

LIONFISH RESPONSE MANAGEMENT PLAN

U.S. Virgin Islands

UPDATE
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Lionfish, St. Croix West End. Photo credit: ©Jenny Keith

Prepared by: Jamie M. Kilgo

Contributing Authors:

Bernard Castillo II, PhD, University of the Virgin Islands
Jenn Travis, St. Croix East End Marine Park
Kitty Edwards, CORE Foundation
Norm Gustafson, CORE Foundation Deep Diver Team

Jeanne Brown, The Nature Conservancy
John Rubattino, CORE Foundation
Nadija Packauskas, CORE Foundation
Zandy Hillis-Starr, National Park Service

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For more information, please visit: <http://virrp.reefconnect.org/programs/usvi-lionfish-response/>

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Table of Contents

Document Control.....	2
Executive Summary	7
I. Introduction.....	10
Goal.....	11
Objectives	11
II. Background Information	14
Species description.....	14
Lionfish impacts.....	14
Lionfish management.....	15
Current conditions in the USVI	16
Lionfish prey base and impacts.....	16
Lionfish abundance and distribution.....	16
Ciguatera fish poisoning	17
Additional resources	18
Territorial resources	18
Regional resources	18
Management plans and guidance	19
III. Education and Outreach.....	20
Objective and strategies	20
Gaps in education and outreach	22
Education and outreach subcommittee	22
IV. Control and Removal	23
Objective and strategies	23
Coordination	23
Training and permits	24
Removal teams.....	26
Incentives	27
Feeding sharks	27
V. Research and Monitoring, Data Gathering and Analysis.....	28
Objective and strategies	28
Ciguatera	29
Invasion impacts and removal effectiveness.....	30
Coordination	30

VI. Marketing.....	31
Objective and strategies	31
Commercial Sale.....	32
Dive tourism.....	32
Marketing subcommittee	32
VII. Communication.....	33
Objective and strategies	33
Internal communications.....	34
Partners:	34
Funding	34
External communications.....	35
Networking sites and listserv	35
Works Cited	36

List of Tables

Table 1. Objectives and priority strategies.....	11
Table 2. Education and outreach objective and strategies	20
Table 3. Target audience and types of outreach for each audience.	21
Table 4. Control and removal objective and strategies	23
Table 5. CORE developed PADI Distinctive Specialty courses.....	25
Table 6. Lionfish removals in protected areas	25
Table 7. CORE lionfish response hotlines	27
Table 8. Research and monitoring, data gathering and analysis objective and strategies.....	28
Table 9. Research questions.....	29
Table 10. Marketing objective and strategies	31
Table 11. Communication objective and strategies	33

List of Figures

Figure 1. Lionfish response management plan update workflow	13
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List of Appendices

Appendix I: Survey questionnaire, public forum announcements, and meeting attendance summary

Appendix II: Lionfish planning team and meeting participants

Appendix III: Current activities

Appendix IV: Gap analysis: public meeting comments and survey responses

Appendix V: Education and outreach materials

Appendix VI: Lionfish legislation

Acronyms

BUIS	Buck Island Reef National Monument
CMES	Center for Marine and Environmental Studies at UVI
CORE	Caribbean Oceanic Restoration and Education Foundation
CRABBS	Caribbean Reef Association of Bubble Blowers of St. Croix
CRCP	Coral Reef Conservation Program (NOAA)
CTX	Ciguatoxin
CFP	Ciguatera fish poisoning
CZM	Coastal Zone Management (Division)
DFW	Division of Fish and Wildlife
DPNR	Department of Planning and Natural Resources
EPSCoR	Experimental Program to Stimulate Competitive Research
FAC	Fisheries Advisory Council
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
PADI	Professional Association of Diving Instructors
REEF	Reef Environmental Education Foundation
SEA	St. Croix Environmental Association
STEER	St. Thomas East End Reserves
STXEEMP	St. Croix East End Marine Park
TNC	The Nature Conservancy
UVI	University of the Virgin Islands
VIMPAN	Virgin Islands Marine Protected Area Network

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Executive Summary

This updated territorial *Lionfish Response Management Plan* addresses the potential ecological and economic threat posed by invasive lionfish with specific strategies for **education and outreach, removal, research and monitoring, marketing, and communications**. The plan was designed to establish agreed-upon goals and objectives and to build a framework for meeting these objectives through coordination among organizations, agencies, businesses and individuals. Since the creation of the original response plan in 2009, the severity of the lionfish invasion has worsened, local circumstances have changed, and researchers, managers and citizen groups are more organized and knowledgeable about what is working and what is not.

Public forums and planning workshops were held on both St. Croix and St. Thomas in October 2013 to gather stakeholder input and compile the most recent knowledge on lionfish in the Virgin Islands. The public forums along with a survey questionnaire administered online or by one-on-one interviews provided an opportunity to review collective knowledge and recent research and to build upon the collaborative process to update and revise the original plan. Several gaps in knowledge became evident, but the following major findings and priority strategies will be helpful in guiding the actions of researchers, educators, managers, fishermen and response groups for the next several years:

MAJOR FINDINGS

- Localized and frequent removal by spearing or otherwise capturing lionfish seems to be effective at keeping lionfish numbers low at popular dive sites and near dive moorings.
- However, lionfish are still found in higher numbers at particular sites, at depth and following storm events. Further studies may reveal the cause of these patterns of recruitment, migration and/or habitat preferences.
- A handful of fishermen have started to successfully sell lionfish in local markets and to interested restaurants.
- Ciguatera testing reveals that although up to 12% of lionfish analyzed have been shown to harbor the neurotoxin above FDA guidance levels, prevalence does not seem to be any worse than other reef fish known to be ciguatoxic and no known case of poisoning from eating lionfish has yet occurred in the Caribbean. Promoting sale and consumption of lionfish by fishermen who already know hotspots of ciguatera to avoid in territorial waters increases the success of developing a safe and reliable market for lionfish.

The proposed objectives, committee recommendations for immediate action and long-term priority strategies are outlined below.

GOAL

To prevent lionfish from negatively impacting local fisheries and marine ecosystems, and endangering public safety

OBJECTIVES

To reach this goal, strategies were identified for five areas of action:

- 1. Education and outreach** (page 20)
- 2. Control and removal of lionfish** (page 23)
- 3. Research and monitoring, data gathering and analysis** (page 28)
- 4. Marketing: commercial sale and dive tourism** (page 31)
- 5. Communication: internal/external** (page 33)

PLANNING TEAM RECOMMENDATIONS for IMMEDIATE ACTION

- A well-maintained mooring system allows divers to conduct removal activities at a large number of sites that are otherwise inaccessible because anchoring could damage benthic habitat. However, many mooring buoys are in need of repair or replacement and cannot be used. DPNR is currently applying for the permits (through the U.S. Army Corps of Engineers) necessary to maintain existing moorings and install new moorings. Expediting the permitting process was identified as a short-term priority (page 23).
- An emerging problem in the USVI is the practice of feeding dead or incapacitated lionfish to sharks, eels or other marine wildlife in an effort to condition these predators to hunt lionfish. However, there is no indication that this conditioning is effective at changing foraging behavior of these predators and divers have increasingly noted sharks “stalking” them at popular dive sites expecting to be fed. Furthermore, according to DPNR policy, it is against regulation to feed wildlife in this manner (see page 16). The planning committee recognizes the potential nuisance and hazard that conditioned predators pose to divers and identified the immediate need to spread the message that lionfish should not be fed to sharks or other predators (page 27).
- The planning team identified the necessity of increased communication with legislators on the impacts of the lionfish invasion and short and long-term priority actions. Means of outreach include this document (namely the executive summary here) and CORE’s website (corevi.org). A short briefing should be created and outreach provided to legislators who may be interested in enacting further legislation, such as the aquatic nuisance species act shown in Appendix VI.

- For safe and effective lionfish removals, the PADI distinctive specialty courses developed by the CORE Foundation should be widely available and offered regularly by local dive shops and CORE staff (page 24).
- A system for organizing the regular exchange of information and convening steering committee meetings on a quarterly basis to address progress and next steps needs to be developed and adhered to. TNC has limited capacity to play the coordinating lead on this in the upcoming year, and a long-term solution to organizing regular updates to this plan should be considered (page 34).

PRIORITY STRATEGIES for the NEXT FIVE YEARS:

- Generate uniform messages to be used in education and outreach (page 20)
- Improve effectiveness of removal by coordinated spearfishing and trap fishing (page 23)
- Facilitate use of recent research and monitoring to guide control and removal efforts (page 23)
- Incentives for spear fishermen and recreational divers to kill lionfish are being explored, recognizing that subsidies for SCUBA air fills, equipment or fuel is not sustainable in the long-run (page 27)
- Explore other effective methods for control and marketing (page 31)
- Build a framework for communication and information-sharing among organizations, agencies, businesses and individuals (page 33)

I. Introduction

The Indo-Pacific lionfish has rapidly invaded the western Atlantic and Caribbean Sea. It is a voracious predator and has the potential to reduce native fish populations, adversely affecting local fisheries and ecosystems. The first confirmed lionfish was sighted in St. Croix, U.S. Virgin Islands (USVI) in November 2008, prompting an ad-hoc working group of territorial resources managers, non-governmental organizations, researchers and other concerned citizens to come together for action. Strategies for addressing control efforts, education and outreach, research/monitoring and data analysis were outlined in a *Lionfish Response Management Plan for the US Virgin Islands* (October 2009). Since the creation of the response plan, the status of the lionfish invasion in territorial waters has changed from sightings of individual fish separated geographically and temporally to sightings of many fish, throughout many habitats and depths. Despite the fact that people are responding more efficiently, that we have more data on the invasion, and more and more of the public are aware of the lionfish impact on our ecosystem and fisheries, many gaps persist in efforts to combat the problem. As a result, there is a need to update and revise the response plan. The Department of Planning and Natural Resources (DPNR), Division of Fish and Wildlife (DFW) and Division of Coastal Zone Management (CZM) with The Nature Conservancy (TNC) and funding from NOAA's Coral Reef Conservation Program (CRCP) supported the revision of the plan that outlines strategies for decision-makers, marine managers, researchers, fishers, divers and educators to implement in an effort to control the worst effects of the lionfish in USVI waters.

To assist in this process, The Nature Conservancy and a DPNR contractor launched a series of informational public forums in October 2013 along with a survey questionnaire to gather information on recent research, collective knowledge, and activities and accomplishments to date. Taking responses from community members who are active in lionfish control and those who are concerned about the impact of the lionfish invasion, a working group compiled a summary of new and current activities and needs, and analyzed gaps that needed to be filled. They then took ideas gathered in the public participatory process to identify solutions and prioritize strategies. The working group put together a management plan that would:

- establish agreed upon goals and objectives for dealing with the lionfish invasion, and
- provide a framework to coordinate activities among government and non-governmental agencies and local individuals, businesses and organizations to control the invasion of lionfish into US Virgin Islands waters.

The 2009 version of the management plan was used as a template upon which updates have been incorporated. This plan addresses the potential ecological and economic threat posed by invasive lionfish to Virgin Islands' waters with specific strategies for removal, education and outreach, research and monitoring, marketing and communications. This update uses the most recent developments and current information to build on the original plan and is designed to establish agreed-upon goals and objectives. It is a framework for meeting these objectives through coordination among organizations, agencies, businesses and individuals. A review of what others have done in the region and various approaches were taken into consideration, and some of the management plans developed by neighboring islands and regional response plans are listed on page 19.

Goal

The goal is to prevent lionfish from negatively impacting local fisheries and marine ecosystems, and endangering public safety.

Objectives

The objectives are to achieve a sustained reduction of the lionfish in the USVI through the following areas of focus:

- **Education and outreach**
- **Control and removal of lionfish**
- **Research and monitoring, data gathering and analysis**
- **Marketing (commercial sale and dive tourism)**
- **Communication (internal/external)**

The working group considered the original objectives, incorporated new ones, and redrafted all using the SMART criteria: specific, measurable, attainable, relevant, and time-limited. Strategies were then developed to meet each objective, with priority strategies identified for each action area (Table 1).

Table 1. Objectives and priority strategies

ACTION AREA	OBJECTIVE	PRIORITY STRATEGIES
EDUCATION & OUTREACH	Every year, awareness and engagement of the VI community through education and participation has increased so that 1000 people on each island have participated in some kind of sighting, removal, and/or consumption activity.	Share CORE's PADI Lionfish Search and Response <i>Distinctive Specialties</i>
		Form education and outreach subcommittee to develop uniform messages and create a framework for coordination and cooperation of education and outreach efforts
CONTROL & REMOVAL	Increase the amount of safe and effective removal to suppress lionfish in certain areas by coordinating efforts and focus removal on sensitive/critical areas.	Finalize permitting process for lionfish removals in territorial protected areas STEER & STXEEMP
		Dedicated response and removal team in partnership with CORE
		Increase removal coverage, depth and area through trap fishing and diver use of rebreathers, trimix
RESEARCH & MONITORING	Improve our understanding of lionfish impacts, effectiveness of removal, and viability of commercial sale by regularly (bi-annually) examining the local and regional scientific (peer-reviewed) results with observational data and by concentrating the collection of removal and sighting data into one shared database.	Use current data and research to guide removal efforts and focus on ecologically significant areas
		Sustain high volume local ciguatera labs and create high resolution ciguatera hotspot distribution maps
		Further research lionfish impacts on local fisheries and reef communities

MARKETING	Increase the demand for lionfish products, such as food fish for homes and restaurants and jewelry or agricultural products so that 20 new fishermen have begun to sell lionfish each year, and engage the dive community and visitors in lionfish spotting and hunting to increase business and revenue for dive operators.	Form marketing subcommittee to research feasibility of potential commercial markets and develop strategy for promoting lionfish consumption and dive tourism
		Explore options that would allow recreational divers to sell lionfish, either through a commercial fishing license exemption or partnerships with fishermen
COMMUNICATION	INTERNAL - Improve communications and sharing of observations so that the active lionfish committee is making progress on strategies outlined in this management plan and getting the message to partners, media and legislators.	Develop framework for continued coordination and cooperation within the Virgin Islands
	EXTERNAL - Improve communications with neighboring islands by sharing new knowledge and observations.	Cultivate down island contacts and communications; utilize regional lionfish listservs and conferences



Priority actions for the planning team to address as soon as possible are marked throughout the document.

The survey questionnaire, public forum announcements, and meeting attendance summary is provided in Appendix I. The workflow followed for the collaborative revision and update process is shown below (Figure 1).

