap to capture lionfish in mesophotic habitats off the Florida Keys by monitoring catch and implementing survey assessments. We will test the effectiveness of the final design of the NC trap as a function of catch per unit effort and habitat type and lionfish densities. Ultimately observing trap deployment and capture success with local commercial fishing experts and then allowing them to fish the traps to the best of their abilities, we will be able to determine the traps efficiency of targeting lionfish in deep waters. As a means of catch comparison and to facilitate deployment of the non-containment traps on lobster vessels some deployments will include permitted lobster traps as well as non-containment traps. All lobster traps will have current trap tags attached.

Statement of Work: We propose to test a non-containment trap (NC trap) for invasive lionfish based on a design developed and evolved by Dr. Steve Gittings (Gittings et al. 2017) (Figure 1). The NC trap design attempts to eliminate or minimize mortality of bycatch from containment and the potential for ghost fishing if the trap were to be lost (Gittings et al. 2016). Lionfish and other fishes can freely move in and out of the trap footprint during deployment, and fish are captured during trap retrieval. The FAD-based, non-containment trap design takes advantage of the natural tendency of lionfish to associate

near structure and manmade objects (Figure 1D). Our objectives are to test designs of the NC trap to assess: gear deployment speed and accuracy (near target site), success of opening, movement of traps post-deployment, and risk of bycatch, and (2) to test trap efficacy or its ability to be used to capture lionfish on commercial vessels in mesophotic habitats in relation to factors including habitat type, lionfish densities, soak-time and seasonality.

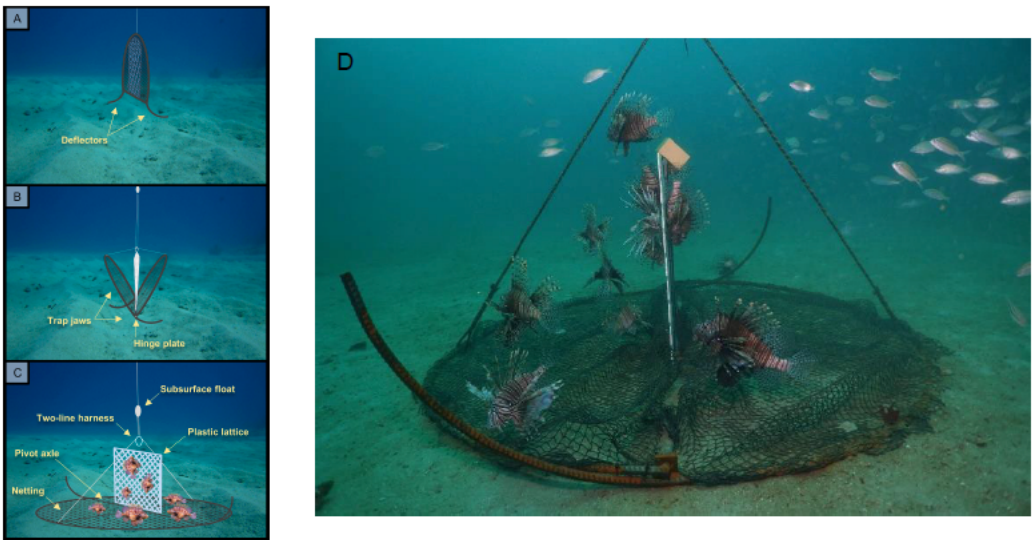


Figure 1. Traps are designed to A) descend closed and B) open when the curved deflectors contact the seafloor. C) The traps remain open during deployment then close when the trap is ascended during retrieval (Harris et al. 2020). D) An NC trap deployed at 35 m near Destin, FL attracting many lionfish (photo credit Alex Fogg). It is similar to the design we plan to use for this project, but the harness will be configured through an eye in the FAD and the rebar will be smaller gauge and modifications will be made to eliminate risk of sea turtle entanglement.

Partner expertise

The success of the proposed study is based on the combined expertise and effort of the collaborating partners. The proposed project will build off years of experience by groups that have been directly and indirectly examining the efficacy of using traps to capture lionfish from deep-water habitats. This project will continue the cooperative work between Florida Keys lobster trap fishermen, researchers and managers. The collaboration of commercial trap fishermen with the PI, project manager and contributing partners listed below will provide the intellectual and field support needed to ultimately determine if a NC lionfish trap is an effective and viable fishing method to target populations in deep-water.

Florida Keys Lobster Trap Fishermen

Spiny lobster fishermen in the Florida Keys have sold lionfish bycatch from lobster traps since the invasion began in their area. Lionfish have also been reported from other trap types, such as stone crab traps on the west Florida shelf and black sea bass pots in US southeast Atlantic waters (NOAA 2018). Through this proposed study we will leverage the knowledge and expertise of Florida Keys lobster trap fishermen. The fishermen who have agreed to provide consultation or boat time towards the project have lobster trap fishing businesses that deploy between 500-2500 traps throughout the season in the Florida Keys targeting lobsters, often in deep habitats. These fishermen have decades of knowledge of best fishing grounds to find lobsters and lionfish in deep habitats. They will provide invaluable insight on how to design and deploy a successful trap on target in these deep reefs. Ultimately by observing the traps with local commercial fishing experts and then allowing them to fish the traps to the best of their abilities, we will be able to determine the traps efficiency of targeting lionfish in deep reefs in the Florida Keys with minimal bycatch. Fishermen will provide the project with an assessment of the potential for a NC trap for lionfish to be scaled up as a removal tool throughout the region. In particular, project partner

Rachel Bowman is a highly experienced commercial lionfish spearfisher, lives and works in Marathon Key, and has close ties to members of the commercial fishing community. She has offered to provide connections with fishers, wholesalers, and retailers, conduct interviews, and assess interest in testing and employing lionfish traps among the fishing community. She is heavily invested in lionfish outreach, removal and research efforts and will help the project coordinator forge productive collaborative relationships.

Florida Fish and Wildlife Conservation Commission (FWC)
Scientists at Florida Fish and Wildlife Conservation Commission, led by Tom Matthews, have agreed to assist with the field logistics and research design of this project (see letter of collaboration attached). They have been testing modified lobster trap designs for two years in the Florida Keys under a NOAA Fisheries issued Exempted Fishing Permit with the goal of creating a version of a lobster trap that will reduce bycatch, increase lionfish catch and be easily integrated into the current Florida fisheries. Deployments of modified lobster traps have revealed that a substantial escape gap is necessary to reduce bycatch, results from recent work is still being analyzed and will be incorporated into the design of the proposed work if relevant.

An FWC boat and crew of up to three scientists will be contracted for the duration of the project to assist with trap field tests. Their vessel is equipped with a winch capable of deploying and retrieving traps. FWC also has 18 time lapse cameras that will be affixed to the traps to assess for successful deployment as well as lionfish behavior and optimal soak time and time of retrieval. FWC has also recently obtained an ROV that will be capable of surveying deep reefs off the Florida Keys. The ROV will survey sites of deployment through the project to determine lionfish densities before and after some deployments.

Holden Harris, PhD (University of Florida)
Dr. Holden Harris is a postdoctoral research fellow at with the University of Florida. His dissertation research studied capacity and strategies for managing invasive lionfish and he has led two studies for testing NC trap effectiveness of removal of lionfish from Northern Gulf of Mexico (nGOM). Dr. Harris will provide consultation with trap design and deployment, survey design, field operations and data analysis. The University of Florida will also provide use of time-lapse camera units developed for monitoring lionfish trap research and development.

Alex Fogg, MSc (Coast Watch Alliance)
Alexander Fogg is the Marine Resource Coordinator for Okaloosa County, Florida. His background in invasive lionfish stems from the implementation of a Gulf of Mexico wide life history study, which incorporated a broad collaboration with Federal, State and local governments, as well as local businesses and stakeholders throughout the Gulf of Mexico. Mr. Fogg will assist with field operations and coordination of collaboration of partners. Holden and Alex will provide vital practical expertise from their research projects in the nGOM assessing lionfish populations and testing trap effectiveness of Dr. Gittings NC trap.

Steve Gittings, PhD, Office of National Marine Sanctuaries
Dr. Steve Gittings will provide technical advice for NC trap construction and use (see letter of collaboration attached). Dr. Gittings has been Chief Scientist for NOAA's Office of National Marine Sanctuaries since 1998. For the last several years, Dr. Steve Gittings has been developing this novel NC trap to capture lionfish from water beyond scuba depths. Dr. Gittings developed prototype NC traps for observing in the northeastern Gulf of Mexico. Following promising results in those observations, the design was modified to attract more lionfish inside the trap perimeter, increasing catch efficiency. Further modifications were made to increase descent speed, facilitate retrieval, and reduce interactions with protected resources. More recently additional changes were made to allow for construction of the trap frame without welding, making it possible for fishermen in small island nations to build the traps without expensive equipment or technical skills. Gittings provided consultation with his own organization, NOAA Office of National Marine Sanctuaries (ONMS), during the preparation of the NOAA National Marine Fisheries Service's 2018 Final Programmatic Environmental Assessment titled

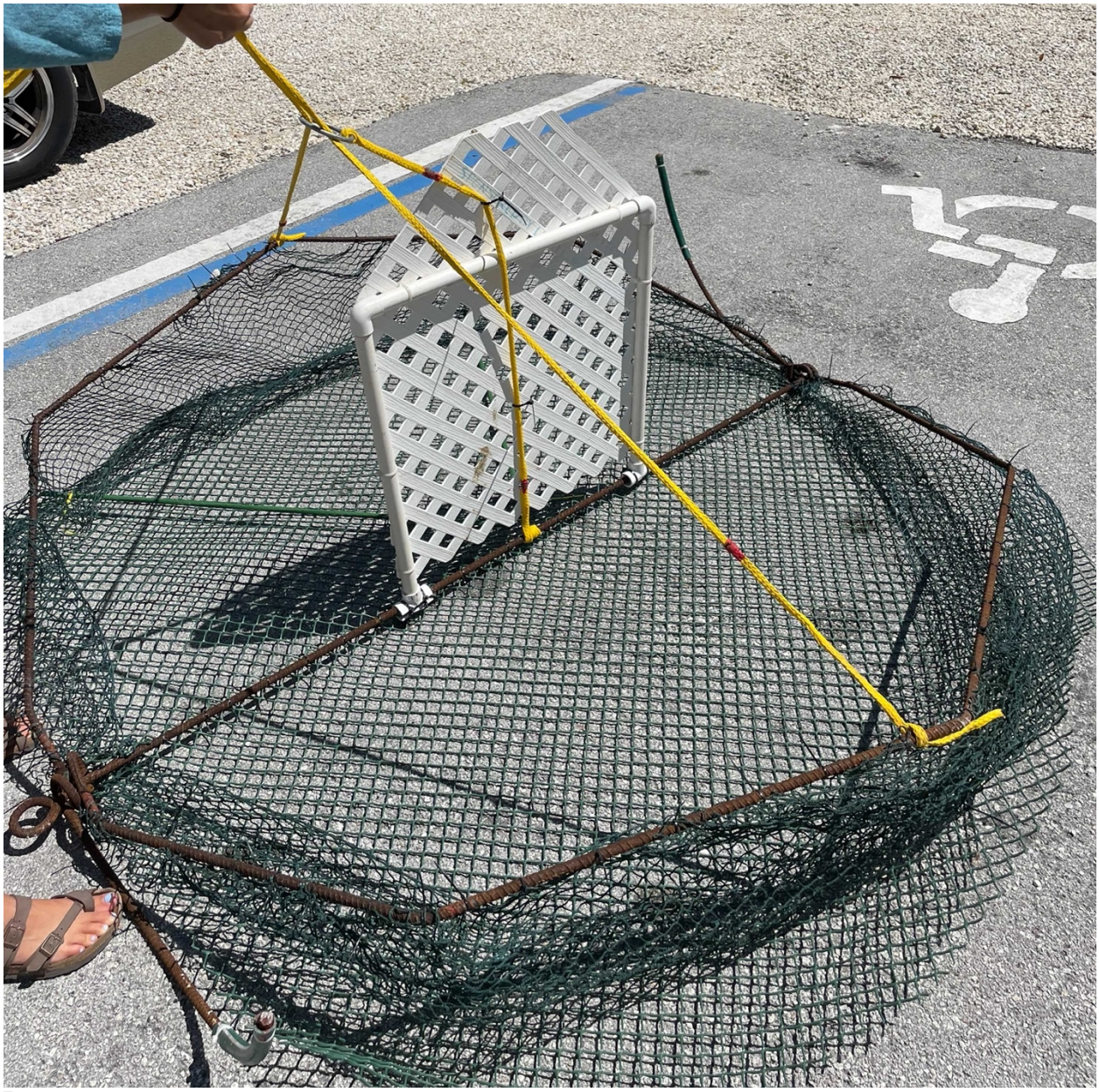
“Testing Traps to Target Lionfish in the Gulf of Mexico and South Atlantic, including within the Florida Keys National Marine Sanctuary.” The document takes a programmatic approach for National Environmental Policy Act (NEPA) compliance to examine the environmental impacts of authorizing limited testing of various trap designs and configurations for capturing lionfish under an Exempted Fishing Permit or a general permit from ONMS.

Project Methodology

Objective 1: Bycatch and entanglement risk reduction and operational considerations

Under a Letter of Acknowledgement issued to REEF in 2020, the project partners have conducted preliminary field observations and verification from mounted cameras to establish the optimal NC trap design. To date, study results have indicated a low potential for environmental impacts (bycatch, ghost fishing, bottom damage, and entanglement). A study in deep waters in the northern Gulf of Mexico conducted 100 trap deployments of the NC curtain trap design (Patterson et al. 2019). NC traps outperformed Atlantic seabass traps and wooden lobster traps in highest catches of lionfish and lowest bycatch of fishes. However, one NC trap test resulted in the entanglement and mortality of one sea turtle. Video footage shows that the turtle swam under the trap for shelter, but then became entangled when trying to swim up and out from under the trap and ultimately drown. Various trap designs have been observed under the 2020 issued Letter of Acknowledgement to determine which one best reduces the likelihood of bycatch and entanglement while still fishing successfully for lionfish. Through consultation with Holden Harris, Steve Gittings, Tom Matthews, sea turtle experts, NOAA specialists including biologist with Southeast Regional Office and scientists with the Southeast Fisheries Science Center Gear Research Branch, and lobster fishers we have determined a prototype to reduce sea turtle entanglement through a more rigid structure at the base of the traps (Figure 2). This design allows the trap to billow upon retrieval, yet it provides a rigid ceiling for any turtle crawling under the trap, preventing it from getting stuck in the netting. The stiff plastic extends beyond the rebar frame of the trap so it cannot invert through the trap and cause confusion for the turtle. There is only a small amount of netting in this design, further reducing entanglement risk, and the stiff plastic is also less likely to snag on the bottom.

A



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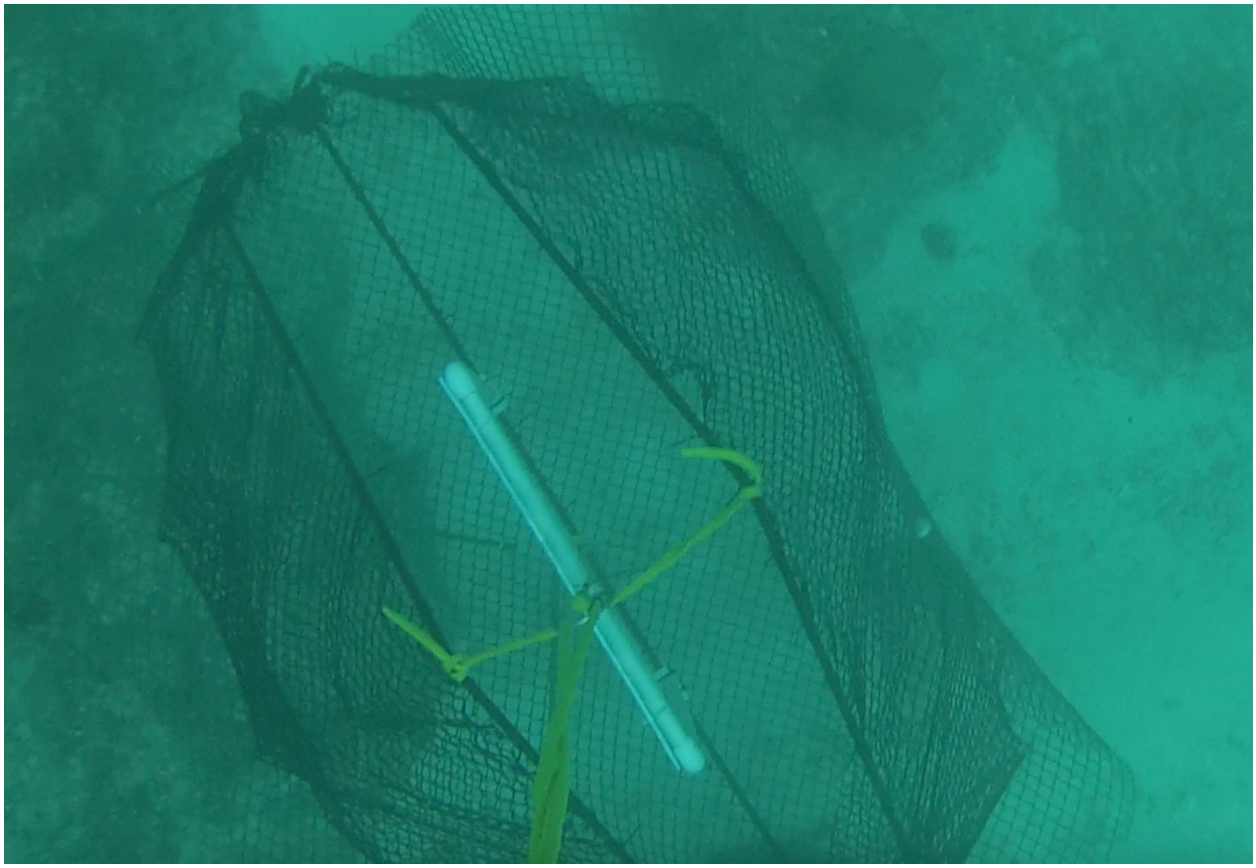

C

Figure 2. Current design of trap to eliminate risk of sea turtle entanglement underneath trap. **A.** A sheet of rigid plastic netting will lay outside the rebar frame with either bars or an additional frame to prevent it from inverting through the rebar frame from below. **B.** In this accordion-like design, 12 inches of netting with attach the rigid plastic to the frame allowing the net to **C.** billow during retrieval.

Two trap designs (the original and one described in Figure 2) were recently delivered to the Southeast Fisheries Science Center Gear Research Branch in Pascagoula, MS so their staff can provide further feedback and recommendations for best practice design modifications.

In future deployments, videos from time lapse cameras and ROVs and diver observations will be used to monitor any encounters, risks or entanglement to mobile protected species. To eliminate marine mammal entanglement a vertical line with a tensile strength of <2200 lb will be used when feasible. All buoys will be attached to a buoy line with a weak link not to exceed 600 lb breaking strength, designed in such a way that the bitter end of the buoy line is clean and free of any knots when the weak link breaks. Weak links will be chosen from the list of NMFS approved gear, which includes: off the shelf weak links, rope of appropriate breaking strength and hog rings. A maximum soak time of 21 days will be employed for deep water deployments.