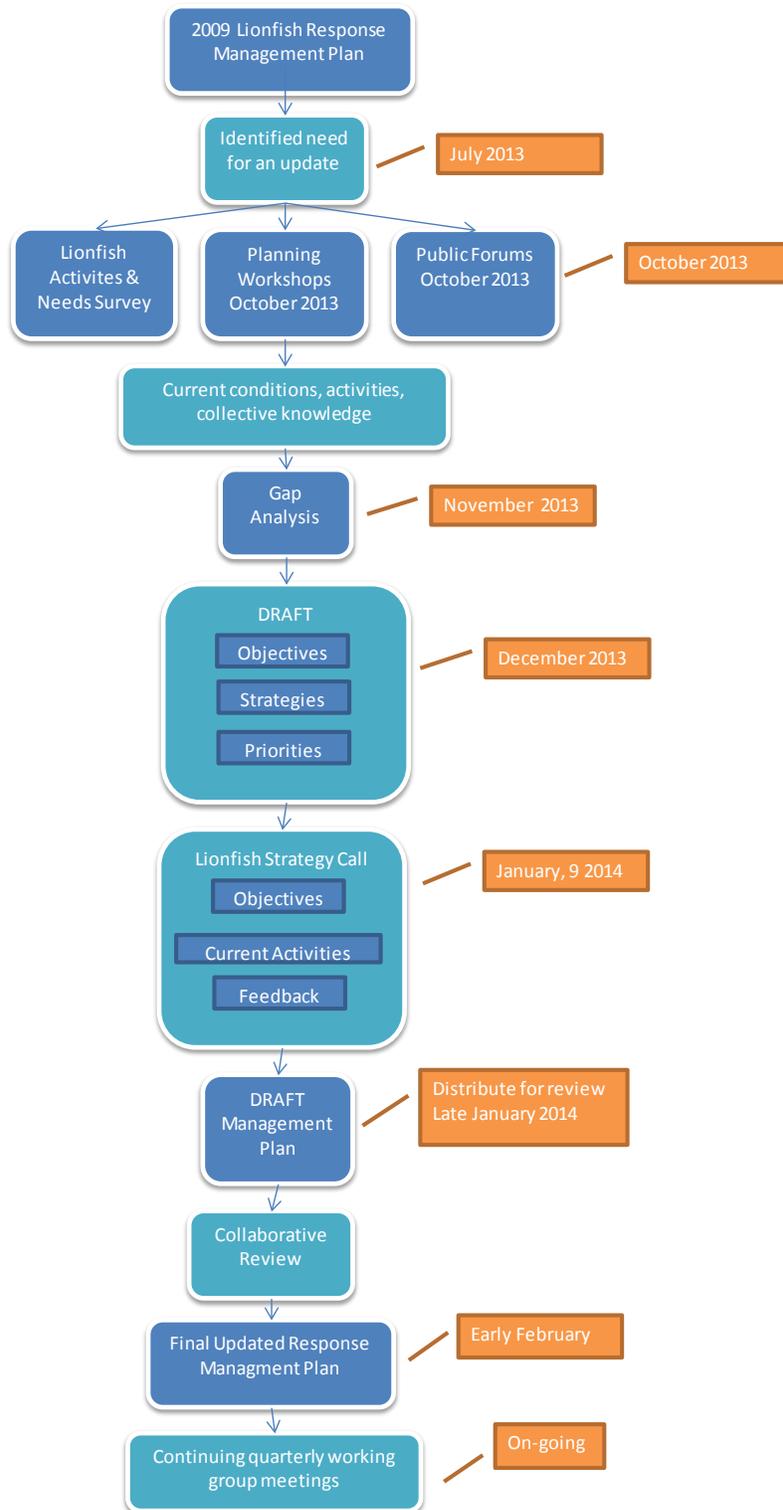


Figure 1. Lionfish response management plan update workflow

II. Background Information

Species description

The lionfish, a native of the Indian and Pacific Oceans, is a member of the scorpionfish family Scorpaenidae. There are several species of scorpionfish native to USVI waters. The most commonly seen scorpionfish in the USVI is the well camouflaged spotted scorpionfish, *Scorpaena plumieri*. All Scorpaenidae have venomous spines on their dorsal, pelvic and anal fins (Bohlke & Chaplin, 1993). They differ from scorpionfish in both their appearance and behavior. Unlike scorpionfish which are well camouflaged and generally found lying motionless on the bottom, lionfish are often brightly colored and, during the day, will often be found tucked under ledges or coral heads with their long, flagged dorsal and pectoral fins outstretched. Similar to the native scorpionfish, lionfish can often be closely approached by a diver.



Spotted Scorpionfish (*Scorpaena plumieri*) ©Jenny Keith



Lionfish (*Pterois volitans*) ©Jenny Keith

Two closely related species of lionfish, *Pterois volitans*, known as the common, turkey, or red lionfish and, *Pterois miles*, the cleartail or devil lionfish have rapidly invaded the waters of the Caribbean (Snyder & Burgess, 2007; Schofield, 2009). Though these two lionfish are difficult to tell apart (impossible underwater), genetic studies have shown that most of the lionfish in the western Atlantic and Caribbean are red lionfish. The red lionfish is native to the tropical waters of the Pacific, while the devil lionfish ranges from NW Australia to East Africa and the Red Sea, (Allen et. al., 2003; Kuitert, 1998; Lieske & Meyers, 2002; Schofield, 2009).

The first lionfish was spotted in Southern Florida in the 1980s and lionfish were established from Miami to North Carolina by 2002 (Schofield, 2009; Schofield, 2010). They were most likely introduced to the Atlantic through the aquarium trade and have since spread rapidly by ocean current through the western Atlantic Ocean and Caribbean Sea in larval and pelagic egg life stages. Invasive lionfish distribution and range is likely to be limited only by temperature (Morris et. al., 2009). The U.S. Geological Service's (USGS) website provides an interactive map that is periodically updated and shows the current range of the invasion (Schofield, 2009). It also shows the location of the presumed initial introduction of the lionfish on the east coast of Florida and the subsequent expansion of this species north as far as Long Island, east to Bermuda and south to the Bahamas and into the Caribbean.

Lionfish impacts

Lionfish are voracious predators with high reproductive rates that have the potential to markedly reduce prey species biomass and out-compete economically important native predators. The lionfish invasion exacerbates the effects of existing anthropogenic stressors including coral bleaching, climate change,

ocean acidification, overfishing, sedimentation and pollution (Morris et. al., 2009). Lionfish have already been shown to reduce prey species abundance and alter coral reef community structure, and models predict complex, indirect impacts that will cascade through the food web (Morris et. al., 2009; Arias-Gonzalez et. al., 2011)

Lionfish consume fish and crustaceans (shrimp, lobster and crabs). In the Bahamas, where lionfish abundances have increased dramatically since 2004, some 50 different species of fish have been found in the stomachs of lionfish, including seabasses, wrasses, cardinalfishes, gobies and juvenile groupers (Green & Cote, 2009; Morris & Akins, 2009). By 2010, lionfish were found to comprise close to 40% of total predator biomass which corresponds with a 65% decline in prey species over two years in the Bahamas (Green et. al., 2012). These same small fishes are also the prey of many species of Caribbean snapper and grouper. There is concern that the lionfish could out-compete native fish, especially commercially and recreationally important snappers and grouper, by drastically reducing the populations of the fish that they feed on and by directly preying on the juveniles of these species.



Common lionfish prey species. Left to right: Fairy Basslet, Glass/Masked Goby, Peppermint Goby. ©Jenny Keith

Lionfish have only a couple known predators in the Atlantic Ocean. Known predators to date are limited to two grouper species (Nassau and tiger) that have been found with lionfish in their stomachs in the Bahamas (Maljkovic et. al., 2008). Piscivorous fish (fish-eaters) likely avoid eating lionfish in part because they do not recognize lionfish as prey and because they have venomous spines distributed among their dorsal, pelvic (ventral) and anal fins. This lack of predation, along with its year round reproduction and high growth rates has resulted in the rapid proliferation of the lionfish (REEF, 2009).

Lionfish management

As the abundance of lionfish has increased and range of lionfish throughout the Caribbean has grown, recognition that lionfish pose a serious threat to marine ecosystems has spurred the development of lionfish management plans across the region. The Regional Strategy for the Control of Invasive Lionfish in the Wider Caribbean, published in 2013, acknowledges the trans-boundary ecological and socio-economic impacts of lionfish and encourages regional coordination and cooperation. It begins to develop a framework that will facilitate further collaboration (Gomez Lozano et. al., 2013). Although specific strategies differ between islands and agencies depending upon culture, needs and individual circumstance, most plans include three key components: education and outreach, control mechanisms, and monitoring protocol. Additionally, local regulatory and legislative instruments and authority, partnership building, a clear framework for cooperation among partners and sustainable funding sources for long-term implementation of strategies need to be addressed by each plan. A guide to invasive lionfish management published by the Gulf and Caribbean Fisheries Institute provides considerations for each of the recommended plan components (Morris ed., 2012).

Current conditions in the USVI

Lionfish were first sighted in St. Croix in November 2008, followed by sightings in St. Thomas and St. John in January 2010. In 2009 when the original lionfish response plan was developed, only nine lionfish had been collected in the waters around St. Croix. The distribution and abundance of lionfish in the Virgin Islands has increased rapidly over the past few years. Many individuals and organizations regularly remove lionfish from territorial waters and research and local knowledge of the lionfish invasion has grown.

Lionfish prey base and impacts

In 2011, Dr. Bernard Castillo II of the University of the Virgin Islands (UVI) dissected 542 lionfish from the west end of St. Croix to analyze gut contents. Though the majority of gut contents were not identifiable (80%), the top three lionfish prey species identified were shrimps (7%), damselfish (6%) and wrasse (5%).

Buck Island Reef National Monument (BUIS) is currently working with UVI, REEF and Dr. Stephanie Green (Post-doctoral Researcher, Oregon State University) to determine lionfish thresholds on coral reefs located within the Monument. Sixteen monitoring sites total were established on patch, linear and continuous reefs in early 2013. UVI continues to coordinate regular removals by volunteers at eight of the sites. NPS staff conduct prey base surveys bi-annually at the 8 removal sites and 8 reference sites. Once data collection is complete in 2014, Dr. Green's mathematical model will be used to determine the maximum number of lionfish that can persist before there is a significant impact to the prey-base (i.e. juvenile fish and small crustaceans). This project will validate Green's model for broad application on USVI reefs. Lastly, NPS managers will prioritize the BUIS reefs and use Green's model to develop a Park-specific lionfish management plan nested within the national NPS lionfish management plan: http://www.nature.nps.gov/water/marineinvasives/assets/documents/Lionfish_Response_Plan_%20final_small.pdf.

Lionfish abundance and distribution

Nikita Thompson, a graduate student in the CMES program at UVI, presented her Master's thesis work "Evaluating the abundance and size distribution of the Indo-Pacific Lionfish (*Pterois* spp.) in the USVI" at the St. Thomas public meeting. To evaluate abundances of lionfish over time, she used data collected by the Territorial Coral Reef Monitoring Program (TCRMP), which consists of 33 established sites, 19 on St. Thomas and St. John and 14 on St. Croix, which are monitored annually for fish abundance and benthic information. She found large increases in the number of lionfish on St. Thomas and St. John (167% increase in average number of lionfish) from 2011 to 2012. St. Croix also showed a rapid increase in the average number of lionfish from 2010 to 2011 (180%) but a decrease from 2011-2012 (61%). The cause of this decreasing trend in St. Croix is not certain but may be attributable to the accessibility of the sites on St. Croix to recreational divers. It is possible that lionfish removals by recreational divers near the St. Croix monitoring locations have caused a decrease in the abundance of lionfish at the sites. The

Things DPNR wants you to know:

- DPNR is responsible for all living resources and the Division of Fish and Wildlife (DFW) protects the VI's native species
- Waters 30m and shallower surrounding STT, STX and STJ are designated critical habitat for corals listed under the Endangered Species Act.
- A permit is required to kill or extract lionfish within no-take territorial waters which includes parts of STXEEMP & STEER. The permitting process, rules and regulations for lionfish removal are currently being finalized.
- A commercial fishing license is required to sell lionfish products.
- It is illegal to feed sharks, eels or other marine species.

St. Thomas and St. John monitoring sites are located in areas not easily accessible to recreational divers and control activities.

To explore the effects of depth and habitat type on lionfish distribution and density, Nikita compiled information from local agencies, fishermen, divers and the TCRMP to create a lionfish sighting database. She found no significant difference in lionfish density by reef complex, but her results show a trend of increasing lionfish density with increasing depth. Lionfish were significantly larger at depths greater than 5 m. Lionfish are settling everywhere but are most abundant in coral reef habitat, specifically coral walls, and they seem to show a preference for artificial structures. Nikita concluded that lionfish abundance is increasing annually, but continuing removal effort may slow the invasion.

Lionfish movement, migration, recruitment and habitat preferences need to be further studied. Localized and frequent removal by spearing or otherwise capturing lionfish seems to be effective at keeping lionfish numbers low at popular dive sites and near dive moorings. Understanding sources and sinks and patterns of recolonization following removal could improve efficiency of control activities. Field observations indicate that lionfish may be migrating to deeper areas when the water warms. Dr. Rick Nemeth, a professor of marine biology at UVI, noted at the St. Thomas public meeting that a lionfish travelled over 5 km from the Grammanik Bank where it was tagged to Hind Bank in 3 weeks.

Ciguatera fish poisoning

Ciguatera fish poisoning (CFP) is a foodborne illness caused by consuming reef fish that contain naturally occurring ciguatoxins. Ciguatoxins bioaccumulate; they originate in benthic dinoflagellates associated with macroalgae on coral reefs, and then move up the food web from herbivorous fish that consume the affected macroalgae to carnivorous fish and onto humans (Freidman et. al., 2008). The distribution of ciguatoxins across reef communities is not uniform, meaning that there are typically hotspots, and reef fish extracted from these areas should not be consumed. Ciguatoxins are tasteless and are not destroyed by cooking or freezing. They can cause gastrointestinal, neurological and cardiovascular symptoms when toxin levels exceed the FDA guidance level of 0.1 ppb (Freidman et. al., 2008; Robertson et. al., 2014). Ciguatoxins are endemic to the Virgin Islands, and Freidman et al. identifies grouper, barracuda, snapper, jack and mackerel as the reef fish most commonly linked to CFP.

Though there have been no documented cases of CFP from lionfish consumption in the U.S. Virgin Islands, it is a potential health risk that must be considered as lionfish are increasingly marketed for consumption (from Castillo II presentation at STX public meeting 10/2013). From September 2010 to December 2011, lionfish from St. Thomas, St. John and St. Croix were sent to the Gulf Coast Seafood Laboratory, Dauphin Island, AL for analysis. This study found ciguatoxins exceeding FDA guidance levels in 12% of the 153 lionfish tested with similar occurrence rates on all three islands. They concluded that concentrations of ciguatoxins found in lionfish “were most likely due to the location from which the fish were caught, length of time spent at that location, and the quantity of toxic prey consumed” (Robertson et. al., 2014). This study does not state that lionfish should not be consumed; however, lionfish should be treated with the same consideration as other reef fish with comparable rates of toxicity, such as schoolmaster snapper. In areas where ciguatoxins are found, it is important to purchase reef fish, including lionfish, from experienced fishers with knowledge of safe fishing grounds (Robertson et. al., 2014). This finding also highlights the need to continue developing local knowledge of ciguatoxin hotspots and high resolution ciguatoxin distribution maps.

In 2012, Dr. Bernard Castillo received funding from VI-EPSCoR to establish a laboratory at UVI to extract ciguatoxins from fish tissues before it is sent to FDA for bioassay. His results corroborate Freidman et al. findings. Of the 20 lionfish tested from 2011, 15% contained levels of ciguatoxins above the FDA guidance (from Castillo II presentation at STX public meeting 10/2013). Dr. Castillo’s lab is also working to establish the spatial distribution of ciguatera concentrations found in lionfish.



UVI research student Khalin Nisbett extracting CTX from lionfish tissue. Photo credit: Dr. Bernard Castillo II (UVI)

Additional resources

Territorial resources

- Department of Planning and Natural Resources (DPNR), Division of Fish and Wildlife website: <http://www.fw.dpnr.gov.vi>
- CORE Foundation website: <http://www.corevi.org/>
- USVI's Reef Resilience Program: <http://virrp.reefconnect.org/>
- Caribbean Lionfish Safari <http://www.caribbeanlionsafari.com/>

Regional resources

- REEF Lionfish website: <http://www.reef.org/lionfish>
- Caribbean Fishery Management Council website with lionfish information: <http://www.caribbeanfmc.com/LIONFISH/lionfish.htm>
- Gulf and Caribbean Fisheries Institute lionfish website: <http://www.gcfi.org/Lionfish/Lionfish.html>
- NOAA coastal science lionfish website: <http://coastalscience.noaa.gov/research/pollution/invasive/lionfish>
- NOAA/USGS Website: <http://nas.er.usgs.gov/queries/FactSheet.asp?speciesID=963> provides information about the lionfish including a detailed fact sheet and an animated map showing the trajectory of the lionfish invasion in the western Atlantic and Caribbean: <http://nas.er.usgs.gov/taxgroup/fish/Lionfishanimation.gif>
- NOAA CoRIS lionfish website: <http://www.coris.noaa.gov/exchanges/lionfish/>

Management plans and guidance***Gulf and Caribbean Fisheries Institute, Invasive Lionfish Control and Management Guide***

Morris, J.A., Jr. (Ed.). 2012. Invasive Lionfish: A Guide to Control and Management. Gulf and Caribbean Fisheries Institute Special Publication Series Number 1, Marathon, Florida, USA. 113 pp.

International Coral Reef Initiative, Regional Strategy

Gómez Lozano, R., L. Anderson, J.L. Akins, D.S.A. Buddo, G. García - Moliner, F. Gourdin, M. Laurent, C. Lilyestrom, J.A. Morris, Jr., N. Ramnanan, and R. Torres. 2013. Regional Strategy for the Control of Invasive Lionfish in the Wider Caribbean. International Coral Reef Initiative, 31 pp.

National Park Service, Lionfish Response Plan

McCreedy, C., C. A. Toline, and V. McDonough. 2012. Lionfish response plan: A systematic approach to managing impacts from the lionfish, an invasive species, in units of the National Park System. Natural Resource Report NPS/NRSS/WRD/NRR—2012/497. National Park Service, Fort Collins, Colorado.

NOAA

Morris, J.A., Jr., and P.E. Whitfield. 2009. Biology, Ecology, Control and Management of the Invasive Indo-Pacific Lionfish: An Updated Integrated Assessment. NOAA Technical Memorandum NOS NCCOS 99. 57 pp.

St. Maarten

St. Maarten Nature Foundation Lionfish Response Plan, Version 1:2010, Tadzio Bervoets, Manager, Nature Foundation St. Maarten.

Bahamas

Sealey, K.S., L. Anderson, D. Stewart and N. Smith. 2009. The invasion of Indo-Pacific lionfish in the Bahamas: challenges for a national response plan. Proceedings of the 61st Gulf and Caribbean Fisheries Institute: 61.

III. Education and Outreach

Objective and strategies

A strong education and outreach program builds community support, aids development of a network of partners and advances awareness and understanding of the lionfish invasion impacts. The program should include diverse stakeholders and identify target audiences, key messages and the method of outreach most effective for each group (Morris ed., 2012).

The objective of outreach and education programs is:

- **Every year, awareness and engagement of the VI community through education and participation has increased so that 1000 people on each island have participated in some kind of sighting, removal and/or consumption activity.**

Strategies identified at the public meetings and planning workshops are in listed in the table below (Table 2).

Table 2. Education and outreach objective and strategies

Objective 3: EDUCATION & OUTREACH - Every year, awareness and engagement of the VI community through education and participation has increased so that 1000 people on each island have participated in some kind of sighting, removal and/or consumption activity.	
Priority Strategies Objective 3	
Form subcommittee to develop uniform messages and strategies for each target audience, and create a framework for coordination of outreach efforts	
Share CORE's PADI Lionfish Search and Response <i>Distinctive Specialties</i>	
Additional Strategies	
Messaging	Make cultural connection
	Shift from "Danger! Warning!" to "Save your reefs"
	Develop consumer brochure that defines lionfish as venomous, not poisonous
	Develop comparison videos, for example, Bahamas vs. USVI
Avenues to disseminate information	Through VINE members' existing education and outreach programs
	Through social media
	Lionfish public awareness presentations
	Lionfish first aid training course; DAN hazardous marine life response training
	Virgin Islands Marine Advisory Service (VIMAS)
Coordination	Framework for communication and cooperation of education and outreach efforts
	Identify and apply for cooperative, joint funding, and utilize VIMPAN
Methods to measure success	Develop indicators
	Exit interviews at dive shops/ cruise ship dock/ airport terminals
	Survey public at Ag Fair and other events
Multi-faceted approach	What can people do at beaches?
	What can recreational divers do?
	What can deep fishers/traps do?

There are currently many organizations engaged in education and outreach programs across the territory (Appendix III). Education and outreach programs and materials focus on dispersing quality information with the purpose of:

- Raise awareness of the *impacts of the lionfish invasion* by describing the biology and ecology of the lionfish, especially as it relates to its rapid spread and impact on *local fisheries* and *marine ecosystems*
- *Increase participation* of fishers, divers and snorkelers in *removing lionfish*, increase general public participation in *reporting sightings of lionfish* and increase knowledge of the *points of contact for lionfish reporting*
- Train fishers and divers in lionfish *safe handling, preparation, ciguatera* and human health issues



Filleting and preparing lionfish at Reef Jam, St. Croix. Photo credit: Jenn Travis (STXEEMP)

Survey questionnaires and public comment identified effective types of outreach for target audiences (Table 3)

Table 3. Target audience and types of outreach for each audience.

AUDIENCE	TARGET AUDIENCE MATRIX						
	Print	Web	Training	Presentations	Events	Radio/TV	1 on 1
Students K-12	x	x		x			
Fishermen		x	x		x		x
Recreational divers	x	x	x	x	x	x	x
General Public	x	x	x	x	x	x	x
Tourists	x	x			x	x	
Legislators	x			x			x
Medical professionals	x	x	x				
Businesses	x	x	x	x		x	x

It is important to continue dispersing accurate, high quality information that makes the connection between the lionfish invasion, ecological and socio-economic impacts and specific actions each target audience can take to support lionfish suppression, all in a cultural context. Audiences that have the

potential to sight lionfish can be broadly divided into three groups with different depth zones: general public at beaches and shallow nearshore public access areas, recreational divers that typically access areas up to 130 feet and fishermen with deep water traps. All these groups should be familiar with what they can do if they see a lionfish. For the general public, they should note the location, perhaps use a lionfish marker so the site can be easily relocated and call the island-specific CORE response hotline or enter the information into the CORE online reporting form. (Refer to Section III, page 23, for more information.) Recreational divers, depending upon experience and training can either remove the lionfish or report the lionfish sighting to CORE via hotline or online form. The PADI distinctive specialty courses designed by CORE, described in detail on page 24, are encouraged for divers who would like to learn how to safely and efficiently remove lionfish. Finally, outreach and education should be provided to fishermen on how to handle and kill lionfish that they catch in their traps, or if interested in selling their catch, the means to safely prepare the fish for market.

Additional outreach and education that provides uniform, high-quality, current information on ciguatera in the Virgin Islands was identified as a current gap and key element in lionfish marketing. See section IV, page 28, for more information.

Gaps in education and outreach

The following gaps or opportunities for further outreach and education were identified:

- Uniform messaging with cultural connections for target audience, and increased bilingual outreach is needed.
- Increased coordination between organizations, agencies, non-profits, businesses, and stakeholders on the types of training and outreach provided and to whom, and more concerted efforts in public activities such as derbies or taste or handling demonstrations.
- Training for healthcare professionals, fishermen, divers and the general public on how to treat lionfish stings.
- High-quality, uniform ciguatera education that includes harvest-safe maps, myths and fact sheets, smart buying options and a symptom guide.
- Targeted education and outreach to legislators.
- Further engage and acknowledge the vital role of local fishermen.

Education and outreach subcommittee

The lionfish planning team determined that a subcommittee should be formed to further develop a cohesive, coordinated education and outreach program that addresses identified gaps and helps implement strategies. Tasks for the education and outreach committee include:

- Finalize strategies and priority strategies.
- Develop indicators and measures of success.
- Formulate uniform messaging for target audiences, especially for ciguatera and requesting divers not feed lionfish to sharks or other wildlife.
- Create a framework for coordination and cooperation among partners and stakeholders.
- Generate a budget and identify joint funding opportunities.

IV. Control and Removal

Objective and strategies

Though complete eradication of invasive lionfish is not possible, suppression of lionfish populations through removals can mitigate impacts.

The objective of lionfish control and removal is to:

- **Increase the amount of safe and effective removal to suppress lionfish in certain areas by coordinating efforts and focus removal on sensitive/critical areas.**

People active in lionfish control in the Virgin Islands indicated that removal efforts have functioned to keep lionfish numbers low at particular sites and possibly moderate lionfish impacts in the Virgin Islands. Committed volunteers, organizations, businesses and agencies have removed hundreds of lionfish. The lionfish planning group identified strategies and new control opportunities summarized in Table 4.

Table 4. Control and removal objective and strategies

Objective 1: CONTROL AND REMOVAL OF LIONFISH - Increase the amount of removal to suppress lionfish in certain areas by coordinating efforts and focus removal on sensitive/critical areas by applying the most safe and effective methods.	
Priority strategies for Objective 1	
Finalize permitting process for lionfish removals in territorial protected areas STEER & STXEEMP	
Dedicated response and removal team in partnership with CORE	
Increase removal coverage, depth and area, through trap fishing and diver use of trimix	
Identify how removal database can be utilized to identify areas that require removals	
Additional strategies	
Removal teams	Paid response and removal team
	Explore possibility of leasing rotating fishing boats for control and removal
Location	Use current data and research to guide removal efforts and focus on ecologically significant areas
	Expand removal coverage to areas not commonly fished or recreationally dived
Regulatory	Develop system to allow dock at Frederiksted pier
	Maintain existing moorings and install new moorings - U.S. Army Corps of Engineers permitting process
Incentives	Consider discounts for air fills or gas (such as CORE card membership discounts)
	Coordinate/support/sponsor dedicated lionfish derbies and incorporate lionfish into other derbies

Coordination

Increased coordination among the individuals, organizations and agencies engaged in control activities would reduce duplication of effort, enhance opportunities for more directed removals and improve efficiency.

A universal removal and sightings reporting form and website for communication should be used by all partners. CORE has already developed an online lionfish sighting and removals reporting form and map that can be used to help track control efforts, and this resource should be utilized as the territorial lionfish control database. The data can be used to guide control activities to prevent duplication of effort and ensure that popular dives sites or priority areas are targeted every few months for removal. It also serves as a way to monitor lionfish populations and the data collected can be used by researchers and managers to guide more directed and strategic.



An immediate priority for the planning team is to determine how the CORE database and website can best be used to fill gaps in removal coordination, to share information, and to serve as a tool for divers to identify which sites require removals.

Training and permits

CORE has developed two lionfish training courses that are sanctioned by PADI as distinctive specialties. PADI recently re-approved these courses, and a near-term priority is to train additional course instructors to increase the availability of these specialties on all islands. The systematic search course teaches lionfish biology and ecology and gives practical experience searching for lionfish. The response course is designed for recreational divers interested in lionfish control and removal. In addition to lionfish biology, ecology and impacts, proper removal techniques, safe use of removal equipment rules and methods to prevent physical damage to the reef and regulations are taught (Table 5).

CORE Lionfish Reporting Form

1. Go to: <http://www.corevi.org/submit.html>
2. Enter required information:
 - Email
 - Island
 - Activity (Fishing, Diving, Snorkeling)
 - Mark location on an interactive map
 - Number of fish
3. Enter optional information:
 - Date of sighting or removal
 - Transport type (i.e. Boat or Land Access)
 - GPS Coordinates
 - Enter size, depth and Method (Spear Gun, Fish Trap, No Kill etc.)
4. Submit!
5. Check the recent removal reports to identify gaps and guide control efforts
6. Questions or requests for information can be directed to:

info@corevi.org

Table 5. CORE developed PADI Distinctive Specialty courses

Course Name	Course Objectives	Requirements
Indo-Pacific Lionfish Systematic Search Distinctive Specialty	(1) To develop the student's practical knowledge of lionfish impacts and biology. (2) To enable the student to participate in lionfish searches.	<ul style="list-style-type: none"> • PADI Advanced Open Water. • A minimum of 20 logged dives • Buoyancy control • Proper use of extraction equipment • 2 open water dives
Caribbean Lionfish Response Distinctive Specialty	(1) To develop the student's practical knowledge of lionfish impacts and biology. (2) To enable the student to use the proper techniques to safely remove lionfish.	<ul style="list-style-type: none"> • PADI Advanced Open Water • A minimum of 50 logged dives • Buoyancy control • Proper use extraction equipment • 2 open water dives (20-40ft) • Complete 2 lionfish extractions

These courses have also been approved by DPNR and St. John NPS and are required in order to obtain permits for removal in several of the protected areas in the territory. Table 6 summarizes lionfish removal activities allowed in protected areas and method for reporting sightings. Note that all fishing and resource extraction, including lionfish removal and control activities, is not allowed in Buck Island Reef National Monument and lionfish sightings should be reported to staff for removal. Removals are not currently allowed in the No-Take zones of STXEEMP or STEER. A mechanism for applying, accepting, and enforcing permits for lionfish removals in the No-Take zones is in development.