When considering deployment and retrieval success, fishermen knowledge will be used to determine appropriate line and float configurations, as well as protocols for fishing the traps. Goals will be to develop a trap and fishing plan that can be deployed easily, open successfully and land and remain on target in deep water habitats, with minimal risk of bycatch or bottom entanglement. During fieldwork, we will be documenting such parameters as descent and ascent orientation, opening efficiency, trap movement, closing speed and escapement of fish. Research in the nGOM found that successful trap deployment was driven by a properly weighted device with balance floats (H. Harris pers. comm.) and the NC trap can be effective in recruiting and capturing lionfish if deployed near sites with high lionfish densities (Gittings et al. 2016; Ahrens el al. 2019). The number of traps deployed was also shown to impact catch success (Patterson et al. 2019) and proper trap retrieval was essential to minimize fish escaping. Consultation with Holden Harris, FWC and Florida Keys Lobster Fishermen will provide vital information to determine best deployment practices. We will address the questions of

effectiveness of single versus multi-trap trawl design as well as soak time (days) and optimal retrieval time (time of day). All traps will contain one subsurface buoy located in close proximity to the harness (Figure 1C) and one (or two if in trawl configuration) vertical lines with surface buoys used to mark and retrieve traps from surface. Multiple buoys may be used on one vertical line to ensure floatation at deep sites and high currents, but will be anchored to only one line and will not exceed 5 buoys per line with a maximum of two vertical lines of buoys per trawl. All surface buoys will be marked with "LF" and, if necessary, the NOAA and FKNMS permit number to indicate lionfish research is occurring. Trap line length will not be longer than necessary for the depth fished. Lines will be outfitted with weights to prevent excess additional lines from floating at the surface. Line between traps fished in a trawl will be limited to the minimum length necessary. Traps will be weighted with a minimum amount of weight necessary to avoid trap movement after deployment. Best practices will be considered when configuring all trap lines including use of sinking or negatively buoyant vertical lines, minimum line breaking strength and white markings on vertical lines.

As a means of comparison and to facilitate deployment of the non-containment traps on lobster vessels some deployments will include permitted lobster traps as well as NC traps. All lobster traps will be marked with current tags. The two trap types will be deployed either within the same trawl or separate trawls near one another or single traps near one another. This will also allow us to compare the efficacy of both trap types. A maximum of 32 traps will be deployed per trawl. No more than 100 NC traps will be deployed in the water at any given time and soak times will vary, but will not exceed 21 days per deployment. No bait will be used in the NC traps. REEF will contract commercial trap fishermen with experience fishing within the study area. Additionally, the contractor will have experience with catch and handling of lionfish. No more than 30 sampling trips total per year will be taken on the FWC research vessel and a maximum of 24 trips total per year on the commercial lobster vessels.

Workshop – Final Design & Fishing strategy

A workshop will be organized to determine a final design for the NC trap based on field observations with FWC and lobster commercial vessels. Each partner that had a chance to fish with the trap will be asked to provide verbal (at workshop) or written (prior to workshop) input on design flaws and recommendations. Other workshop participants will also be encouraged to provide further suggestions.

Objective 2 (Catch success): Determine the efficacy of the NC trap to capture lionfish in mesophotic habitats off the Florida Keys

Catch Success: Gear test by Fishermen

During the project EFP timeline, we will ask Florida Keys lobster trap fishermen to target known locations of high lionfish catch based on their seasonal bycatch. As a means of comparison and to facilitate deployment of the NC traps on lobster vessels some deployments will include lobster traps as well as NC traps. These will be deployed either within the same trawl or separate traps or single traps near one another. This will also allow us to compare the efficacy of both trap designs. We will equip each boat with 20 NC traps to deploy and retrieve. The project manager will join the crew for deployments and retrievals whenever the schedule permits. Lobster fishermen will be equipped with datasheets to record catch and environmental statistics with each deployment. We will also compare operations and catch success in different weather, current, and sea conditions.

Catch Success: Surveys

We will collect data with certain trap deployments from the FWC vessel to: evaluate attraction and capture rates in relation to proximity of source lionfish populations, document behaviors of lionfish near traps, evaluate diel behaviors of lionfish around the traps to determine the best times to pull traps, identify optimal soak times, document any captures of non-targeted species, monitor traps set to develop best practices for lionfish fishing, identify optimal depths, seasons, and time of day to pull traps to maximize removal, and minimize possible negative effects to other marine life. This information will be obtained through the following methods:

ROV surveys

A key priority to ensure the traps success will be modeling fisher's behavior in site selection. Not surprisingly, close proximity to source reefs has been found to be essential for successful lionfish catch in traps. This has been shown in both the NC traps (Ahrens et al. 2019) as well as lobster traps for both lionfish and lobsters (G. Nicols, pers. comm.). Because field time is costly and limited, it will be important to understand how these traps will perform when deployed near source populations of lionfish. We will conduct ROV surveys before and after periodic trap deployments to assess source populations of lionfish. These surveys will be used to select sites as well as assess effectiveness of traps on reducing local lionfish numbers. Data from ROV surveys conducted previously by FWC will also be used to select sites for deployment.

Time-lapse cameras

We will mount time lapse cameras to traps to record lionfish recruitment, behavior and habituation. Time-lapse cameras are available for use from FWC, REEF and University of Florida. Videos from traps will be used to assess optimal soak time as well as optimal time of day to retrieve traps. Surveys by scientists at REEF on deep (35-45m) low relief sites off the Florida Keys showed lionfish catch per unit effort at these deep habitats was three-fold greater during the day than at dusk (Candelmo and Mussey 2019). Lionfish are also more active in the evening (Green et al. 2011) and therefore we hypothesize trap catch rates may be higher in the daytime when the fish tend to be aggregating around structure. Cameras affixed to the traps will provide evidence of this movement and aggregation at the trap structure and determine optimal time of day. Analyses of remote videos will be conducted to assess a potential optimal time of day for trap retrieval.

Passive acoustics

During certain deployments one trap will be affixed with a Soundtrap 300 hydrophone (available from REEF). An in situ lionfish call has been identified by scientists working at FWC and REEF (Scharer-Umpierre et al. 2019). During recent deployments this call has been detected frequently during dusk time periods in sites with lionfish present. The known call is of a relatively low decibel and therefore if detected indicates lionfish are within close (100m) proximity to the hydrophone. We will deploy the hydrophone to use the recordings to determine whether lionfish were in fact in the area of the trap deployment. The hydrophone will be deployed with a paired time-lapse camera unit and opportunistically coupled with ROV surveys to assess the efficacy of using passive acoustic to assess the presence/absence of lionfish at deep habitat fishing sites. Comparison of acoustic and video data will also be done to gain a better understanding of lionfish calls that are associated with specific behavior.

Data collection and analysis

We will collect data on the research vessel and on the commercial vessels when a researcher is or isn't present during each trap deployment and retrieval. This will include environmental data, catch data, and in some cases video and/or ROV survey data and hydrophone recordings. More detailed data will be collected if a researcher is present. Environmental data will include water temperature, current and sea conditions, and habitat (when possible from cameras and ROVs). Catch data will include trap design, date, location (latitude and longitude), soak time, time of day, depth, condition of the trap, and number and sizes (total length) of each fish or invertebrate that is recovered from each trap. All lionfish will be retained. All other fish and invertebrates will be identified and enumerated. Lionfish and fish captured in NC traps will be measured to the nearest cm; lobster will be measured to the nearest mm (Standard length for fish, Carapace length for lobster). Permitted species caught in the NC traps (not expected to be much, if any) will be retained for sale by commercial fishermen during the lobster open season only. Only lionfish would be retained for sale during the lobster closed season. All NC trap bycatch discards that do not meet the regulations and permits regarding size and season for harvest will be returned to the water as soon as possible. Contracted commercial fishermen will be able to retain species they would otherwise be able to legally retain within their permitted lobster traps, namely species harvested from allowable areas within the allowed season, size limits, gear requirements, vessel requirements, and any other requirements. Representative photographs will be collected for species identification verification in the laboratory as needed. All identifications will be made to the species level. Imagery captured from Go Pros will be secured via trading out of memory cards and batteries will be replaced

with fresh batteries to facilitate rapid re-deployment. If a researcher cannot be present on the commercial vessel during deployment or retrieval a datasheet will be provided to the fisher to collect standard metrics including soak time, depth, GPS coordinate, total number of lionfish, and photos of all catch from each trap.

Comparisons of catch and bycatch will be made between and among trap designs. Depth, date, soak time, time of day and weather conditions will also be dependent variables when analyzing catch rate. Lionfish catch per unit effort (CPUE) will be determined for each trap deployment and will be compared to cost of each trip. ROV survey data will be analyzed to assess for changes in lionfish CPUE in the source area before and after deployment. Imagery will be analyzed and compared to catch to assess trap deployment and catch success and to document any pertinent behaviors.

Workshop – Final debriefing of trap effectiveness and future work
A workshop will be organized to debrief about the lionfish catch rates of the NC trap in the Florida Keys. All participating partners will be provided the opportunity to present their opinion on the efficacy of this trap in reducing lionfish populations in mesophotic habitats. Participants will be asked to provide recommendation on the specific NC trap as well as future efforts to target lionfish in deep habitats.

Study Sites

The project study area for observing trap deployment from the vessel and lionfish recruitment will be in waters deeper than 30 m in the Florida Keys National Marine Sanctuary (Sanctuary) and in federal waters between Alligator reef and Looe Key (Figure 3). This area encompasses the Atlantic waters from a depth of 30m to 100m. Only areas open to commercial lobster fishing will be included in the study area. Both the Sanctuary and the National Marine Fisheries Service have areas designated as closed to commercial fishing and these areas will be avoided. The study area is well known to commercial trap fishermen and these areas are regularly fished for lionfish. ROV surveys and depth finders will be used to identify appropriate habitat to deploy traps. Traps will be preferentially placed in sand. Areas with more than 1-foot relief associated with coral and hardbottom habitat will be avoided. No trap testing will occur in waters less than 30 meters deep to avoid Endanger Species Act (ESA) listed corals. No trap testing will occur around historical resources.

Figure 3. Project study area.

Expected Timeline of Research

Anticipated research period: January 1, 2022 to September 30, 2023. We plan to continue observation and deployment of various trap designs developed under the 2020 issued LOA, but now allow for commercial fishermen participation and sale of catch. Trap deployment and observations will be conducted year-round throughout the two-year period (weather permitting). We anticipate 30 trips per year total on the FWC vessels and 20 trips per year total on the commercial lobster vessels. Each vessel will carry on board and prominently display the EFP.

Reporting

We will provide an annual report with detailed description of all gear used including trap type, construction material, dimensions, approximate weight, line type, length and material used and line breaking strength, buoy type, buoy size, and buoy amounts per trap or trawl. We will provide information on the numbers of each trap type deployed, configuration of traps, and report of any los or missing traps or gear.

We will report the GPS coordinate of each individual set trap or starting and end point of a trawl at the time of deployment and retrieval. Water depth of each trap or start and end point of trawls will be recorded as well as information on seas state such as wave height and any impending conditions. Catch information reported will include soak time, numbers and species ID of all fish and crustaceans captured by each trap type and numbers, length and weights of all lionfish captured and retained. Any ESA-listed species interactions will be immediately reported to NMFS and any hotlines as requested.

Research Vessels

FWC has two FWRI boats that may be used for the project:

1986 25’ Boston Whaler FL1530FF. Hull lettering - FWC Marine Research 1983 25’ Tcraft FL9156EM. Hull lettering - FWC Marine Research

Commercial Lobster Vessels

The following commercial lobster fishermen have been contacted about the project and expressed interest in participating as a contractor. Project partners are still determining which contractor(s) would be best based on expertise, schedule, cost and fishing grounds. It is anticipated that 2-3 contractors will be used to fish the Noncontainment traps.

Glenn (Butch) H Hewlett Jr., 815 100TH. STREET Marathon FL 33050
Bus-3057434594 , mobile-3056647433 bnbfishing@comcast.net

Mitch Gale
29467 Geraldine St. Big Pine Key, Fl 33043 Phone: 305-872-9026
Galesforce
USCG# DO942934 (this is the commercial equivalent of the FL number)
37 ft Monzon style vessel is docked at the home address

Gary Nicols
Bruce Irwin
Buddy Becker

References

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Appendix I – Letters of Support

NOAA Saltonstall-Kennedy Program Proposal

Strengthening the Supply Chain for Lionfish to Promote Fishing and Protect Native Species

Florida Fish and Wildlife Conservation Commission

Commissioners
Robert A. Spottswood
Chairman
Key West

Michael W. Sole
Vice Chairman *Tequesta*

Carlos Beruff
Bradenton

Joshua Kellam
Palm Beach Gardens

Gary Lester *Oxford*

Gary Nicklaus
Jupiter

Sonya Rood
St. Augustine

Executive Staff
Eric Sutton
Executive Director

Thomas H. Eason, Ph.D.
Assistant Executive Director

Jennifer Fitzwater
Chief of Staff

Fish and Wildlife Research Institute
Gil McRae Director

727-896-8626
727-823-0166 FAX

Managing fish and wildlife resources for their long-term well-being and the benefit of people.

Fish and Wildlife Research Institute
100 Eighth Avenue SE
St. Petersburg, Florida
33701-5020
Voice: (727) 896-8626
Fax: (727) 823-0166
Hearing/speech-impaired:

Alli Candelmo, PhD
Invasive Species Program Manager
Reef Environmental Education Foundation (REEF)
www.REEF.org
305-852-0030

November 11, 2019

To whom it may concern:

We are writing to express our commitment to participate with Dr. Alli Candelmo on the REEF proposal to investigate and develop a trap to catch and remove the invasive lionfish from deep waters near Florida as part of the Saltonstall-Kennedy Competition.

The State of Florida has prioritized the control of the invasive lionfish population as one aspect of the efforts to protect Florida's coral reefs. Control of lionfish in shallow waters by divers has proceeded well, but water below 40 m depth are largely inaccessible to divers and appear to be the sites of considerable reproduction and a nearly continuous source of new recruits to the population. Traps are considered the most likely mechanism to remove deep-water lionfish. However considerable research is required to both improve the catch of lionfish in traps and ensure the bycatch of other fish and invertebrates is low. Habitat traps, like that developed by Gittings et al, 2017, appear promising but need to be tested in high fish diversity habitats, like the coral reefs in south Florida.

Dr. Candelmo is a leading expert on lionfish and has considerable volunteer resources at her disposal. FWC has made considerable investment in equipment to conduct lionfish trap research including boats, ROVs, and underwater cameras. Both organizations have offices in the Florida Keys and are well positioned to work with the commercial fishing industry to both test existing trap designs and work with fishermen to develop novel traps. This research collaboration has a high probability of improving management of Florida's natural resources.

Respectfully,

Tom Matthews
Research Administrator

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL OCEAN SERVICE
Office of National Marine Sanctuaries
1305 East-West Highway
Silver Spring, Maryland 20910

November 9, 2019

TO: Dr. Allison Candelmo, Reef Environmental Education Foundation

FROM: Dr. Steve Gittings, ONMS

RE: Letter of Collaboration for Lionfish trap project

Please accept this letter in collaboration for your project proposal to evaluate the commercial potential of lionfish traps. With it, I offer my experience, advice, time, and assistance, to the extent possible, to support your work.

As you know, I have been working for several years with a number of people and groups, including Lionfish University, ReefSave, Coast Watch Alliance, Holden Harris, Alex Fogg, and Peter Angelotti, to design and improve a FAD-based, non-containment lionfish trap that could be used for commercial fishing. The trap has proven effective under certain test conditions, and now needs to be evaluated by professional fishermen. The project you are proposing would accomplish that.

I would be eager to provide advice on trap design improvements, as well as participate in discussions with the fishing community and the public, and with field trials, if that is possible.

Thank you for your commitment to leading efforts to test the traps for commercial use and provide fishermen with a potentially substantial new economic opportunity.

Sincerely,

Dr. Stephen R. Gittings
Chief Scientist
NOAA Office of National Marine Sanctuaries
1305 East West Hwy., N/ORM62
Silver Spring, MD 20910
(301) 713-7274 (work)
(301) 529-1854 (cell)

Appendix II – Curriculum Vitae of Project PI and Partners

NOAA Saltonstall-Kennedy Program Proposal

Strengthening the Supply Chain for Lionfish to Promote Fishing and Protect Native Species

Allison Candelmo

Professional Statement

As a marine ecologist with 17 years' experience, I am dedicated to focusing my career and research goals to foster tangible improvements to the management of coastal fisheries and marine ecosystems. By seeking to understand both fine-scale and large-scale anthropogenic impacts to these resources and by educating and engaging communities and stakeholders we can improve our conservation efforts.

Education

Ph.D. 2010 Rutgers, The State University of New Jersey, New Brunswick, NJ, Graduate Program, Ecology and Evolution

B.S. 2000 Rutgers College, Rutgers, The State University of New Jersey, New Brunswick, NJ

Ph.D. Dissertation: Responses of YOY bluefish, *Pomatomus saltatrix*, to contaminants from an urban estuary.

Professional Research Experience

Invasive Species Program Manager, REEF, Key Largo, FL, 2018-Present

- Principle Investigator on NFWF funded Invasive Lionfish Control and Management in the Coral Reef Systems of Southeast Florida (2018-2019) – Project coordinated an education, research and management initiative to reduce the population growth and spread of the invasive lionfish species across southeast Florida. Project coordinated removal derbies to remove thousands of non-native lionfish in one-day events, research attractants and lionfish populations in deep habitats to increase their capture and conduct collection, handling and culinary workshops. $89,000
- Grant writing, budgeting and reporting
- Organize and schedule research activities for lionfish and invasive species field research projects
- Management of data from lionfish research projects
- Public education and outreach through talks, workshops, and demonstrations
- Develop and post appropriate media content for press releases, social media outlets, websites
- Researcher on Grouper Moon project – Conservation of a grouper spawning aggregation site in the Cayman Islands – population assessment and impacts of climate change on early life stage.

Research Associate, Central Caribbean Research Institute, Cayman Islands, 2015-2018

- Principle investigator of 2017-2018 lionfish research and management project funded but European Commission IUCN BEST 2.0 Small Grant Program ($115,000); Principle investigator of a lionfish research program funded by Guy Harvey Ocean Foundation (2015-2018) ($60,000)
  - Internally implanted Vemco V9P acoustic transmitters in lionfish in situ at 30m depth to determine vertical and horizontal movement patterns of lionfish
  - Established a fine-scale passive acoustic receiver array
  - Mapped the current and change in lionfish density and CPUE through Little Cayman
  - Lionfish population dynamics assessment and management – organized research and community lionfish removal efforts and dissections, stored and analyzed long-term data
  - Captured, handled and/or dissected over 7,500 lionfish
  - Worked closely with the Cayman Island Department of Environment (CI DoE)
  - Findings reported in 5 scientific meeting presentations, 2 extended abstracts, 3 publications in prep.
- Coral nursery management, maintenance, outplanting and monitoring;

- Lab manager; organized, maintained and stocked laboratory and research equipment

National Institute of Health Postdoctoral Fellow, NYU Langone Medical Center, 2014-2015

- Estimating effects of Hudson River contaminants and climate change on critical early life-stages of sturgeons
- Large scale experimental design, planning, monitoring with qRT-PCR gene expression analysis in response to toxins
- Undergraduate intern and volunteer mentoring and management
- Report of final results through scientific meetings and a peer-reviewed publication

National Research Council Postdoctoral Fellow, NOAA Fisheries, Highlands, NJ, 2012-2014

- Examining the effects of ocean acidification and temperature on the early life-stages of finfish species
- Large scale experimental design, scheduling and monitoring, mentoring a large team of volunteers and interns.
- Fish collection, husbandry, spawning and embryo and larval morphological imaging and measurements
- Biomolecular analysis – RNA, DNA and protein concentrations and gene expression analysis
- Participation at NOAA national planning committee to improve the state of OA science (final report/publication

Research Scientist, Cayman Islands Department of Environmental (CI DoE), 2012

- Collection and analysis of size, condition and stomach content of 500 invasive lionfish in the Cayman Islands.