Table 6. Lionfish removals in protected areas

Island	Protected Area	Management	What to do
STX	BUIS	NPS	No fishing or resource extraction is allowed in BUIS. This includes lionfish. Note location and report sightings to NPS staff. Reporting form available at NPS Headquarters in Christiansted or call 340-773-1460.
	STXEEMP	DPNR - CZM	Removals in No-Take and Recreational Zones by permit only. Permit application process currently in development. To report sightings call: 340-718-3367
STT	STEER	DPNR - CZM	Removals by permit only. Permit application process currently in development. Report sightings to CORE: sttdive@corevi.org 340.201.2341
STJ	VINP	NPS	Removals by NPS permit only. For more information contact: Leslie Charpentier, CORE removal coordinator on STJ: 340.201.2342 stjdive@corevi.org NPS VINP Lionfish Coordinator Thomas Kelley thomas_kelley@nps.gov
	VICRNM	NPS	

Removal teams

Currently, most removal and control activities are opportunistic and are completed by volunteers or dive operators as time and resources allow. Dedicated and funded removal teams would support more coordinated, site-specific and regularly scheduled control activities. The planning group proposed several possible arrangements for a dedicated removal team and were particularly interested in involving fishermen. One possibility is to lease rotating fishing boats for removal activities. This structure serves the dual purposes of utilizing existing equipped boats and of supporting local fishermen while promoting lionfish removal and marketing among fishers. A second possibility is a dedicated removal team consisting of recreational divers supported in partnership with CORE using alternating private boats, partnering with dive operators or a purchasing a dedicated boat. Liability issues would need to be addressed with either the use of private boats or dive operator boats. CORE has also proposed purchasing a boat in 2014 devoted to lionfish control, monitoring and research.

Most recreational dive operators already participate in lionfish removals at popular dive sites, either to maintain the dive site or as a demonstration to customers. An opportunity exists for a more organized, concerted removal system among tourism-based dive operators or dive safaris. Dive shop instructors could begin teaching the CORE developed lionfish PADI distinctive specialties and conduct more rigorous pre-dive lionfish briefings. This marketing structure incentivizes lionfish removals and education and outreach. Lionfish removal tourism is further discussed in Section V, page 32.



Paul Vrabcak removing lionfish at Frederiksted Pier. ©Jenny Keith

Several organizations and agencies respond to reports of lionfish sightings, but again, response is often limited by available time and resources. The planning group identified the need for a single, agreed-upon reporting and response system. CORE has established response hotlines on each island, and the planning group proposed using this system for response with an additional framework for support from other organizations and agencies (Table 7). Once dedicated removal teams are in place, they can respond to sightings.

Table 7. CORE lionfish response hotlines

Island	CORE Response Hotlines
STT	sttdive@corevi.org 340.201.2341
STX	stxdive@corevi.org 340.201.2340
STJ	stjdive@corevi.org 340.201.2342

Incentives

Lionfish removal incentive programs were an area of focus for public comments and survey questionnaire responses. Many participants proposed free airfills or equipment discounts in exchange for lionfish tails. Currently, CORE members are offered some discounts at several dive vendors, however the programs are supported by the individual vendors and this arrangement is not a feasible large-scale option. Subsidized reward or discount programs are also not a sustainable long-term solution.

More sustainable options are annual lionfish derbies that serve multiple purposes: education and outreach, training and removal. These concerted efforts can also yield important information, either in coordination with specific research projects or in the reporting of location, size, and severity of colonization and effectiveness of removal. Several annual derbies are currently scheduled for 2014 (Appendix III). Some derbies in the past have had poor turn-out. One potential problem is that participants have issues handling the lionfish safely and transporting them to the weigh-in location. Zookeepers are a safe option, but are expensive. Friends of STXEEMP proposed holding a ‘make-your-own zookeeper’ workshop each year. Further scoping to find derby prizes that appeal to divers and fishermen was also suggested. Another sustainable solution with its own built-in incentive system is to develop a lionfish market both for consumption and dive tourism. Section V further discusses marketing.

Feeding sharks

Sharks and other marine wildlife are being fed dead or incapacitated lionfish by divers in order to condition predators to hunt and feed on live lionfish. It was initially hoped that the practice of feeding lionfish to sharks would encourage natural predation of lionfish. However, observation has shown that while sharks and morays will eat dead lionfish that are offered to them, they do not hunt live lionfish. This effort to condition sharks has created a potentially hazardous situation for divers at popular sites who are reporting sharks “stalking” divers in the expectation of hand-outs. The association of recreational divers with food has caused concern.

CORE, Caribbean Lionfish Safari, CRABBS and Jolly Roger’s printing are working to promote a “Do Not Feed the Sharks” campaign. Posters and logos were printed in the fall of 2013 and disseminated among dive shops, commercial fishermen, fisherman board and tourism (Appendix V). Promoting and dispersing this message to all divers is a short-term priority.

V. Research and Monitoring, Data Gathering and Analysis

Objective and strategies

Research and monitoring, data gathering and analysis of lionfish biology, ecology and socio-economic impacts can guide removal efforts, increase effectiveness and assess the success of current activities.

The objective of research and monitoring, data gathering and analysis is to:

- **Improve our understanding of lionfish impacts, effectiveness of removal, and viability of commercial sale by regularly (bi-annually) examining the local and regional scientific (peer-reviewed) results with observational data and by concentrating the collection of removal and sighting data into one shared database.**

Strategies identified at the public meetings and planning workshops are in listed in the table below (Table 8).

Table 8. Research and monitoring, data gathering and analysis objective and strategies

Objective 2: RESEARCH AND MONITORING, DATA GATHERING AND ANALYSIS Improve our understanding of lionfish impacts, effectiveness of removal, and viability of commercial sale by regularly (bi-annually) examining the local and regional scientific (peer-reviewed) results with observational data and by concentrating the collection of removal and sighting data into one shared database.	
Priority Strategies Objective 2	
Ciguatera	Sustain high volume local ciguatera labs
	High resolution ciguatera distribution maps
	Identify funding sources – National Institutes of Health, Dept. of Agriculture, Dept. of Health, DPNR, UVI, Homeland Security
Invasion effects	Impacts on local fisheries and reef fish communities
Recolonization after removal	Sources and sinks
	Lionfish migration
	Effect of currents and hurricanes on movement
Additional Strategies	
Research to guide removal efforts	Which trap designs and baits are most effective
	Sources of lionfish recolonization after removal
	Document the benefits of moorings in lionfish removal efforts for the U.S. Army Corps of Engineers mooring maintenance and installation permitting process
	Additional studies on removal effectiveness, thresholds, removal frequency and effort
Viability research	Feeding tarpon
	Farming of groupers, gobies and other important species
	Use as fertilizer
Coordination	Coordinate research and monitoring efforts through permits, reporting, increased communication or central website

A complete list of research questions identified through the update process is shown in Table 9.

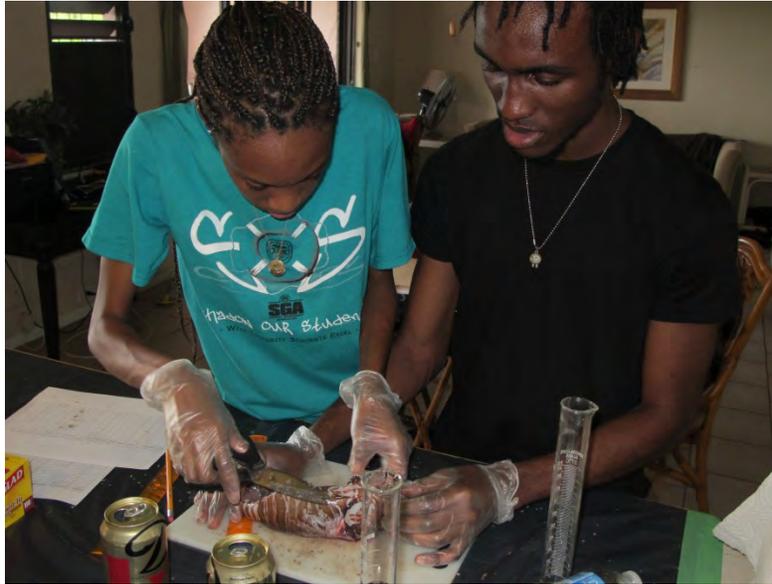
Table 9. Research questions

Future research questions/topics
Ciguatera fish poisoning
Local levels and hotspot
Are people being affected by ciguatera poisoning from consumption of lionfish?
Distribution, abundance and movement
Habitat types, depths, food supply
Highest densities of juvenile lionfish
Egg movement, migration, sources and sinks
Recolonization after removals
Effect of currents and hurricanes on movement
Are they moving deeper when the water is warmer?
Are lionfish moving deeper during the day and moving shallower at night to hunt?
Benefits of moorings in lionfish removal efforts for the U.S. Army Corps of Engineers mooring maintenance and installation permitting process
Natural population controls
What are the population controls in their native range?
Are there natural predators here? Grouper? Lobster?
Impacts of feeding lionfish to sharks, eels, etc.
Invasion Impacts
Which fisheries/invertebrates/resources are most affected?
Lionfish stomach content analysis to determine target prey species
Removal effort and effectiveness
Trap types and bait - why are some traps catching more lionfish?
Focused removals in priority areas such as nurseries, spawning areas, high tourism sites etc.
Removal frequency - how often do lionfish need to be removed for different desired management outcomes?
Additional studies on removal effectiveness, thresholds, removal frequency
Viability studies – marketable uses for lionfish

Ciguatera

Understanding the levels of ciguatoxins in lionfish and the location of hotspots is vital to widespread marketing of lionfish for consumption. As discussed in the introduction, page 17, Dr. Bernard Castillo's lab at UVI is currently researching the levels and spatial distribution of ciguatoxins found in lionfish within the territory. Fine-scale maps of ciguatera hotspots are important not just for commercial fishing and outreach to customers but also for enhanced safety for recreational divers who want to eat the lionfish

they catch. Continuing this work, expanding the capacity of the lab and ensuring that information is accurately presented to the public was identified by the public and working group as a priority strategy.



UVI students Lorne Joseph and Gejae Jeffers dissecting lionfish. Photo credit: Dr. Bernard Castillo II (UVI)

Invasion impacts and removal effectiveness

Continued research on invasion impacts and removal effectiveness was identified as a high priority need. Many researchers have on-going and proposed lionfish projects (Appendix III). The public and working group recognized the value of further research that builds from the BUIS lionfish threshold study which can be used to guide control efforts by categorizing high priority ecological areas, lionfish threshold population by habitat and removal effort and frequency.

Coordination

Research and monitoring results and data need to be easily accessible to managers, organizations and interested volunteers. CORE's website and online reporting form should be utilized as a centralized data and research depository, and regular research and monitoring forums will be held to update one another on projects, results and remaining questions. Links to the CORE website should be provided by partner organizations. Coordination and communication will be discussed further in section VII.

VI. Marketing

Objective and strategies

Increasing the demand and building capacity for commercial sale of lionfish and promotion of removal activities for dive tourism were recognized as the most sustainable approach to incentivizing removals.

The objective of marketing lionfish for commercial sale and dive tourism is to:

- **Increase the demand for lionfish products such as food fish for homes and restaurants and jewelry or agricultural products so that 20 new fishermen have begun to sell lionfish each year and engage the dive community and visitors in lionfish spotting and hunting to increase business and revenue for dive operators.**

Strategies identified at the public meetings and planning workshops are in listed in the table below (Table 10)

Table 10. Marketing objective and strategies

Objective 4: MARKETING - Increase the demand for lionfish products, such as food fish for homes and restaurants and jewelry or agricultural products so that 20 new fishermen have begun to sell lionfish each year, and engage the dive community and visitors in lionfish spotting and hunting to increase business and revenue for dive operators.	
Priority Strategies Objective 4	
Commercial fishing license exemption for lionfish	Approach FAC with institutional license exemption for invasive species
	Draft a statement for FAC with ideas, options, transparencies, number of fish/month
	DPNR and CORE draft letter
	Annual review/evaluation of exemption effectiveness
	Use funding from license fees to sponsor events and tastings
	Collect letters of support from dive operations including their costs
	Coordinate with sustainable seafood program
If no action on commercial fishing license lionfish exemption within 3 months, explore co-op or fishermen partnerships.	
Form subcommittee to research feasibility of potential commercial markets and develop strategy for promoting lionfish consumption and dive tourism; coordinate with the sustainable seafood "reef responsible" program to acknowledge fishermen that are removing and selling lionfish.	
Additional Strategies	
Explore viability	Promote lionfish consumption at restaurants
	Develop a local market
	Promoting lionfish among cruise ships tourists
Organize tastings, promotional events, and trainings at fish markets, Ag Fair, Carnival, Food and Wine Experience, etc.	

Commercial Sale

The public and the working group identified the sale of lionfish for jewelry-making, food or fertilizer as possible markets. Lionfish spines can be used in jewelry-making and some conservationists in Belize have had success selling spines to jewelry artists (personal communication with Philip Karp).

Lionfish have a mild flavor similar to grouper and can be marketed for consumption; however, there is the public perception that lionfish are poisonous or are not suitable for eating. A further complication is that lionfish is often associated with ciguatera. Additional ciguatera research and education is a key component in a lionfish marketing stratagem. The Bahamas and the Florida Keys, for example, have developed successful lionfish marketing campaigns that have engaged fishermen, restaurants and the general public. Partners have targeted fishermen by hosting tournaments and trainings that demonstrate safe removal and preparation techniques, and lionfish appetizers at local events promote lionfish consumption to the general public. Several restaurants in the Bahamas serve lionfish and some restaurants in the Florida Keys have marketed the availability of lionfish on their menus to attract local business and tourists.