Lecturer, School for Field Studies, South Caicos, TCI, British West Indes, 2011-2012

- Directed research two research projects 1. Surveying the impacts and distribution the invasive lionfish in South Caicos, and 2. The growth and sustainability of the native finfish fisheries
- Collaborated with Turks & Caicos Department of Environment and Coastal Resources on; queen conch assessment, invasive lionfish management, docklanding finfish analysis, sea turtle surveys, assessment of MPA effectiveness
- Established strong community relations with local fishers to obtain knowledge of past and present fisheries status
- Collaborated with TCI REEF Fund and REEF to engage the local fishers and processing plant operators and help establish a lionfish export fisheries in South Caicos
- Organized a Lionfish Community Day to encourage locals to capture and eat lionfish

Postdoctoral Research Associate, NOAA Fisheries Highlands, NJ, 2010-2011

- Use of statistical methods in support of a National Fish Habitat Action Plan coastal habitat assessment
- Identified ecological indicators of habitat conditions and attributed data to a GIS geospatial framework

Ph. D. Dissertation Research, Rutgers University, New Brunswick, NJ, 2003-2010

- Investigated the behavioral, growth, hormonal and neurochemical response of YOY bluefish to contaminants
- Devised and implemented experimental design; laboratory behavioral and field collections
- PCB, pesticide, mercury, thyroid histological and neurotransmitter analysis

Research Scientist, End to End Technical Services, NOAA Fisheries, Highlands, NJ, 2008/2006

- Examined the functional nutritional value of invasive tunicates for a NOAA status report
- Planned and executed field collections, a multi-tank recirculation system and laboratory feeding experiments

HOLDEN EARL HARRIS, PHD

Postdoctoral Research Scientist
University of Florida , Institute of Food and Agriculture Sciences
Nature Coast Biological Station
Gainesville, Florida
+1 (904) 476–0984 | holdenharris@ufl.edu

EDUCATION

Doctorate in Philosophy	University of Florida	May 2020
Major	Interdisciplinary Ecology	
Concentration	Fisheries and Aquatic Sciences	
GPA	4.00 / 4.00	
Committee chairs	Micheal Allen and William Patterson	
Committee members	Thomas Frazer, Sherry Larkin, and Robert Ahrens	
BSc, Zoology, *Cum Laude*	University of Florida	Dec 2009
Major	Zoology	
Minor	Environmental Science	
GPA	3.96 / 4.00	
Research advisor	Brian Silliman	

RELEVENT GRADUATE COURSEWORK

Fish Population Dynamics (2015)
Fisheries Management (2015)
Natural Resource Economics (2016)
Applied Statistics (2016)
Grant Writing (2016 and 2017)
Quantitative Wildlife Ecology (2016)
Data Carpentry (2016)
Management of Exploited Populations (2017)
Ecological Dynamics and Forecasting (2017)
Journal Colloquium (2017)
Invasion Ecology (2018)

RESEARCH POSITIONS

Postdoctoral Researcher	UF Nature Coast Biological Station	2020 – Present
Graduate Research Fellow	National Science Foundation	2017 – 2020
Graduate Research Assistant	UF School of Natural Resources and Environment (SNRE)	2015 – 2017
Environmental Scientist	Florida Department of Environmental Protection	2014 – 2015
Research Director	Flyotech Industries, LLC	2013 – 2014
Research and Teaching Assistant	School for Field Studies (SFS), Center for Marine Resource Management (CMRS)	2012 – 2013
Fisheries Biological Scientist	Florida Fish and Wildlife Research Institute	2012
Biological Technician	UF Aquatic Food Products Laboratory	2011

TEACHING EXPERIENCE

Invited Lecturer	PhD Fellowship Preparation Course, EGN 6937	2017
Assistant Instructor	Undergraduate Research Training and Recruitment Program (National Marine Fisheries Service / UF)	2016
Scuba Instructor	Native Diver Charters	2012 – 2016
Teaching Assistant	Undergraduate Directed Research (SFS CMRS)	2013
Teaching Assistant	Resource Management (SFS CMRS)	2013
Teaching Assistant	Marine Ecology (SFS CMRS)	2012
Marine Science Instructor	Newfound Harbor Marine Science Laboratory	2011

MARITIME EXPERIENCE

Captain	Native Diver Charters	2015 – 2017
Commercial Fisherman	Native Diver F/V	2012 – 2014
Commercial Fisherman	Key West Fisheries	2011
Deckhand & Ecotour Guide	Fury Catamarans	2010 – 2011

PEER-REVIEWED PAPERS

Harris, H. E., B. X. Whalen, A. G. Gude, and M. S. Allen. Gear testing hook modifications to reduce handling time in catch-and-release fishing. *Fisheries.* Submitted September 2020. — In Review

Harris, H. E., W.F. Patterson III S., M.S. Allen, R. N. M. Ahrens, and S. L. Larkin. The bioeconomic paradox of market-based invasive species removals: a case study of lionfish in the northern Gulf of Mexico. *Ecological Applications*. Submitted July 2020. — In Review

Harris, H. E., A. Q. Fogg, S. R. Gittings, M. S. Allen, R. N. M. Ahrens, and W.F. Patterson III. Testing the efficacy of lionfish traps deployed on artificial reefs in the northern Gulf of Mexico. *PLoS One.* doi.org/10.1371/journal.pone.0230985 — 2020

Harris, H. E., A. Q. Fogg, M. S. Allen, and W.F. Patterson III. Precipitous population declines in northern Gulf of Mexico invasive lionfish following emergence of an ulcerative skin disease. *Scientific Reports*. 10(1934). nature.com/doi/s41598-020-58886-8 — 2020

Harris, H. E., W.F. Patterson III, R. N. M. Ahrens, and M. S. Allen. Detection and removal efficiency of invasive lionfish in the northern Gulf of Mexico. *Fisheries Research*. 213(2019):22-32. doi.org/10.1016/j.fishres.2019.01.002 — 2019

Harris, H. E., A. Q. Fogg, R. P. Yanong, S. Fraca Jr., T. Cody, T. B. Waltzek, and W.F. Patterson III. First report of an emerging ulcerative skin disease in invasive lionfish. *UF/IFAS Electronic Information Source*. FA209(2019)1-7. edis.ifas.ufl.edu/fa209 — 2018

Chagaris, D.D., S. Binion, A. Bodanoff, K. Dahl, J. Granneman, **H. E. Harris**, J. Mohan, M. Rudd, M. Swenarton, R. Ahrens, M. Allen, J. Morris, and W.F. Patterson III. An Ecosystem-Based Approach to Evaluating Impacts and Management of Invasive Lionfish. *Fisheries*. Vol. 42, Iss. 8. doi.org/10.1080/03632415.2017.1340273 — 2017

Papers in Preparation

Maneval, P. M., **H. E. Harris**, C. Jacoby, D. Behringer, and T. K. Frazer. Genotype, nursery design, and depth Influence the growth of *Acropora cervicornis* fragments. *PLoS One.* — In Prep

Harris, H. E., S. R. Gittings, M. S. Allen, and W.F. Patterson III. Efficacy of traps for to removing lionfish from mesophotic natural reefs. *Frontiers in Marine Science.* — In Prep

Cody T., R. P. Yanong, **H. E. Harris,** W.F. Patterson III, A. Q. Fogg, S. Fraca Jr., and T. B. Waltzek. Etiology of an ulcerative skin disease in northern Gulf of Mexico invasive lionfish, *Pterois volitans*. *Journal of Aquatic Animal Health*. — In Prep

H. E. Harris, G. Scholten, D. Chagaris, and M. S. Allen. Temperature dependent discard mortality of Spotted Seatrout. *Fisheries Transactions*. — In Prep

Procopio J. L., **H. E. Harris**, D. D. Chagaris, and M. S. Allen. Influence of sexually dimorphic growth on optimal harvest regulations for Spotted Seatrout. North American *Journal of Fisheries Management.* — In Prep

FELLOWSHIPS AND AWARDS

Graduate Research Fellowship	National Science Foundation	$146,000	2017– 2020
Best Student Presentation	72nd Gulf & Carib. Fish. Inst.	$1,500	2019
3X Graduate Student Travel Awards	University of Florida	$1,050	2018– 2019
Guy Harvey Scholar	Florida Sea Grant	$5,000	2016
Best Student Presentation	Big Bend Science Symposium	$100	2016
		Ttl. $153,650	

RESEARCH FUNDED

Harvesting lionfish in deep-water habitat with the use of a non-containment curtain trap	Florida Fish and Wildlife Conservation Commission	$48,648	2018
Lionfish detection, removal efficiency, and the potential for deep-water harvest gear	Graduate Research Endowment, Cynthia Melnick Foundation	$4,000	2017

Assessment of spotted seatrout management to provide economic growth in the Big Bend	The Conservation Fund	$19,912 Ttl. $72,560	2016

RESEARCH PROJECTS MANAGED

Deepwater trapping to remove invasive lionfish from Gulf of Mexico mesophotic reefs (PI: William Patterson)	Florida Fish and Wildlife Conservation Commission	$249,864	2018 – 2019
Assessing the efficacy of lionfish removals in high-density artificial reefs systems in the Florida Panhandle (PI: Micheal Allen)	Florida Fish and Wildlife Conservation Commission	$148,470	2016 – 2018
Assessing the viability of a commercial lionfish fishery in the U.S. Virgin Islands (PI: Sherry Larkin)	NOAA Saltonstall-Kennedy Program	$297,219 Ttl. $695,553	2015 – 2017

INVITED PANELS AND COMMITTEES

Invited panelist speaker, "GCFI Student Committee – COVID-19", *Gulf and Caribbean Fisheries Institute*	June 2020 (remote)
Invited panelist speaker and planning committee member, "Sustainable Fisheries in St. Croix" *St. Croix Environmental Sea Walls Summit*	Dec 2019 St. Croix, USVI
Invited panelist speaker, "Finding Jobs in Zoology and Environmental Science" *Brevard County Youth Environmental Summit*	Mar 2019 Melbourne, FL
Steering committee member and invited speaker *North West Florida Lionfish and Artificial Reef Conference*	Feb 2019 Fort Walton Beach, FL
Steering committee member and invited speaker *Florida Fish and Wildlife Lionfish Summit*	Oct 2018 Cocoa Beach, FL

SELECTED SYMPOSIUM PRESENTATIONS

Population declines in northern Gulf of Mexico invasive lionfish following emergence of an ulcerative skin disease. *72nd Gulf and Caribbean Fisheries Institute Meeting.* *AWARDED TOP GRADUATE STUDENT PRESENTATION*	Nov 8, 2019 Punta Cana, Dominican Republic
Efficacy of lionfish traps in the northern Gulf of Mexico. *71st Gulf and Caribbean Fisheries Institute Meeting*. Online: gcfi.org/download/56/71/4832/gcfi71book_of_abstracts	Nov 8, 2018 San Andreas, Colombia
Efficacy of lionfish removals by divers and traps in the northern Gulf of Mexico. *Florida Fish and Wildlife Lionfish Summit*. Online: content.govdelivery.com/LionfishSummitAgenda.pdf	Oct 3, 2018 Cocoa Beach, FL
Detection and removal efficiency of invasive lionfish on natural and artificial reefs in the northern Gulf of Mexico. *American Fisheries Society Southern Division Meeting.* Online: sd.fisheries.org/puerto-rico-2018-meeting	Mar 10, 2018 San Juan, Puerto Rico
Detection and removal efficiency of invasive lionfish on natural and artificial reefs in the Florida Panhandle. *North Florida Marine Science Symposium*. Online: sfrc.ufl.edu/nfmss	Jan 24, 2018 Marineland, FL
Assessing the efficacy of lionfish removals in high-density artificial reefs systems in the Florida Panhandle. *147th Annual Meeting of the American Fisheries Society*. Online: afs.confex.com/2017/Paper/28992	Aug 20, 2017 Tampa, FL
Insights from vanguard entrants in Florida's commercial lionfish fishery. *North Florida Marine Science Symposium*. Online: sfrc.ufl.edu/nfmss *AWARDED TOP GRADUATE STUDENT PRESENTATION*	Jan 29, 2016 Cedar Key, FL.