Several local restaurants in the St. Croix have been serving lionfish as availability allows including Villa Morales, Tutto Bene, Deep End Bar and Restaurant and You Are Here Bar and Grill. Some fishermen have also begun to sell lionfish filets to customers at local fish markets or are exporting their lionfish catches.

Many divers are also interested in selling or donating their catch to restaurants, commercial farms or jewelry-makers; however, a commercial fishing license is required for any exchange of fish. The working group suggested two options that would allow recreational divers to sell lionfish. The first is a commercial fishing license exemption for lionfish. This exemption would need to be approved by the Fisheries Advisory Council (FAC) with a qualification for annual review to assess effectiveness and to ensure that an exemption does not encroach on commercial fishermen's business. A second option would be to create co-ops or partnerships with local fishermen. The marketing subcommittee should evaluate the practicality of each alternative. It is also important to consider that recreational divers are not as familiar with ciguatera hotspots as local fishermen. This again emphasizes the need for a high resolution map of ciguatera hotspots.

A subcommittee will be formed to assess viability and further develop a marketing strategy.

Dive tourism

There is also an emerging market for dive tourism that caters to visitors' desire to hunt lionfish. A major concern with the development of a lionfish removal tourism industry is the liability of dive operators in the case of injury. Partnerships with the VI Bureau of Tourism and other tourism organizations should be explored.

Many dive operators remove lionfish to enhance customers' dive experience or expend their own time and resources to regularly remove lionfish at popular dives sites to reduce ecological impacts. Dive operators and other individuals that frequently remove lionfish are interested in recovering some of the control expenditures by selling them which would require a special license, as discussed above.

Marketing subcommittee



- Assess viability of commercial sale of lionfish for consumption, jewelry and agriculture
- Build partnerships with sustainable seafood program, restaurants, dive operators and fishermen
- Develop education and outreach strategy for marketing of lionfish consumption

- Address dive operators' liability concerns for lionfish removal tourism industry
- Pursue an institutional commercial fishing license exemption or co-op

VII. Communication Objective and strategies

Many individuals, organizations, businesses and agencies are engaged in education, control, research and marketing activities, but the Virgin Islands currently lacks a strong framework for communication and coordination between groups and to the public. In addition to improved communication within the territory, lionfish pose a trans-boundary threat; therefore, communication and cooperation with other Caribbean islands is vital.

The objectives of an internal and external communication program are:

- **Communication – internal: Improve communications and sharing of observations so that the active lionfish committee is making progress on strategies outlined in this management plan and getting the message to partners, media and legislators.**
- **Communication – external: Improve communications with neighboring islands by sharing new knowledge and observations from USVI by communicating regularly on regional listservs (GCFI/CAMPAM, UNEP/SPAW's lionfish email list).**

Strategies identified at the public meetings and planning workshops are in listed in the table below (Table 11).

Table 11. Communication objective and strategies

Objective 5a: COMMUNICATION - INTERNAL - Improve communications and sharing of observations so that the active lionfish committee is making progress on strategies outlined in this management plan and getting the message to partners, media and legislators.	
Objective 5b: COMMUNICATION - EXTERNAL - Improve communications with neighboring islands by sharing new knowledge and observations from USVI by communicating regularly on regional listservs (GCFI/CAMPAM, UNEP/SPAW's lionfish email list).	
Priority Strategies Objective 5	
Develop framework for continued coordination and cooperation within the Virgin Islands	
Cultivate down island contacts and communications; utilize regional lionfish listservs and conferences	
Additional Strategies	
Planning group	Quarterly planning and coordination calls or web-ex
	Submit accomplishments before the meeting for participants to review
	Identify funding opportunities
Public	Bi-annual public meetings
	Quarterly newsletter
	Recognition for accomplishments through PSA or announcements
	Develop channels for disseminating ciguatera research

Internal communications

A comprehensive framework for inter-agency and organizational cooperation needs to be developed. Two elements for internal communications identified by the working group are quarterly or semi-annual calls and a central lionfish website.



A central website should be used to share announcements, education, outreach and training materials, funding opportunities, and serve as a repository for lionfish reporting data, current research and peer-reviewed articles. The CORE website already includes a lionfish reporting form and map and would most likely be the best site to utilize as a hub for internal communications. The CORE website can also link to partners programs and vice versa.

Partners:

- Blue Flag USVI <http://blueflagusvi.org/>
- Caribbean Lionfish Safari <http://www.caribbeanlionsafari.com/>
- Coral World Ocean Park www.coralworldvi.com
- CORE Foundation <http://www.corevi.org/>
- Don't Stop Talking Fish, NOAA Initiative <http://www.dontstoptalkingfish.com/>
- Friends of the St. Croix East End Marine Park <http://www.friendsofstxeemp.org/>
- Friends of Virgin Islands National Park <http://www.friendsvinp.org/>
- NOAA, Ocean and Coastal Management U.S. Virgin Islands http://coastalmanagement.noaa.gov/mystate/virgin_islands.html
- St. Croix Environmental Association <http://www.stxenvironmental.org/index.html>
- The Nature Conservancy, Eastern Caribbean Program <http://www.nature.org/ourinitiatives/regions/caribbean/virginislands/>
- University of the Virgin Islands, Center for Marine and Environmental Studies <http://www.uvi.edu/research/center-for-marine-environmental-studies/default.aspx>
- University of the Virgin Islands, Virgin Islands Marine Advisory Service <http://www.uvi.edu/community/virgin-islands-marine-advisory-service/default.aspx>
- USVI's Reef Resilience Program <http://virrp.reefconnect.org/>
- Virgin Islands Department of Planning and Natural Resources <http://www.dpnr.gov.vi/>
- VINE google group
- St. Croix East End Marine Park

Funding

Funding is a key necessity for an ongoing strong lionfish program. Many organizations use private donations or members' personal funds and resources to remove lionfish. There is a critical need for collaborative efforts to identify and secure funding for lionfish programs. Some possible funding sources identified by the planning group were:

- VI EPSCoR
- National Science Foundation

- Donations from organizations such as Friends of the Park or Audubon Society
- UVI grants
- Territorial Coral Reef Monitoring Program
- 501c funds and federal grants
- Local and federal government grants
- PADI Aware grants
- CORIS
- Cruise ship corporations
- Mitigation funds
- Department of Health and Homeland Security (ciguatera research)
- VI Tourism
- REEF Educational Foundation from the Keys
- National Park Foundation
- National Environmental Education Foundation

External communications

The lionfish invasion has affected the entire Caribbean, making regional communications and coordination imperative. Increased communication with other islands will help cultivate new approaches and introduce opportunities to adopt successful lionfish management elements employed in other areas. Developing relationships and contacts around the Caribbean and joining regional listservs will foster cooperation and information-sharing.

Networking sites and listserv

- Caribbean Fisheries Management Council
<http://www.caribbeanfmc.com/LIONFISH/lionfish.htm>
- Gulf and Caribbean Fisheries Institute <http://www.gcfi.org/Lionfish/Lionfish.html>
- International Coral Reef Initiative, Regional Lionfish Committee
<http://www.icriforum.org/groups/our-committees/regional-lionfish-committee>
- International Union for Conservation of Nature (IUCN), Marine and Polar Programme
https://www.iucn.org/about/work/programmes/marine/marine_our_work/marine_invasives/?13868/International-plan-launched-to-tackle-invasive-lionfish
- Lionfish Hunters <http://www.lionfishhunters.org/index.html>
- REEF <http://www.reef.org/lionfish>
- Lionfish listservs
- CAMPAN network and forum

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**Appendix I: Survey questionnaire, public forum
announcements, and meeting attendance summary**

Lionfish Activities and Needs Survey

This survey is designed to capture what is working and what is missing for the USVI territory's lionfish control efforts. Responses will be compiled and incorporated into an update to the 2009 "LIONFISH RESPONSE MANAGEMENT PLAN for the US VIRGIN ISLANDS". This updated plan will outline efforts conducted, identify gaps and necessary resources, and provide a means for coordination of funding and other efforts.

Please tell us what's being done by you or your group, what's been working, and what you needs to happen moving forward. Any and all information is appreciated!

For follow up purposes, please provide:

Name: _____

Organization or group's name: _____

Email: _____ Phone: _____

Keep your name confidential?

Yes

No

Please describe yourself:

- | | |
|---|---------------------------------------|
| <input type="checkbox"/> Fisherman | <input type="checkbox"/> Researcher |
| <input type="checkbox"/> Resource Manager | <input type="checkbox"/> Educator |
| <input type="checkbox"/> Recreational Diver or Operator | <input type="checkbox"/> Other: _____ |
| <input type="checkbox"/> Commercial Diver or Operator | |

Who else would you recommend we interview?

A. CAPTURE: Please describe your lionfish control efforts.	
1. If you are a diver, how often do you actively hunt for lionfish?	
<input type="checkbox"/> Daily	<input type="checkbox"/> 1x per month
<input type="checkbox"/> 1x per week	<input type="checkbox"/> Other:
2. If you are a fisherman, how often do you capture lionfish during regular fishing activities?	
<input type="checkbox"/> Daily	<input type="checkbox"/> 1x per month
<input type="checkbox"/> 1x per week	<input type="checkbox"/> Other:
3. What kind of equipment and gear do you use?	
<input type="checkbox"/> Hawaiian sling /pole spear	<input type="checkbox"/> Trap/pot
<input type="checkbox"/> Spear gun	<input type="checkbox"/> If you catch lionfish as bycatch, what are you doing with them??
<input type="checkbox"/> Catch bag/gloves/other tools? (describe):	<input type="checkbox"/> Other: (describe)
4. How long on average do you spend <u>actively</u> hunting for or killing lionfish per dive or fishing trip?	
<input type="checkbox"/> Some part of the dive (1hour or less)	<input type="checkbox"/> 1-2 hours of my fishing trip
<input type="checkbox"/> All of the dive (1-2 hours)	<input type="checkbox"/> 2-5 hours of my fishing trip
<input type="checkbox"/> Other:	<input type="checkbox"/> more than 5 hours
5. How many lionfish do you typically catch per dive or fishing trip?	
<input type="checkbox"/> 1	<input type="checkbox"/> 11-30
<input type="checkbox"/> 2-5	<input type="checkbox"/> 31-50
<input type="checkbox"/> 6-10	<input type="checkbox"/> 51 or more
6. What are your costs to capture lionfish per month?	
<input type="checkbox"/> Minimal- would be doing it anyway	<input type="checkbox"/> Cost to purchase equipment= \$_____
<input type="checkbox"/> Costs for fuel, boat= \$_____	<input type="checkbox"/> Costs of air fills=\$_____
<input type="checkbox"/> Payment to dive operator= \$_____	<input type="checkbox"/> Other (describe):
7. What methods or activities are working to control lionfish?	
<input type="checkbox"/> Lionfish removal dives	<input type="checkbox"/> Trap/pot fishing
<input type="checkbox"/> Frequent removal at a particular site (describe below)	<input type="checkbox"/> Other
Please describe:	
8. What do you need to more effectively control lionfish?	
<input type="checkbox"/> Funding	Specify:
<input type="checkbox"/> Training	Specify:
<input type="checkbox"/> Equipment or Gear	Specify:
Please describe:	

9. What gaps exist in control efforts?

<input type="checkbox"/> Available resources	<input type="checkbox"/> Awareness of the problem
<input type="checkbox"/> Depth	<input type="checkbox"/> Too many lionfish, too much space
<input type="checkbox"/> Knowledge of level of effort needed to make a difference	<input type="checkbox"/> Knowledge of effective control techniques
<input type="checkbox"/> Location	<input type="checkbox"/> Other:

Please describe:

10. Are there additional incentives for others to capture lionfish?

11. Other issues, observations, etc.:

B. MARKET: seafood, tourism

12. What market incentives do you see working?

<input type="checkbox"/> Availability in local markets	<input type="checkbox"/> Dive Tourism
<input type="checkbox"/> Serving at restaurants	<input type="checkbox"/> Export of lionfish filets
<input type="checkbox"/> Derbies with cash or other prizes	<input type="checkbox"/> Other:

13. What is needed for a market for lionfish? Ideas for government program or funding?

C. RESEARCH and MONITORING

14. Are you involved with or do you know of any recent local or regional research of interest? Please describe (contact of PI, location of report or proposal, duration, costs, funding sources, etc.):

15. What research questions are important to improving overall lionfish control, or better understanding the ecological or human safety impacts? Please describe:

D. EDUCATION and OUTREACH

16. What have you or your organization done to promote awareness of lionfish?

<input type="checkbox"/> Radio PSAs	<input type="checkbox"/> Outreach activities
<input type="checkbox"/> TV PSAs	<input type="checkbox"/> Events
<input type="checkbox"/> Posters	<input type="checkbox"/> School Activities
<input type="checkbox"/> Flyers/Brochures	<input type="checkbox"/> Other

17. To what audience?

<input type="checkbox"/> General public	<input type="checkbox"/> Legislators
<input type="checkbox"/> Schools	<input type="checkbox"/> Fishermen
<input type="checkbox"/> Divers and Dive Operators	<input type="checkbox"/> Restaurants
<input type="checkbox"/> Fish market vendors or buyers	<input type="checkbox"/> Others (tourists?, etc.):

18. What is working?

<input type="checkbox"/> Radio PSAs	<input type="checkbox"/> Outreach activities
<input type="checkbox"/> TV PSAs	<input type="checkbox"/> Events
<input type="checkbox"/> Posters	<input type="checkbox"/> School Activities
<input type="checkbox"/> Flyers/Brochures	<input type="checkbox"/> Other

19. What is missing, and for what audience?

E. GENERAL: observations, suggestions, resources

20. How much do you spend on lionfish activities?

What is your source of funding?

What funding do you need?

Ideas for funding (local government, federal or private grants, publicly raised funds, etc.)? Please be specific:

21. Is there anything else you'd like to see incorporated into a territorial lionfish management plan?

US Virgin Islands

LIONFISH Public Forums

St Croix: Tuesday, October 22, 4-6pm

The Nature Conservancy's Estate Little Princess

St Thomas: Thursday, October 24, 4-6pm

UVI Administration and Conference Center, Rm 203

- ♦ *What activities have been working to control lionfish populations on Virgin Islands' reefs?*
- ♦ *Come learn the latest techniques, studies, and tools!*
- ♦ *Share your experiences and give input on future direction for Territorial lionfish control, marketing, outreach, and research!*

For more information on the public forums, contact Jeanne Brown: jeanne_brown@tnc.org (340) 718-5575

For more info on Territorial lionfish activities, contact Dr. William Coles, Division of Fish and Wildlife: wiliam.coles@dpnr.vi.gov (340)773-1082



Please bring your sample tools, outreach and materials to display.