SELECTED PUBLIC AND WORKSHOP PRESENTATIONS

Efficacy of lionfish control mechanisms in the northern Gulf of Mexico. *2019 North West Florida Lionfish and Artificial Reef Conference.* Online: eventbrite.com/2019-lionfish-and-artificial-reef-workshop-in-northwest-florida	Feb 19, 2019 Fort Walton Beach, FL
Gear testing non-containment curtain traps for deep-water harvest of invasive lionfish. *Lionfish Awareness Day at the Capital.*	Feb 7, 2018 Tallahassee, FL
University of Florida research projects on invasive lionfish in the Gulf of Mexico. *Advisory Board Meeting for UF Nature Coast Biological Station.*	Feb 1, 2018 Cedar Key, FL
University of Florida lionfish research: collaboration and support from the Florida Fish and Wildlife Conservation Commission. *Florida Fish and Wildlife Conservation Commissioner Meeting*	Dec 6, 2018 Gainesville, FL

Removal efficiency of lionfish on high-density artificial reef structures in the northern Gulf of Mexico. *UF/FWC Lionfish Research Workshop*, *Florida Centers for Excellence*.	Nov 20, 2017 Cedar Key, FL
Developing your story for the NSFGRFP: how to get reviewers to see you as a person rather than an applicant. *Invited speaker for PhD Fellowship Preparation, EGN 6937.*	Sep 19, 2017 Gainesville, FL
Characterizing a commercial fishery for lionfish in Florida. *FWC Lionfish Derby Workshop.*	Oct 18, 2016
Modeling lionfish management strategies on the west Florida shelf. *Reef Environmental Education Foundation Open House*.	Jul 14, 2015 Key Largo, FL
Lionfish in Northeast Florida. *Guana Tolomato Matanzas National Estuarine Research Reserve Public Lecture Series*. Online: govdelivery.com/FLDEP/bulletins	Oct 23, 2014 Marineland, FL
Ecology impacts and management of invasive lionfish. *School for Field Studies Center for Marine Resource Studies Community Engagement*.	Mar 03, 2013 Turks and Caicos Islands

PROFESSIONAL CERTIFICATIONS

AAUS Closed Circuit Rebreather Diver American Academy of Underwater Sciences, Univ. of FL.	2018
US Coast Guard 100-ton Master of Vessels Endorsed for 200 miles Near Coastal, Sailing, and Auxiliary Towing. 720+ days-at-sea.	2011 (First issued) 2017 (Last renewed)
AAUS Scientific Diver American Academy of Underwater Sciences, Univ. of FL.	2012
NASE SCUBA Instructor 800+ logged dives. Compressor Operator, Rescue Diver Instructor.	2012
Emergency Medical Technician (EMT-B) Florida State School of Jacksonville. Renewed bi-annually. Current through 2021.	2007 (First issued) 2019 (Last renewed)
American Red Cross Instructor for Emergency Responder, CPR, First Aid, OW Lifeguarding	2006

ALEXANDER Q. FOGG

9416 Octavia Lane
Navarre, FL 32566
Phone: (443) 995–6416
Email: Fogg.Alex@gmail.com

GRADUATE SCHOOL:	University of Southern Mississippi
Degree:	Master of Science in Coastal Sciences
Graduated:	December, 2016
Major Professor:	Dr. Mark S. Peterson
COLLEGE:	University of South Carolina
Degree:	Bachelor of Science in Marine Science
Graduated:	May, 2011

WORK AND FIELD EXPERIENCE:

Coastal Resource Manager, Visit Destin – Fort Walton Beach, Okaloosa County Board of County Commissioners, Fort Walton Beach, FL, (October 10, 2017-Present)

- Contract manager for more than $5 million of artificial reef construction projects.
- Constructed the Continental United States first fish aggregating device (FAD) buoy network.
- Revitalized one of the states only private reef deployment programs.
- Developed a long-term management plan for artificial reef construction and monitoring.
- Implementing an acoustic and satellite tagging project for large pelagic species of sharks and fish to track interactions with FADs and local reefs.
- Committee member for the Tri County Community Partnership Initiative, Florida Local Environmental Resource Agencies and Marine Advisory Committee.
- Coordinate with Federal, State and local governments, local businesses and stakeholders to ensure all parties are consulted and represented in decisions regarding coastal resource management.
- Serve on the Board of Directors for the Pensacola and Perdido Bay Estuary Program.
- Assist with the operation of the Choctawhatchee Bay Estuary Program.
- Manage an invasive lionfish monitoring program that utilizes local citizen scientists for data collection.
- Host the largest invasive lionfish collection and outreach event in the world with more than 14,000 lionfish being removed during the 2-day event.
- Manage beach restoration and inlet dredging projects associated with Okaloosa County property.
- Contract manager for the endangered sea turtle survey services and lighting modifications that minimize impacts to sea turtles while also maintaining public safety.
- Assisting with numerous projects relating to innovative methods (traps, remotely operated vehicles…etc) for harvesting invasive lionfish from depths beyond diver accessibility

Fisheries Biologist IV OPS, Florida Fish and Wildlife Conservation Commission (FWC), Division of Marine Fisheries Management, Artificial Reef Program, Tallahassee, FL, (May 1, 2015-October 5, 2017)

- Artificial Reefs
    - Contract manager for state and federally funded artificial reef construction and for the Natural Resource Damage Assessment Phase III Early Restoration Northwest Florida Artificial Reef Creation and Restoration project.
    - Reviewed permit applications associated with artificial reef construction.
    - Developed side scan sonar sampling protocols including data processing for use in planning and monitoring of agency projects.

        - Developed and initiated a comprehensive monitoring plan to monitor reef condition as well as commercially and recreationally important species assemblages.
        - Coordinate with other project managers on the county and city level, stakeholder groups, and other private firms.
        - Developed agreements and solicitations for the deployment and monitoring of more than 3,000 new artificial reefs in northwest Florida state waters.
        - Administer over $11 million.
        - Represented FWC at local and national meetings, conferences and conventions.
        - Organized a project wide monitoring effort coupling multiple methods to quantify human use of artificial reefs.
        - Lead field operations and communicate with volunteers to assist in these operations.
        - Conduct pre and post construction surveys utilizing side scan sonar, SCUBA diving activities and other methods.
        - Oversaw public solicitations and vendor selections by Florida counties.
        - Utilized geographic information system (GIS) software to manage an artificial reef database, create deployment/sampling plans and protocols.
- Lionfish Outreach
    - Aided staff in lionfish outreach event operations.
    - Participated in agency lionfish removal SCUBA dives throughout the state.
    - Coordinated with research entities to provide samples and logistical support.
    - Organized lionfish removal dives with stakeholders.
    - Educated stakeholders about commercial harvesting protocols.
    - Maintained relationships with commercial and recreational divers and fishermen who were integral parts of previous lionfish research activities.

Research Technician / Graduate Student, University of Southern Mississippi, Ocean Springs, MS, (May 1, 2013-April 30, 2015)

- Lionfish life history (Thesis)
    - Described distribution, feeding ecology, age/growth and reproduction within the northern Gulf of Mexico.
    - Enlisted the help of commercial and recreational divers and fishermen to provide samples.
    - Additional collaboration with National Parks Service, Mississippi Department of Marine Resources, Alabama Department of Conservation and Natural Resources, Florida Fish and Wildlife Conservation Commission, University of South Florida, University of Southern Mississippi, University of Alabama, University of West Florida and University of New Orleans.
    - Oversaw a team of students helping to process lionfish samples.
    - Maintained a database of more than 15,000 specimens.
    - Maintained a lionfish specific budget of approximately $10,000 per year.
    - Regularly attended and presented at lionfish outreach events around the Gulf of Mexico.
    - Co-founder and board member of the Gulf Coast Lionfish Coalition.
- Abundance and Distribution of Commercially Important Estuarine Dependent Populations within the Gulf of Mexico. Funding provided by the Bureau of Ocean Energy Management.
    - Quantified abundance and distribution of blue crab, white shrimp, and brown shrimp using fisheries independent methods.
    - Sorted and identified entire catch to species level.
    - Characterized the habitat and assess water quality and other abiotic factors.
    - Operated small vessels
- Gulf Sturgeon movement and habitat use. Funding provided by U.S. Army Corps of Engineers, Housing and Urban Development, and NOAA-NMFS Office of Protected Species.

- Deployed, maintained, and downloaded acoustic arrays used for tracking diadromous movements of tag implanted Gulf Sturgeon.
- Sampled for sturgeon using different gill nets set at numerous points within target river system.
- Operated small vessels

Fisheries Biologist I, National Oceanic Atmospheric Administration/National Marine Fisheries Service/IAP Worldwide Services, Pascagoula, MS, (May 1, 2011-April 30, 2013)

- Participated in a number of annual surveys (~190 days at sea from 2011-2012) including:
    - Chief scientist during an Extended Annual Stock Assessment
        - Managed a captain, two scientists, and two deckhands
        - Collected fisheries independent data for Gulf of Mexico stock assessments using bottom longline and vertical longline gear.
        - Completed cruise instructions and reports documenting protocols and catch data.
    - Winter and spring ichthyoplankton
        - Familiarized and conducted operations using different plankton sampling methods including:
            - Neuston, Spanish neuston, bongo, Multiple Opening/Closing Net and Environmental Sensing System (MOCNESS), and Continuous Underway Fish Egg Sampler (CUFES).
        - Preserved collected samples in different solutions of Ethanol and Formaldehyde.
    - Summer and fall groundfish, part of Southeast Area Monitoring and Assessment Program
        - Selected as watch lead for numerous survey logs.
        - Conducted bottom trawl operations to determine the abundance and distribution of benthic fauna.
        - Identified entire catch to lowest taxonomic level.
        - Sampled different fish species according to sample protocols outlined for age, growth, abundance and distributional studies.
- Dissected a number of teleost and elasmobranch species that contributed to numerous research projects.
- Developed and implemented a lionfish life history study in the Gulf of Mexico that utilizes volunteer participation to collect invasive lionfish from Gulf of Mexico waters from Florida to Texas.
- Assisted with community outreach events promoting fisheries related topics.

Volunteer, National Oceanic Atmospheric Administration/National Marine Fisheries Service, Pascagoula, MS, (June 1, 2010-July 15, 2010)

- Participated in the Southeast Area Monitoring and Assessment Program (SEAMAP) to collect fisheries data that included plankton sampling, eggs/larvae monitoring, water profiles & fish size measurements.
- Collected maritime animals (sea turtles, pelicans, other birds) impacted by the Deep Water Horizon Spill
- Sampled fish populations and water status within the areas closed to fishing due to the oil spill.

Research Assistant, Newfound Harbor Marine Institute, Big Pine Key, FL, (May 1, 2009- August 10, 2009)

- Safely captained oceanographic research vessels and instructed students conducting maritime research.
- Observed and collected different shark species in a natural habitat to facilitate discussions.
- Regularly contributed data to the Reef Environmental Education Foundation (REEF).

- Taught fisheries science classes to young visitors of the institute. Employed different methods of specimen collection from long-lining to general net collection.

Research Fellow, International Union for Conservation of Nature, Wash. DC, 12 weeks, 20hrs/wk (May 15, 2008-August 15, 2008)

- Attended weekly forums and seminars on marine related issues in the Washington DC area.
- Maintained accurate minutes from meetings and developed a new website for the Marine Program.
- Discussed issues facing our world's marine habitats and energy concerns with area experts.
- Researched & authored an article on marine renewable energy technologies.

Conservation Assistant, Maryland Department of Natural Resources, Annapolis, MD, May-September (2005-2008)

- Assisted in website maintenance: update home page, post news, activities, and updates.
- Supervised beach safety and security operations at a State Park complex (Sandy Point State Park).
- Promoted conservation awareness and outreach for park events.

OTHER EXPERIENCE:

- Oyster Restoration and Monitoring with Magothy River Association: 2005-2010.
- Chesapeake Bay grass restoration and monitoring with Chesapeake Bay Foundation: 2005-2010.
- Assisted in a comparative hook study to test circle style hooks and experimental hooks in the recreational fishery; 2011.
- Port sampled commercially gill-netted King Mackerel during three-day season; 2012.
- Aided in large shark sampling and dissection at local shark tournament; 2012.
- Responded to sea turtle stranding's along the Mississippi coast and barrier islands where they were collected or tagged and released; 2011-2013.
- Participated in multi-agency research including large pelagic shark (whale and hammerhead shark) satellite tagging; 2012-2013.
- Aid in the deployment and monitoring of artificial reefs with Mississippi Gulf Fishing Banks inc.

PUBLICATIONS:

- Blakeway, R.D., A.Q. Fogg and G.A. Jones. (2020). Oldest Indo-Pacific lionfish (*Pterois volitans/P. miles*) on record collected from the northwestern Gulf of Mexico. Gulf and Caribbean Research (In Review).

- Harris, H.E., A.Q. Fogg, S.R. Gittings, R.N.M. Ahrens, M.S. Allen and W.F. Patterson III. 2020. Testing the efficacy of lionfish traps in the northern Gulf of Mexico. PLoS ONE 15(8): e0230985.

- Harris, H.E., A.Q. Fogg, M.S. Allen, R.N.M. Ahrens and W.F. Patterson III. 2020. Precipitous Declines in Northern Gulf of Mexico Invasive Lionfish Populations Following the Emergence of an Ulcerative Skin Disease. Scientific Reports 10:1934.

- Fogg, A.Q., J.T. Evans, M.S. Peterson, N.J. Brown-Peterson, E.R. Hoffmayer and G.W. Ingram Jr. 2019. Comparison of age and growth performance of invasive red lionfish (*Pterois volitans*) in the northern Gulf of Mexico. Fishery Bulletin 117:1–15.

- Harris, H.E., A.Q. Fogg, R.P. Yanong, S. Frasca Jr., T. Cody, T.B. Waltzek and W.F. Patterson III. 2018. First report of an emerging ulcerative skin disease in invasive lionfish. University of Florida Cooperative Extension Service, EDIS, (in print).

- Fogg, A.Q. and M.E. Faletti. 2017. Lion King: Invasive lionfish (*Pterois* sp.) agonistic behavior observations. Bulletin of Marine Science 94(1):1-2.

- Pérez-Portela R., A. Bumford, B. Coffman, S. Wedelich, M. Davenport, A. Fogg, M.K. Swenarton, F. Coleman, M.A. Johnston, D.L. Crawford, and M.F. Oleksiak. 2017. Genetic homogeneity of lionfish across the Atlantic coast of Florida and the Gulf of Mexico based on Single Nucleotide Polymorphisms (SNPs). Scientific Reports 8:5062.

- 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.

- Fogg, A.Q., N.J. Brown-Peterson, and M.S. Peterson. 2017. Reproductive life history characteristics of invasive lionfish (*Pterois volitans*) in the northern Gulf of Mexico. Bulletin of Marine Science 93(3):1-23.

- Fogg, A.Q., G.C. Trier, B.L. Barbara and M.S. Peterson. 2016. The rise of northern Gulf of Mexico Lionfish derbies: how do they compare? 69th Gulf and Caribbean Fisheries Institute, GCFI Lionfish Special Session, 7-11 November, Grand Cayman (extended abstract) 69:1-2.

- Fogg, A.Q., C.F Ruiz, S.S. Curran and S.A. Bullard. 2016. Parasites from the Red Lionfish, *Pterois volitans* from the Gulf of Mexico. Gulf and Caribbean Research 27(1):SC1-SC5.

- Johnson, J.E., C.E. Bird, M.A. Johnston, A.Q. Fogg and J.D Hogan. 2016. Regional genetic structure and genetic founder effects in the invasive lionfish: comparing the Gulf of Mexico, Caribbean and North Atlantic. Marine Biology 163:1-7.

- Fogg, A.Q., J.T. Evans, G.W. Ingram Jr., M.S. Peterson and N.J. Brown-Peterson. 2015. Comparing age and growth patterns of invasive lionfish among three ecoregions of the northern Gulf of Mexico. 65th Gulf and Caribbean Fisheries Institute, GCFI Lionfish Special Session, 9-13 November, Panama (extended abstract) 68:197-198.

- Fogg, A.Q., N.J. Brown-Peterson, and M.S. Peterson. 2014. Northern Gulf of Mexico lionfish: Insights into their reproductive life history. 64th Gulf and Caribbean Fisheries Institute, GCFI Lionfish Special Session, 3-7 November, Barbados (extended abstract) 64:194-195.

- Fogg, A.Q., M.S. Peterson, and N.J. Brown-Peterson. 2013. Northern Gulf of Mexico lionfish: Distribution and reproductive life history trajectories. Proceedings of the Gulf Caribbean Fisheries Institute (extended abstract) 63:206-207.

- Fogg, A.Q., E.R. Hoffmayer, W.B. Driggers III, M.D. Campbell, G.J. Pellegren, and W. Stein. 2013. Distribution and length frequency of invasive lionfish (*Pterois* sp.) in the northern Gulf of Mexico. Gulf and Caribbean Research 25(1):111-115.

- Hannan, K.M., A.Q. Fogg, W.B. Driggers III, E.R. Hoffmayer and W.R. Ingram. 2013. Size selectivity and catch rates of two small coastal shark species caught on circle and J hooks in the northern Gulf of Mexico. Fisheries Research 147:145-149.

PRESENTATIONS:

- Fogg, A.Q. The Continental United States First Fish Aggregating Device Network: Opportunities for Tourism and Pelagic Fisheries Monitoring. 71th Gulf and Caribbean Fisheries Institute, Punta Cana, Dominican Republic. November 2019.

- Fogg, A.Q. E.G. Johnson and M.S. Peterson. Monthly growth rate and population structure changes of northern Gulf of Mexico Red Lionfish (*Pterois volitans*) using a length-based population model. 70th Gulf and Caribbean Fisheries Institute, San Andreas, Columbia. November 2018.

- Fogg, A.Q. Okaloosa County: An Adventure Tourist Destination. Wildlife Viewing and Nature Tourism Academy. McAllen, TX. February 2018.

- Fogg, A.Q. Okaloosa County Marine Resource Activities. Destin Forward. January 2018.

- Fogg, A.Q. and M.E. Faletti. Lion King: Invasive lionfish (*Pterois* sp.) agonistic behavior observations. 69th Gulf and Caribbean Fisheries Institute, Merida, Mexico. November 2017.

- Fogg, A.Q. and K. Mille. Measuring Human Use of Artificial Reefs: Questions Asked and Methods Used in Florida's Largest Artificial Reef Project. American Fisheries Society Annual Meeting. Tampa, FL. August 2017.

- Fogg, A.Q., Natural Resource Damage Assessment; Northwest Florida Artificial Reef Creation and Restoration Update. Northwest Florida Artificial Reef Workshop. Crestview, FL. February 2017.