Light refreshments will be available.

Lionfish Public Forums

FOR IMMEDIATE RELEASE:

Contact: Jeanne Brown,
The Nature Conservancy
(340) 718-5575 Jeanne_brown@tnc.org

St. Croix: Tuesday, October 22, 4:00-6:00pm TNC's Estate Little Princess

St. Thomas: Thursday, October 24, 4:00-6:00pm UVI Administration and Conference Center, Room 203

Lionfish pose a significant risk to USVI coral reef ecosystems and fisheries resources. An ad-hoc working group of territorial resources managers, non-governmental organizations, researchers and other stakeholders created the "Lionfish Response Management Plan for the US Virgin Islands" in 2009. Since the creation of the response plan, the status of the lionfish invasion in territorial waters has changed from one of sightings of individual fish separated geographically and temporally to sightings of many fish, throughout many habitats and depths, and throughout the territory. As a result, there is a need to update and revise the response plan. The Department of Planning and Natural Resources, Divisions of Fish and Wildlife and Coastal Zone Management is supporting the revision of the plan thereby providing a strategy for decision-makers, marine managers, researchers, fishers, divers and educators to implement in an effort to control the worst effects of the lionfish in USVI waters.

To assist in this process, The Nature Conservancy and a DPNR contractor are launching a series of informational public forums to gather information on activities and accomplishments to date, incorporating new activities in the management plan, and filling in gaps on what is needed. We need input from community members who are active in lionfish control and those who are concerned about the impact of the lionfish invasion. We will present a summary of current activities and needs we've been gathering from interviews and the on-line survey (<https://www.surveymonkey.com/s/RGZSN3D>), then identify solutions, prioritize strategies and map efforts. *Please join us in St. Croix on Tuesday October 22 at The Nature Conservancy's Estate Little Princess from 4:00pm- 6:00pm and on St. Thomas Thursday, October 24 at UVI's Administration and Conference Center, Room 203, 4:00pm to 6:00pm.* We invite participants to bring their tools, educational materials, or other resources to display at the public forums. Light refreshments will be served.

- **What activities have been working to control lionfish populations on Virgin Islands' reefs?**
- **Come learn the latest techniques, studies, and tools!**
- **Share your experiences and give input on future direction for Territorial lionfish control, marketing, outreach and research.**

For more information on the public forums, contact Jeanne Brown, jeanne_brown@tnc.org, (340) 718-5575. For more info on Territorial lionfish activities, contact Dr. William Coles, Division of Fish and Wildlife: wiliam.coles@dpnr.vi.gov (340) 773-1082.

October 2013 Lionfish meeting summary

LOCATION	TYPE	DATE	ATTENDANCE	AGENDA
St. Croix The Nature Conservancy's Estate Little Princess	Public forum	Tuesday October 22, 2013 4:00- 7:00pm	37 CORE, CRABBS, dive operators, volunteers, researchers, media and representatives from Delegate Christiansen's office	<ul style="list-style-type: none"> • Dr. William Coles - Introduction • Jeanne Brown - Survey results • Dr. Bernard Castillo II - Presentation of ciguatera research • Public comments and questions
St. Croix The Nature Conservancy's Estate Little Princess	Planning workshop	Wednesday October 23, 2013 10:00am – 3:00pm	12 CORE, DPNR Div. of Fish and Wildlife, NOAA, NPS, TNC, recreational divers	<ul style="list-style-type: none"> • Goal of the lionfish control plan • Objectives of the updated plan • Priorities and strategies
St. Thomas Univ. of the Virgin Islands Conference Room 203	Public forum	Thursday October 24, 2013 4:00pm- 7:00pm	22 CORE, DPNR Div. of Fish and Wildlife, DPNR CZM, The Nature Conservancy, University of the Virgin Islands, Dive operators, volunteers	<ul style="list-style-type: none"> • Dr. William Coles - Introduction • Jeanne Brown - Survey results • Nikita Thompson - Abundance and size distribution of lionfish in the VI • Dr. Rick Nemeth - UVI current research • Public Comments and Questions
St. Thomas DPNR Conference Room	Planning workshop	Friday October 25, 2013 10:00am- 3:00pm	8	<ul style="list-style-type: none"> • Prioritizing strategies and integrating information from the public forums

Appendix II: Lionfish planning team and meeting participants

Lionfish Planning Team

Name	Organization/Affiliations
Anne Marie Hoffman	TNC
Bernard Castillo II	UVI
Carol Cramer-Burke	SEA
Chris Brizzolara	Caribbean Lionfish Safari
Henry Tonnemacher	7-Seas-Ltd
Ian Lundgren	NPS
Jason Quetel	CORE
Jeanne Brown	TNC
Jean-Pierre Oriol	DPNR CZM
Jenn Travis	STXEEMP
John Rubattino	CORE
Kemit-Amon Lewis	TNC
Kitty Edwards	CORE
Lia Ortiz	NOAA
Marlon Hibbert	NOAA
Michele Pugh	Dive Experience
Nadija Packauskas	CORE
Norm Gustafson	CORE
Paul Chakroff	VICA
Paul Vraback	Private/Dive Shop
Rick Nemeth	UVI
Tony Mastroianni	Caribbean Lionfish Safari
Tyler Smith	UVI
Wess Tester	CORE
William Coles	DPNR Div. of Fish and Wildlife
Zandy Hillis-Starr	National Park Service

Participants

Name	Organization/Affiliations
Andrew Hananchak	CLS
Argel Horton	CFD
Bud Brand	Deep Blue Air
Dale Blyde	ICM
Dan Scott	Caribbean Lionfish Safaris
David Dahne	UVI student
David Goldstein	NPS
Franklin Tulloch	STJ/CORE/DSTF
Hubert Brumant	MBA
Jan Alexis Barry	Coral World
Jason Budsan	UICS and East
Jennilee Beth Robinson	UVI
John Greer	CORE/CRABBS
John Kopaska	CORE
John Rubattino	CORE
Ken Haines	SEA
Kilian Hammerbeck	Blue Island Divers
Kynoch Reale-Munroe	UVI- Contractor
Laura Hausch & Duane	CORE/ Admiralty Dive Center
Lenny James	Delegate's office
Leslie Charpentier	CORE
Lori Buckley	UVI MBI Professor
Marcia Taylor	UVI/VIMAS
Maureen Wheeler	Friends for Barnes Campaign
Nikita Thompson	UVI-MMES
Rick Coats	CRABBS
Robert Georgopal	CRABBS
Sharon Grimes	CORE
Steve Grimes	CORE
Steve Prosterman	UVI/CORE
Thomas Kelley	NPS
Tyler Fortune	Coral World
Wyndi Ambrose	STX Aus

Appendix III: Current activities

Current education and outreach activities by audience

Audience	Description of Activity	Status	Cost	Funding Source	Responsible Organization	Contact Person
Students K-12	Presentations to schools upon request - lionfish as part of environmental education presentation	Ongoing; 29 presentations in 2013			DPNR/DFW St. Croix	William Coles 340.773.1082 william.coles@dpr.vi.gov
	Snorkel clinics include lionfish education	Ongoing		Non-profit	St. Croix Environmental Association	Emily Weston emilygweston@gmail.com Carol Cramer-Burke 340.773.1989 cburke@stxenvironmental.org
	Classroom Marine Awareness/lionfish education program	Ongoing		Non-profit-private donations	CORE	info@corevi.org
	Present hands-on educational programs to several public and private schools - covers marine awareness, <i>Pterois volitans</i> biology, habits, expansion and effects to the ecosystem and economy.	Ongoing		Non-profit-private donations	CORE	info@corevi.org
	Partnered with St. John's Giff Hill School minimester program. Public awareness presentation, as well as systematic search training in 2013. Students have participated in several dives to assist CORE responders in sighting lionfish.	Ongoing		Non-profit-private donations	CORE	info@corevi.org

	Monthly field activities for second graders with hands-on lionfish presentation and "Ambassador to the Sea Pledge"	Monthly	~ \$150/month	Mostly out of pocket, volunteer, and non-profit	SEA in partnership with CORE	SEA: Emily Weston or Carol Cramer-Burke 340.773.1989 CORE: Nadija Packauskas stxoutreach@corevi.org
	Ranger outreach programs and "Leave Paradise in its Place" campaign incorporate information about lionfish	Ongoing			EEMP	Migdalia Roach migdalia.roach@dpr.vi.gov John Farchette john.farchette@dpr.vi.gov
	We will include lionfish impact to park marine resources in education and outreach. Lionfish impacts to BUIS are highlighted in new BUIS 50th Anniversary movie which will be shown in schools and on local TV and cruise ships.	Ongoing		Federal Base funds and project funds	BUIS, SARI, VIIS & VICR	David Goldstein, Chief of Interpretation; Zandy Hillis-Starr, Chief of Resource Management; Ian Lundgren, Biologist
Fishermen	One on one talks, nothing formal at this time					
Divers	CORE developed, PADI Distinctive Specialty courses: "Indo-Pacific Lionfish Systematic Search Distinctive Specialty" and "Caribbean Lionfish Response Distinctive Specialty"	PADI approved training of additional course instructors; approved by DPNR and STJ NPS		Non-profit - private donations	CORE	info@corevi.org
	Deep Diver Lionfish Program – remove lionfish deeper than the recreational dive limits of 130'. CORE's deep dive team is for certified technical divers.	STX established team; STT in process of establishing Deep Fishermen		Non-profit - private donations	CORE	info@corevi.org
	"Do not feed the sharks" campaign	Posters and trainings to		Non-profit - private	CORE, CRABBS, CLS, Jolly	info@corevi.org

		encourage divers not to feed sharks or other marine wildlife		donations	Roger's Printing	
	Pre-dive lionfish briefings on dive boat	Most dive and snorkel operators			Commercial dive operators	
Public	Public Awareness Presentations for the public across the territory	Held regularly or upon request		Non-profit - private donations	CORE	info@corevi.org
	Lionfish education fieldtrips and seminars; lionfish markers available at gift shop	Included in seminar series		Non-profit	Friends of Virgin Islands National Park	seminars@friendsvinp.org (340)779-4940
Tourists	Outreach to cruise ship passengers - partner with Royal Caribbean to distribute lionfish ID cards to tourists	Ongoing			CORE and Royal Caribbean	info@corevi.org
	Lionfish materials, ID cards, post cards and factsheets				CORE	info@corevi.org
Restaurants	Reef responsible, sustainable seafood program http://virrp.reefconnect.org/	Ongoing			TNC and NOAA	Kemit-Amon Lewis klewis@tnc.org
Legislators	Presented a Comprehensive Invasive Species Management Plan to the 2012 USVI Senate.	Made into law		Non-profit - private donations	DPNR Fish and Wildlife	
Medical professionals	CORE first aid cards			Non-profit - private donations	CORE	John Rubattino 340-514-4625 president@corevi.org

Businesses/ partnerships	Lionfish Management Network throughout the entire USVI, with resource managing agencies, dive shops, snorkel tour companies, fishermen associations, diving supply companies, marinas, boat supply companies and charter operators	Ongoing		Non-profit - private donations	CORE	info@corevi.org
	Caribbean Alliance between Puerto Rico's Ecotono, Reef Guardians BVI and The Frapper in Florida to continue expanding the education about the invasion and eco-friendly safe lionfish extraction.	Ongoing		Non-profit - private donations	CORE	info@corevi.org
	Partnered with, educated, and trained 16 local dive shops across the USVI and BVI territories to search for and safely remove lionfish.	Ongoing		Non-profit - private donations	CORE	info@corevi.org
	Charter Boat Partnership Program – joint effort with USVI, BVI and Puerto Rico.	Ongoing		Non-profit - private donations	CORE	info@corevi.org

Current education and outreach materials

Education Activity	Description	Cost	Funding Source	Responsible Organization	Contact Person
Factsheets & Cards	VI DPNR Factsheet			DPNR	William Coles 340.773.1082 william.coles@dpnr.vi.gov
	Lionfish sighting rack cards		Non-profit - private donations	CORE	info@corevi.org
	Visitor lionfish identification card - ID photo, contact information and sighting protocol		Non-profit - private donations	CORE	info@corevi.org
Posters	Island-specific lionfish education posters		Non-profit - private donations	CORE	info@corevi.org
	Lionfish first-aid poster - 9x11 poster with lionfish & information on invasion and biology		Non-profit - private donations	CORE	info@corevi.org
	“Don’t feed the sharks” education campaign		Non-profit - private donations	CORE, CRABBS, CLS, Jolly Roger’s Printing	info@corevi.org
	International Public Awareness Invasive Lionfish Placard- 9x11 Placard with lionfish picture, information on invasion and biology & sighting hotlines for USVI, BVI and PR I		Non-profit - private donations	CORE	info@corevi.org

	Public awareness/management starter lionfish placard- Distributed to Caribbean islands and countries that don't have public awareness information on lionfish. Photo of lionfish, scorpionfish & space to write contact information to assist with building a lionfish management program in their territory.		Non-profit - private donations	CORE	info@corevi.org
	General lionfish education poster			TNC	Kemit-Amon Lewis kewis@tnc.org
Websites	CORE website - lionfish information, education, online lionfish form and interactive map. corevi.org		Non-profit - private donations	CORE	Kitty Edwards info@corevi.org
	DPNR				William Coles 340.773.1082 william.coles@dpnr.vi.gov
	Don't stop talking fish www.dontstoptalkingfish.com			NOAA & VI DPNR	Franklin Tulloch 323.363.4755 dontstoptalkingfish@yahoo.com Lia Ortiz NOAA CRCP USVI Fisheries Liaison Lia.ortiz@noaa.gov
	VINE www.usvine.wordpress.com			VINE	
	Caribbean Lionfish Safari http://www.caribbeanlionsafari.com/			CLS	Tony Mastroianni tony@allroundersystems.com
	Friends of STXEEMP www.friendsofstxeemp.org			Friends of STXEEMP	Jennifer Travis travija@hotmail.com
Radio and TV	CORE Foundation featured on USVI TV2 News 2011, 2012 and 2013.		Non-profit - private donations	CORE	