- Fogg, A.Q., B.L. Barbara, G.C. Trier and M.S. Peterson. Poster: The rise of northern Gulf of Mexico Lionfish derbies: how do they compare? 69th Gulf and Caribbean Fisheries Institute, Grand Cayman. November 2016.

- Fogg, A.Q., Natural Resource Damage Assessment; Northwest Florida Artificial Reef Creation and Restoration Update. Southwest Florida Artificial Reef Workshop. Palmetto, FL. March 2016.

- Fogg, A.Q., J.T. Evans, G.W. Ingram Jr., M.S. Peterson and N.J. Brown-Peterson. Poster: Comparing age and growth patterns of invasive lionfish among three ecoregions of the northern Gulf of Mexico. 68th Gulf and Caribbean Fisheries Institute, Panama. November 2015. **Best Student Paper.**

- Fogg, A.Q. Derby lionfish donated for research: What happens next? FWC and REEF Lionfish Derby Workshop, Clearwater, FL. January 2015.

- Fogg, A.Q., N.J. Brown-Peterson, and M.S. Peterson. What's new in Lionfish Reproduction? Escambia County Lionfish Summit, Pensacola, FL. November 2014.

- Fogg, A.Q., N.J. Brown-Peterson, and M.S. Peterson. Northern Gulf of Mexico lionfish: Insights into their reproductive life history. 67th Gulf and Caribbean Fisheries Institute, Barbados. November 2014.

- Fogg, A.Q., M.S. Peterson, and N.J. Brown-Peterson. Northern Gulf of Mexico lionfish: Distribution and reproductive life history trajectories. 66th Gulf and Caribbean Fisheries Institute, Corpus Christi, TX. November 2013. **Runner-up Best Student Paper.**

- Fogg, A.Q., E.R. Hoffmayer, W.B. Driggers III, M.D. Campbell, G.J. Pellegren, and W. Stein. Distribution and length frequency of invasive lionfish (*Pterois* sp.) in the northern Gulf of Mexico. Mississippi American Fisheries Society. 39th annual meeting, McComb, MS. February 2013.

- Fogg, A.Q. Invasive Lionfish: Distribution, length frequency, and ongoing research in the northern Gulf of Mexico. NOAA MS Labs Seminar Series. NOAA Fisheries, Pascagoula, MS. December 2012.

SCHOLARSHIPS AND AWARDS:

- 2021 Phoenix Award Nominee
- 2019 Dimitris Kollias Award for the contribution to the sport of diving
- 2019 Florida Man of the Year
- 2015 Gulf and Caribbean Fisheries Institute Best Student Paper
- 2014 Gulf and Caribbean Fisheries Institute Travel Award
- 2014 Mississippi Chapter AFS Travel Award
- 2014 Drs. Julia and Thomas Lytle Coastal Sciences Scholarship
- 2014 Tom McIlwain Fisheries Endowment
- 2013 Ron Schmied Scholarship

CERTIFICATIONS/LICENSES:

- Uninspected Passenger Vessels/OUPV (6-pack) Captains License
- Master SCUBA Diver including Rebreather, Trimix, Rescue, Dry Suit, American Academy of Underwater Sciences (AAUS), and level 1 freediving certifications
- Transportation Workers Identification Credential (TWIC)
- Florida Certified Contract Manager
- Wildlife and Sportfish Restoration Project Leader
- First-aid, CPR, AED and oxygen administration

REFERENCES:

1. Dr. Mark S. Peterson, University of Southern Mississippi, (228) 827-4203, mark.peterson@usm.edu
2. Dr. Steve Gittings, NOAA, (301) 529-1854, steve.gittings@noaa.gov
3. Dr. Eric Hoffmayer, NOAA, (228) 549–1691, eric.hoffmayer@noaa.gov
4. Dr. Will Stein, University of New Orleans, (504) 830–4614, doctarpon@gmail.com

CURRICULUM VITAE - STEPHEN R. GITTINGS

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EDUCATION

Ph.D. & M.S., Oceanography, Texas A&M Univ., B.S., Biology, Westminster College, PA

PROFESSIONAL INTERESTS

Marine Protected Areas; Ecology of coral reefs and hard-banks; Ecological monitoring; Invasive species; Scientific diving, submersibles, and ROVs

EMPLOYMENT HISTORY

- Chief Scientist, National Oceanic & Atmospheric Administration, Office of National Marine Sanctuaries, 2/98 to present
- Manager, Flower Garden Banks National Marine Sanctuary (NOAA), 1/92 to 2/98
- Member of Graduate Faculty, Texas A&M University, 10/89 to 12/05
- Assistant Research Scientist, Geochemical and Environmental Research Group, Texas A&M University, 4/89 to 1/92
- Research Associate, Dept. of Oceanography, Texas A&M University: 7/88 to 3/89
- Research Assistant, Dept. of Oceanography, Texas A&M University: 11/85 to 6/88
- Graduate Research Assistant, Dept. of Oceanography, Texas A&M University, 1/81 to 11/85
- Graduate Research Assistant, Dept. of Physics, Texas A&M University, 8/80 to 12/80

SELECTED PUBLICATIONS

Harris, H.E., A.Q. Fogg, W.F. Patterson, S.R. Gittings, M.S. Allen, and R.N.M. Ahrens. 2018. Efficacy of lionfish traps in the northern Gulf of Mexico. Gulf and Caribbean Fisheries Inst.

Caporaso, A., D.J. Warren, and S.R. Gittings. 2018. The Evolution of Recent Multidisciplinary Deep-Water Archaeological and Biological Research on the Gulf of Mexico Outer Continental Shelf. Chapter 10 In: Historical Archaeology and Environment (M.A.T. deSouza and D.M Costa, Eds). Springer International Publishing AG. https://doi.org/10.1007/978-3-319-90857-1_10.

Hepner, M., K. Shulzitski, B. Best, C.D. Stallings, S.R. Gittings, and F. Muller-Karger. (in prep). Reef fish biodiversity in no-take marine zones and habitat strata in the Florida Keys National Marine Sanctuary: 1999-2016.

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.

Gittings, S.R. 2016. Encouraging results in tests of new lionfish trap design. Proceedings of the 69th Annual Gulf and Caribbean Fisheries Institute. 69:206-214.

Delgado, J.P., H.K. Van Tilburg, B.G. Terrell, D. Marx, C. Marzin, S. Gittings, W. Kiene, V. Grussing, and P. Orlando. 2016. How NOAA's Office of National Marine Sanctuaries engages the public in the ocean through the science and management of maritime heritage. Aquatic Conserv: Mar. Freshw. Ecosyst. 26 (Supp. 2): 200–212.

Basta, D.J., L. LaFeir, S. Gittings K. Broughton, T. Casserly, P. Chetirkin, J. Delgado, A. DeVogelaere, R. Green, E. Hickerson, J. Hoyt, M. Lawrence, T. Lillestolen, M. Pickett, T. Reyer, S. Rohmann, G. Schmahl, K. Thompson, D. Wiley, and D. Wilkes. 2015. Technology use in NOAA's National Marine Sanctuary System. Mar. Tech. Soc. J. 49(2):178-192.

Johnston, M.A., Gittings, S.R., and Morris, J.A., Jr. 2015. NOAA National Marine Sanctuaries Lionfish Response Plan (2015-2018): Responding, Controlling, and Adapting to an Active Marine Invasion. Marine Sanctuaries Conservation Series ONMS-15-01. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Office of National Marine Sanctuaries, Silver Spring, MD. 55 pp.

Abbott, R.E., T. Bright, C. Caldow, R. Clark, S. Gittings, and E. Hickerson. 2014. Flower Gardens Banks. Pp. 229-232 In: Jackson, J.B.C., M.K. Donovan, K.L. Cramer, V.V. Lam (editors). (2014) Status and Trends of Caribbean Coral Reefs: 1970-2012.Global Coral Reef Monitoring Network, IUCN, Gland, Switzerland.

Gittings, S.R., M. Tartt, and K. Broughton. 2013. National Marine Sanctuary System condition report. U.S. Dept. of Commerce, Nat'l Oceanic and Atmospheric Admin., Office of National Marine Sanctuaries, Silver Spring, MD 33 pp. (http://www.sanctuaries.noaa.gov/science/condition)

Gittings, S.R. 2009. Cirripedia (Crustacea) of the Gulf of Mexico. Ch. 45, pp. 827-836 In: Felder, D.L. and D.K Camp. (eds.) Gulf of Mexico – Origins, Waters, and Biota: Volume 1: Biodiversity. Texas A&M University Press, College Station, TX. 1393 pp.

Gittings, S.R. 2006. Conservation science in NOAA's national marine sanctuaries: description and recent accomplishments. Marine Sanctuaries Conservation Series ONMS-06-04. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Office of National Marine Sanctuaries, Silver Spring, MD. 30 pp.

Shulter, S.K., S. Gittings, T. Penn and J. Schittone. 2006. Compensatory restoration: How much is enough? Legal, economic, and ecological considerations. Ch. 5 In: Coral Reef Restoration Handbook (W.F. Precht, ed.). CRC Press Taylor and Francis Group, LLC. 363 pp.

Pattengill-Semmens, C.V. and S.R. Gittings. 2003. A rapid assessment of the Flower Garden Banks National Marine Sanctuary (stony corals, algae and fishes). Atoll Res. Bull. 496: 500-511.

Gittings, S.R., K. Benson, L. Takata, and K. Witman. 2003. Conservation science in the National Marine Sanctuary Program. Marine Technology Society Journal 37(1):5-9.

Gittings ,S.R., K.E. Benson, P.J. Souik and M.S. Tartt. 2002. Sanctuary Science: Evaluation of status and information needs. NOAA National Ocean Service, Silver Spring, MD 75 pp.

Grigg, RW, EE Grossman, SA Earle, SR Gittings, D Lott, and J McDonough. 2002. Drowned reefs & antecedent karst topography, Au'au Channel, SE Hawaiian Islands. Coral Reefs 21:73-82.

Gittings, S.R., C.L. Ostrom, and K.J.P. Deslarzes. 1997. Regulation by reason: Science and management in the Flower Gardens Sanctuary, northwest Gulf of Mexico. Proc. 8th Int. Coral Reef Symposium. 2:1967-1972.