	BUIS 50th Anniversary movie - includes information on lionfish impact & will be shown on local TV		No cost Public Service Announcement; free to TVs; might even be shown in local theatres	NPS BUIS	David Goldstein, Chief of Interpretation Zandy Hillis-Starr, Chief of Resource Management
Documentaries	CORE Foundation featured in PBS documentary "Lionfish: The Beautiful Outlaw" directed and produced by Paul Cater Deaton.		Non-profit - private donations	CORE	info@corevi.org
	CORE Foundation featured in Blue World tv.com Invasive Species Episode		Non-profit - private donations	CORE	info@corevi.org
	CORE Foundation featured in the documentary "Under St. John Project: Lions of the Deep" directed and produced by Franklin Tulloch.		Non-profit - private donations	CORE	info@corevi.org

Current control and removal activities

Control Activities	Description of Activity	Cost	Funding Source	Responsible Organization	Contact Person
Lionfish response hotline and removal team	Lionfish sighting hotline on each island - purchase of one or more boats and ROVs is planned for 2014 to support lionfish, response, removal and research.		Non-profit - private donations	CORE	STJ: Leslie Charpentier stjdive@corevi.org 340.201.2342 STX: Wess Tester stxdive@corevi.org 340.201.2340 STT: Jason Quetel sttdive@corevi.org 340.201.2341
CORE developed PADI Distinctive Specialty courses	Indo-Pacific Lionfish Systematic Search Distinctive Specialty	~\$40 per instructor application	Non-profit - private donations	CORE	John Rubattino 340.514.4625 president@corevi.org Jason Quetel sttdive@corevi.org 340.201.2341
	Caribbean Lionfish Response Distinctive Specialty	~\$40 per instructor application			
Sighting and removal form and database	www.corevi.org/submit		Non-profit - private donations	CORE	info@corevi.org
Lionfish Removals	Dive shops			Numerous dive shops on STX, STT and STJ	
	Caribbean Lionfish Safari http://www.caribbeanlionsafari.com		Non-profit 501(c)3	Caribbean Lionfish Safari	Tony Mastroianni tony@allroundersystems.com

	CORE supported Deep Diver Team and Hit or Miss Team - weekly removals	Large boats: \$350 for 8 or more divers, 16+ tanks; Small boats: \$175 for 4 divers, 8+ tanks	Non-profit - private donations	CORE	info@corevi.org or Norm Gustafson ngustafson@live.com
	Many independent citizens, fishermen, and volunteers spend their time and resources on removing lionfish				
Lionfish reporting in Buck Island Reef National Monument	Fishing, including spearfishing and removal of lionfish, is not permitted within BUIS. Report sightings to resource management staff for removal. Reporting forms are being finalized Jan 2014 and will be distributed to park concession operations, to public when receiving anchoring permit and will be available at park headquarters.		NPS Base Funding	National Park Service - Buck Island Reef National Monument	Ian Lundgren, Biologist Zandy Hillis-Starr, Chief of Resource Management zandy_hillis-starr@nps.gov 340.773.1460
Derbies and removal incentives	Lionfish derby hosted by DPNR and NOAA at the Don't Stop Talking Fish event held at STXEEMP www.dontstoptalkingfish.com			DPNR and NOAA	Migdalia Roach migdalia.roach@dpnr.vi.gov John Farchette john.farchette@dpnr.vi.gov E Franklin Tulloch dontstoptalkingfish@yahoo.com 323.363.4755 Lia Ortiz NOAA CRCP USVI Fisheries Liaison Lia.ortiz@noaa.gov
	Lionfish derby hosted by Friends of STXEEMP at Reef Jam www.friendsofstxeemp.org			Friends of STXEEMP	Jennifer Travis travija@hotmail.com www.friendsofstxeemp.org

	Dive Shop / Response Diver Partnership Program – free tank fills and discounted costs for invasive lionfish extraction equipment for CORE certified response divers; On-going in STT and establishing STX and STJ		Non-profit - private donations	CORE	Admiralty Dive Center 340.777.9802 Red Hook Dive Center 340.777.3483 Coral World, Jason Quetel 340-201-2341
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Current research and monitoring activities

Research/monitoring description	Cost	Funding Source	Responsible Organization	Contact Person
Diet, distribution, abundance			UVI	Rick Nemeth PhD rnemeth@uvi.edu
Territorial Coral Reef Monitoring Program			UVI	Tyler Smith PhD tsmith@uvi.edu
Lionfish susceptibility to marine parasites and immune response to parasite infestation			UVI	Jennilee Beth Robinson PhD jrobins@uvi.edu
Abundance and distribution of lionfish in the USVI			UVI	Nikita Thompson, graduate student
CTX extraction lab, ciguatera toxicity research and testing			UVI	Bernard Castillo II PhD bcastillo@live.uvi.edu
Lionfish sighting reports and mentoring of student projects			DPNR	William Coles PhD william.coles@dpr.vi.gov
BUIS Ciguatera Toxicity and Predation Impact Thresholds of Lionfish		BUIS Concession Franchise Fee project funding 2012-2013	NPS	Ian Lundgren Ian_Lundgren@nps.gov ; Bernard Castillo, PhD bcastillo@live.uvi.edu
Parasites affecting lionfish in the VI			Arkansas State University	Paul Sikkel PhD paul.sikkel@gmail.com
Lionfish pheromones research project			UVI?	Unknown
Online mapping tool - sightings and removal database			CORE	Kitty Edwards info@corevi.org

Current marketing activities

Marketing Activity	Description of Activity	Cost	Funding Source	Responsible Organization	Contact Person
Sustainable seafood - reef responsible program	http://virrp.reefconnect.org/reef-responsible/			TNC and NOAA	Kemit-Amon Lewis kLewis@tnc.org
Lionfish served at local restaurants and events	Villa Morales, Tutu Bene, Deep End Bar and Restaurant, You Are Here Bar and Grill, Taste of St. Croix				
Fishermen	Some fishermen are selling lionfish filets				
VI Tourism Agency	Promotes tourism in VI				

Appendix IV: Gap analysis: public meeting comments and survey responses

The following tables summarize issues and gaps that were identified for each major area of focus through survey questionnaires, one-on-one interviews and the October 2013 lionfish planning meetings.

Education and outreach

OUTREACH & EDUCATION	Gaps	Fishermen	Need additional meetings to involve fishermen?
			Outreach - creating a market for lionfish
			Impacts of lionfish on local fisheries
		Hospitals	How to treat lionfish stings
		Legislators	What senators are interested in these issues?
		Public	Courses on how to fillet, clean and cook
			Encourage use of markers - way to involve public and reach audiences that don't dive or fish
			Ecological impact of lionfish invasion
			Make cultural connection - parrotfish (potfish)
		Schools	CORE does school lessons upon request
			Use Vine
		Restaurants	Promote and educate
			Trainings on safe handling and preparation
	Divers	Pre-dive briefings	
	What is working	Radio and TV PSA	Discussions on the radio
		Outreach activities	Lionfish dissections
			Public presentations such as Rotary
			Dive shops educate and train customers
		Events	Derbies and tournaments
		Posters	CORE, DPNR and TNC all have posters
School activities		Visiting classrooms and giving presentations	
		Summer camps and mini-mester programs	
Fliers and brochures	CORE distributes fliers and brochures		
Legislation	Work with Senator Cole, Senator Jackson and Senator Malone on lionfish bill		

Control and removal

CONTROL	Gaps	Communications	Coordinated removal efforts	Need central website with removal information - use CORE website
				Removal frequency at popular sites - add filter by date on CORE website
		Funding	Equipment and gear	Discounts for spears, catch bags, boats, safety equipment, dive equipment, GPS
			Response team	Permanent, paid response and removal team
			Identify funding sources	Lease rotating fishing boats for removals
		Incentives	Tank fills, CORE member discounts	
			Pay fishermen expenses	They will donate their time
			Impact on native fish population	Educate fishermen and public on lionfish impacts
		Training	One recognized training course	John Rubattino - PADI course instructor, but not additional instructors allowed, go through another organization
				Dive shop liability
			Recreational divers	How to use spears, safely handle and dispose, safety and tech
		Regulations	Fishermen	How to handle lionfish; how to kill and dispose of quickly
			Permits	Required training
		Access	Feeding lionfish to sharks, eels	
			Moorings	Moorings allow access for removals - maintain existing and install new
			Dock at Frederiksted Pier	Allow docking at the Frederiksted Pier
		Research and Monitoring	Deep water sites	Rebreather and deep dive training to reach deeper sites - Deep diver team has been established
			Additional research to guide removal efforts	Nursery areas, movement, dispersal patterns etc.
	What's working	Derbies	Trouble attracting participants	What incentives do participants want?
			Add lionfish to existing derbies	
		Removal dives	Sites that are regularly maintained- fewer lionfish, smaller sizes	
			CORE's response hotline	
	Trap fishing	Access and target deeper water		

Research and monitoring

RESEARCH & MONITORING	Important research questions	Ciguatera	Local levels and hotspot Are people being affected by ciguatera poisoning from consumption of lionfish?
		Distribution, abundance and movement	Habitat types, depths, food supply
			Highest densities of juvenile lionfish
			Egg movement, migration, sources and sinks
			Recolonization after removals
			Are they moving deeper when the water is warmer?
		Natural population controls	What are the population control in their native range?
			Are there natural predators here?
			Impacts of feeding lionfish to sharks, eels, etc.
		Growth and reproductive biology	Growth rates
			Reproductive biology
			Reproductive frequency
		Invasion Impacts	Which fisheries/invertebrates/resources are most affected?
	Lionfish stomach content analysis to determine target prey species		
	Removal effort and effectiveness	Trap types and bait - why are some traps catching more lionfish?	
		Focused removals in priority areas such as nurseries, spawning areas, high tourism sites etc.	
		Removal frequency - how often do lionfish need to be removed for different desired management outcomes?	
	Current research and monitoring	University of the Virgin Island	Rick Nemeth PhD - diet, distribution, abundance
			Tyler Smith PhD - Territorial Coral Reef Monitoring Program
Bernard Castillo II PhD - CTX extraction lab, ciguatera toxicity research and testing			
Jennilee Beth Robinson PhD - susceptibility to marine parasites and immune response to parasite infestation			
Nikita Thompson, graduate student - abundance and size distribution			
Territorial		VI DPNR Div. Fish and Wildlife - William Coles PhD - tracks lionfish sighting reports and mentors student projects	
National Park Service - BUIS Ciguatera Toxicity and Predation Impact Thresholds of Lionfish		Ian Lundgren - NPS Biologist	
		Stephanie Green PhD - Oregon State University	
		Lad Aakins - REEF	
		Bernard Castillo III PhD and Kynoh Reale-Munroe - UVI	
Other Universities	Paul Sikkell - Arkansas State University - lionfish parasites in the VI		
CORE	Online mapping tool displays sighting and control locations		

Marketing

MARKETING	Gaps	Consumption	Incentives	Incentives for fishermen to start selling lionfish with hope that it will then become self-supporting
			Allow recreational divers to sell lionfish	Commercial fishing license exemption for lionfish - submit to FAC - institutional license
				Partner with commercial fishermen or create a co-op (recreational divers aren't as familiar with ciguatera hotspots, so ciguatera distribution map needs to be developed)
			Encourage restaurants to sell lionfish	Education and training on handling and prep Education on ciguatera
		Other commercial uses	Viability of other commercial uses	Organic fertilizer, feed for aquaculture, jewelry
		Dive tourism	Dive operators	Marketing and liability considerations
		Outreach and training	Outreach opportunities	Ag fair, Taste of St. Croix, utilize Sustainable Seafood project, fish markets Social media, outreach to local schools
			Training	How to handle and prepare lionfish
		Ciguatera concerns	Strong public association between lionfish and ciguatera	Need public outreach and education with unified message Additional research into hotspots
			Ciguatera high capacity lab for testing	Bernard Castillo II has lab at UVI on STX
	What's working	Consumption	A availability in local markets	Some fishermen have had success selling lionfish
			Serving lionfish at restaurants	Several local restaurants sell lionfish appetizers and entrees
		Dive tourism	Dive operators	Market for divers to come down and hunt lionfish
		Derbies or hunts	Lionfish derbies or inclusion in other derbies	Dive equipment as prizes, boat repair and maintenance

Communication

COMMUNICATIONS - INTERNAL/EXTERNAL	Gaps	Role of each organization	Who takes the lead? How do we define roles?
			Who are we as a planning group?
		Communication between groups	How to disseminate information and share information? - Bi-annual or quarterly meetings
		Central site for research and information	Student projects, current research, monitoring & removals - CORE website

Appendix V: Education and outreach materials

LIONFISH



LIONFISH IDENTIFICATION CARD STOP - RELAX - IDENTIFY

- 1 - If you think you see a lionfish stop and relax.
- 2 - Slowly back away from the fish and identify.
- 3 - Do not scare or disturb the fish.
- 4 - Report all lionfish sightings to your Environmental Officer or dive master.

**IF STUNG APPLY HIGH TOLERABLE HEAT
SEEK MEDICAL ATTENTION IF CONDITION WORSENS**



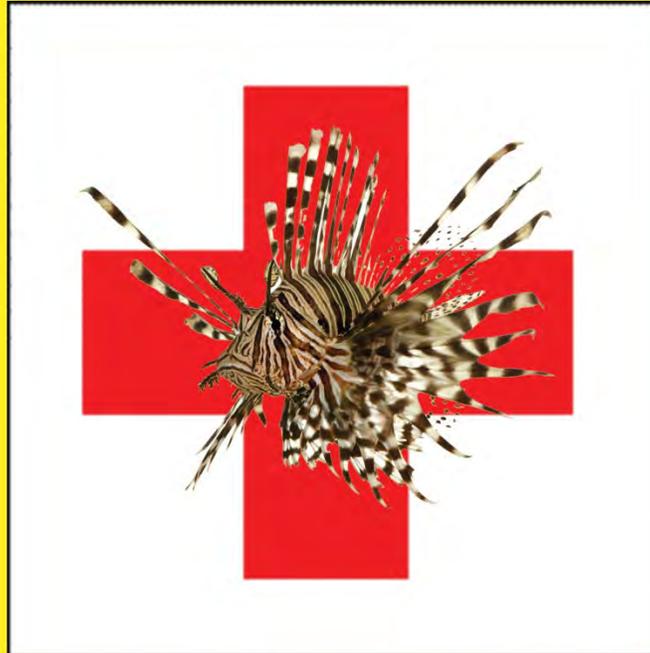
The CORE Foundation
www.corevi.org



ATTENTION

First Aid for Lionfish Stings

WARNING-Venomous Spines DO NOT TOUCH



**The Lionfish Venom is a Protein Based Toxin
The Sting can cause Intense Pain, Redness and Swelling
around the wound.**

**IF "STUNG" SOAK AREA WITH TOLERABLE HOT WATER
BE CAUTIOUS NOT TO BURN OR BLISTER SKIN**

SEEK MEDICAL ATTENTION

NEVER USE BOILING WATER!!!

IF USING HEAT PACKS, MAKE SURE THE AFFECTED AREA IS DRY

A Lionfish Sting is usually not fatal, but in extreme cases could lead to allergic reactions, nausea, vomiting, and cardiovascular events.

The CORE Foundation
CARIBBEAN LIONFISH RESPONSE PROGRAM

www.corevi.org - info@corevi.org



The Indo-Pacific Lionfish

WARNING-Venomous Spines DO NOT TOUCH

*One Lionfish can eat 80% of all the juvenile fish off of one coral head in less than 5 weeks.

*The female Lionfish can lay up to 30,000 eggs every 4 days.

*The Lionfish is capable of destroying our entire marine ecosystem.

*If left unchallenged there will be no fish to catch, no fish to see.



13 Dorsal Spines
3 Anal Fin Spines
2 Pelvic Fin Spines
(One each fin)
ALL VENOMOUS

Long Pectoral Fins
(Not Venomous)



REPORT ALL SIGHTINGS
ON ST THOMAS CALL



340-201-2341



REPORT ALL SIGHTINGS
ON ST THOMAS CALL



**ALL LIONFISH - SPOTTED, MARKED,
OR REMOVED NEED TO BE REPORTED**

THERE ARE A LOT OF STRIPED FISH IN THE CARIBBEAN SEA, ONLY ONE WITH LONG PECTORAL FINS ACCORDING TO DPNR - DEPT. OF FISH AND WILDLIFE ALL THE FISH BELOW HAVE BEEN REPORTED AS LIONFISH. NOTICE THE FEATHER DUSTERS LOOK JUST LIKE LIONFISH.



Harlequin Bass



Magnificent Feather Duster



Flying Gurnard



Magnificent Feather Duster



Redspotted Hawkfish

The CORE Foundation

FOR MORE INFORMATION - WWW.COREVI.ORG





***It is illegal to feed any wildlife in the U.S. Territories!**

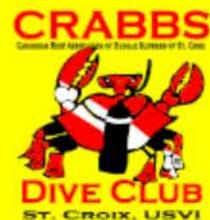
Protect our sharks. Protect our reef.

DIVE RESPONSIBLY!

For more information, visit CORE's website at COREVI.org
or email to stxoutreach@corevi.org

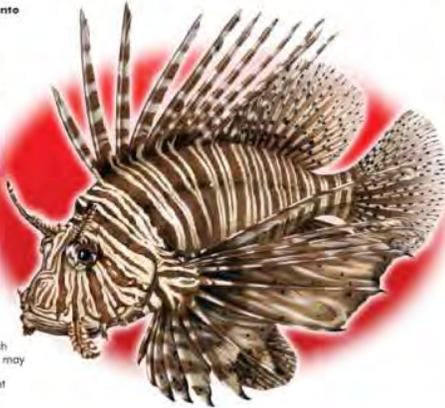


SPONSORED BY



Portrait of an Invasion

- **Lionfish were introduced by humans into local waters.** The invasive lionfish quickly become established in Atlantic ecosystems.
- **Invaders take advantage of an overfished sea.** Over-harvest of large predators that may eat lionfish, or compete with lionfish for prey, may have set the stage for proliferation.
- **Lionfish are formidable.** Their venomous spines and unique appearance may deter potential predators and make them unrecognizable as prey.
- **Lionfish reproduce quickly.** Lionfish are able to breed year-round, as frequently as every 4 days, and mature at a young age.
- **Lionfish may out-compete native predators.** Native species, such as snappers and groupers, may not be able to compete with lionfish for food and habitat.
- **Lionfish can decimate reefs.** With their voracious appetites, lionfish can reduce populations of juvenile and small fish on coral reefs by up to 90 percent. Lionfish may indirectly affect corals by overconsuming grazing parrotfishes, which normally prevent algae from growing over corals.



RED Lionfish

Pterois volitans

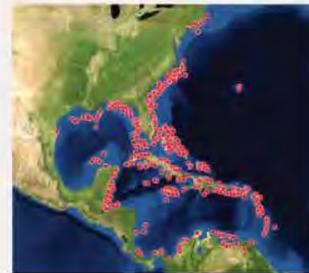
The red lionfish is an invasive species native to the Indo-Pacific Ocean. Their human-caused introduction and subsequent population increase are now causing negative impacts on marine ecosystems in the southeastern seaboard of the U.S. and the Caribbean Sea. Lionfish are efficient predators invading a variety of natural and artificial habitats, competing with native predator fish and consuming smaller fishes, including the young of large species. A similar species, the devil firefish, *Pterois miles*, has also been observed in the Atlantic.



Lionfish are effective predators. Their techniques include ambushing prey, cooperative hunting, and "corraling" with their fan-like pectoral fins. Lionfish can consume substantial numbers of small fish and crustaceans in one feeding, reducing small fish populations by up to 90 percent.

Affected Areas

Observations of red lionfish have been recorded on coral patch reefs and deep reefs (up to 1000 feet deep or 305 meters), wrecks, mangroves, seawalls, docks, and estuaries ranging from the northeastern U.S. and Bermuda to the western Gulf of Mexico and throughout the Caribbean Sea.



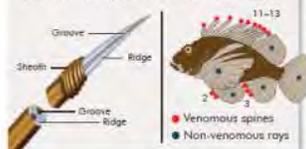
What Do Lionfish Eat?

Lionfish are indiscriminate predators that will consume many prey small enough to fit in their mouth, including the young of important fishery species such as grouper and snapper and ecologically important species such as parrotfishes. Lionfish may impact fishery populations which may impact local economies.



The Venomous Spines

Lionfish have two grooves on each spine. These grooves are filled with venom-producing tissue. After the spine punctures the skin, the venom glands release a potent neurotoxin that travels up the grooves into the wound. First aid for stings: Take a pain reliever and soak the wound in hot water. Consult a physician as soon as possible.



How to Help

- Never release aquarium fish into the wild.
- Report lionfish sightings to your local or national marine regulatory agency.
- Participate in lionfish tournaments to reduce local lionfish populations.
- Eat more lionfish. Their white, flaky meat is delicious.
- Wear thick gloves when handling to prevent injury. Venomous spines can be removed by carefully cutting with shears, making it easier to handle the fish safely.



The Nature Conservancy
Protecting nature. Preserving life™

Turrell, Hall & Associates, Inc.
marine & environmental consulting

Loxahatchee River District
"Preserving Nature by Design"™
Poster Series, No. 7
www.loxahatcheeriver.org



Appendix VI: Lionfish legislation

LEGISLATURE OF THE VIRGIN ISLANDS

CERTIFICATE OF ENACTMENT
NOTWITHSTANDING THE GOVERNOR'S VETO

THIS IS TO CERTIFY THAT (Bill No. 29-0103), An Act to amend title 7, chapter 13 of the Virgin Islands Code to enact the "Virgin Islands Native Aquatic Species Protection Act", enacted by the Twenty-Ninth Legislature at its regular session on August 21, 2012, (a copy of which is attached hereto) and vetoed by the Governor on September 11, 2012, was duly enacted, by override, by the Twenty-Ninth Legislature at its regular session on September 17, 2012, pursuant to section 9(d) of the Revised Organic Act of the Virgin Islands, 48 U.S.C. §1575 (d), notwithstanding the Governor's veto and has become law.

DATED: 9/21/12


Ronald E. Russell
President



ATTEST:

Samuel Sanes
Legislative Secretary

OVERRIDDEN
DATE: 09/17/2012

ACT 1 7407
BILL NO. 29-0103

VETOED
SEP 11 2012

GOVERNOR

TWENTY-NINTH LEGISLATURE OF THE VIRGIN ISLANDS

Regular Session

2012

An Act to amend title 7, chapter 13 of the Virgin Islands Code to enact the "Virgin Islands Native Aquatic Species Protection Act"

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WHEREAS, the *Pterois volitans/miles* complex, also known as the lionfish, is a species native to the Pacific and Indian Oceans that was introduced to the Atlantic Ocean beginning in the 1980's likely through the releases of private aquarium fish; and

WHEREAS, the lionfish is a brightly colored member of the family Scorpaenidea, and should not be confused with the well-camouflaged native fish such as the spotted scorpionfish and other scorpionfish native to the United States Virgin Islands; and

WHEREAS, lionfish have flourished and spread along the Southeast United States and Caribbean Sea within the past 10 years, reproducing at a remarkably rapid rate, and feeding upon native juvenile fish, invertebrates, and mollusks in large amounts; and

WHEREAS, lionfish have no natural predator in the Atlantic and grow larger than they do in their native range; and

WHEREAS, lionfish are considered an invasive species to the Southeast coast of the United States, Bermuda, the Bahamas, the Gulf of Mexico, the Caribbean, Mexico, and Central and South America; and

WHEREAS, we are in a crisis in the Virgin Islands, which is highly time sensitive, as lionfish are top level predators consuming enormous amounts of forage fish and large numbers of native juvenile fish; and

WHEREAS, it is in the best interest of all Virgin Islanders to preserve, sustain, and restore the condition of the marine ecosystem of the Virgin Islands to ensure the sustainable development and the long-term viability of this natural resource and its biodiversity; and

WHEREAS, the survival of our native aquatic resources is of paramount importance to the survival of both our fishing and tourism industries, to the health and welfare of our citizens and to the overall economy of the United States Virgin Islands; and

WHEREAS, other aquatic invasive species may pose a threat to human health, our environment and our economy in the future; and

WHEREAS, it has been demonstrated that management of aquatic invasive species by collection works in defined areas to mitigate the devastating effects these species have on marine environments in the Caribbean; and

WHEREAS, it is the responsibility of the government to safeguard the welfare of the environment, economy, and public health of its citizens; and

WHEREAS, it is necessary for the Legislature to enact a law to protect our marine environment from the damage caused by invasive species, afford opportunities for residents to participate in the protection of native species, promote an appreciation for our native aquatic species and develop the balance between the protection of our aquatic environment and its many commercial uses; Now, Therefore,

Be it enacted by the Legislature of the Virgin Islands:

SECTION 1. Title 7, chapter 13 of the Virgin Islands Code is amended by adding a new subchapter II entitled "Virgin Islands Native Aquatic Species Protection", and a new section 199 to read as follows:

"Subchapter II. § 199. (a) This section may be cited as the 'Virgin Islands Native Aquatic Species Protection Act'.

(b) The 'Virgin Islands Native Aquatic Species Protection Act' is hereby enacted to establish, maintain, and support by appropriations to the Department of Planning and Natural Resources (DPNR), efforts to develop strategies to protect Virgin Islands native aquatic species through control of invasive species and other methods, thus benefitting our aquatic ecosystem and our economy:

(c) *Definition*

'Invasive Species', as similarly defined in Executive Order 13112, means an alien species or species complex whose introduction does or is likely to have an adverse impact in the Territory, causing economic or environmental harm or harm to human health.

(d) The Department of Planning and Natural Resources is instructed and given the authority to form and adopt rules, regulations and guidelines for the implementation of an Aquatic Nuisance Subcommittee. This subcommittee shall be formed within 90 days of this bill being signed into law, and initial rules, regulations and guidelines for the subcommittee shall be adopted within 90 days of the formation of the subcommittee. The subcommittee shall be comprised of the appropriate government personnel, including the Commissioner of the Department of Planning and Natural Resources, representatives from the Department of Planning and Natural Resources Division of Fish and Wildlife, Coastal Zone Management, and Environmental Protection, and community members with relevant knowledge or expertise, to ensure a wide-ranging representation of the community. At a minimum, the guidelines, rules or regulations for the operation of the Aquatic Nuisance Subcommittee must address and include the following:

- (1) Implementing a Lionfish Response Management Plan that will include a strategy to: control lionfish populations through both targeted and opportunistic removal; implement a multi-tiered management approach that covers water depth below recreational diving limits and areas not frequented by water-based user groups such as recreational dive operators and spear fishermen; provide assistance and/or training for recreational and commercial fishermen, divers, and concerned citizens to encourage support in suppressing the lionfish population; and educate the public to increase public awareness of the lionfish threat; and
- (2) Conducting routine monitoring of aquatic ecosystems to detect aquatic invasive species before they become widespread; and
- (3) Proposing rapid response actions for other invasive species and preparing detailed rapid response plans that can be carried out quickly and effectively; and
- (4) Preventing further proliferation and/or minimizing the impact of harmful aquatic invasive species by ongoing control of established aquatic invasive populations, creative methods of control, and commercialization; and
- (5) Developing initiatives capable of building and expanding markets to control invasive aquatic species; and
- (6) Providing a recognition system for resource users participating in the program; and
- (7) Developing and implementing a sustainable long-term plan for the conservation of native aquatic species that includes immediate action to prevent the extinction of certain native aquatic species should government funds no longer be available; and

(8) Developing criteria to provide assistance to concerned citizens who provide, within reasonable guidelines, the proof needed to receive incentives, grants, loans, in-kind assistance, or any other support for their assistance in managing aquatic invasive species.

(e) The Department of Planning and Natural Resources is authorized to distribute, manage and operate the appropriations, grants, awards or other sources of funding provided, directly or indirectly related to this section, with the advice of the Aquatic Nuisance Subcommittee, to limit the proliferation of invasive aquatic species and to carry out the purpose and intent of this section.

(f) The Department of Planning and Natural Resources or the Aquatic Nuisance Subcommittee is authorized to seek any additional funding to operate, manage and mitigate any environmental and economic damage caused by invasive aquatic species.

(g) The Department of Planning and Natural Resources may issue permits to properly trained individuals to remove lionfish and other invasive species, as identified by the Department of Planning and Natural Resources, from protected waters, such as Buck Island and East End Marine Park.

SECTION 2. (a) The sum of one hundred fifty thousand dollars (\$150,000) is appropriated in the fiscal year ending September 30, 2013, from the Fish and Game Fund to the Department of Planning and Natural Resources, for the implementation of the Virgin Islands Native Aquatic Species Act through the Aquatic Nuisance Subcommittee.

(b) The sum appropriated in subsection (a) remains available until expended.

Thus passed by the Legislature of the Virgin Islands on August 21, 2012.

Witness our Hands and Seal of the Legislature of the Virgin Islands this 28th Day of August, A.D., 2012.



Handwritten signature of Ronald E. Russell in blue ink.

Ronald E. Russell
President

Handwritten signature of Samuel Sannes in blue ink.

Samuel Sannes
Legislative Secretary