

FWC Lionfish Summit Summary Report



October 22-24, 2013
Cocoa Beach, Florida

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Missed the FWC Lionfish Summit?

View photos at the MyFWC Flickr site at:

[Flickr.com/photos/myfwcmedia/sets/72157636902670555](https://www.flickr.com/photos/myfwcmedia/sets/72157636902670555)

Watch video of the event at the Florida Channel website at: TheFloridaChannel.org

Introduction

Lionfish were documented as being introduced to the western Atlantic Ocean system as early as 1985, but have become an invasive species recognized as causing harm to the fish and invertebrate communities of reef systems in Florida and other areas where they occur. Recent evidence suggests that this species can invade estuarine systems, threatening the important nursery communities that they support. The

reproductive biology, novel and aggressive predatory behavior on a diversity of small fish and invertebrates, lack of natural predators and ability to exploit a wide-range of habitats has allowed lionfish to expand throughout the western Atlantic and Caribbean rapidly and in high densities. This non-native marine fish may threaten populations of ecologically and economically important species, such as grouper and snapper. The venomous nature of this species also poses a health and safety risk to people who may come into contact with them. Resource managers recognize that once marine invasive species are established, such as lionfish, eradication is not feasible. Controlling lionfish populations through active removal and other management efforts requires extensive participation by engaged organizations, the public and resource managers in order to be effective.



The Florida Fish and Wildlife Conservation Commission (FWC) lionfish team held a meeting in August 2012 to develop an agency approach to addressing the control of lionfish. In this meeting, the working group drafted desired future conditions (Figure 1) and identified the need to convene a lionfish summit with our stakeholders to receive input and identify collaborative opportunities and efficiencies related to research needs and management

strategies for the control of lionfish populations. The FWC relies upon the input and contributions to fish and wildlife conservation of its partners and the public it serves, so holding such a summit is an important step in developing a network of active participants in lionfish control efforts.

Figure 1. Draft Desired Future Conditions developed during 2012 FWC Lionfish Team Meeting

A Florida where;

- The lionfish population is controlled so there is no negative impact to native fish and wildlife populations and their habitats;
- The general public knows about the negative ecological and social impacts of lionfish and is knowledgeable about what to do when they encounter them;
- FWC is exercising leadership and co-manages lionfish collaboratively with sister agencies, NGOs and stakeholders;
- Stakeholders are engaged and empowered to implement appropriate management actions;
- Stakeholder influence leads to political and financial support for a broad and adaptive suite of management actions;
- and where the presence of lionfish causes no negative economic impacts.

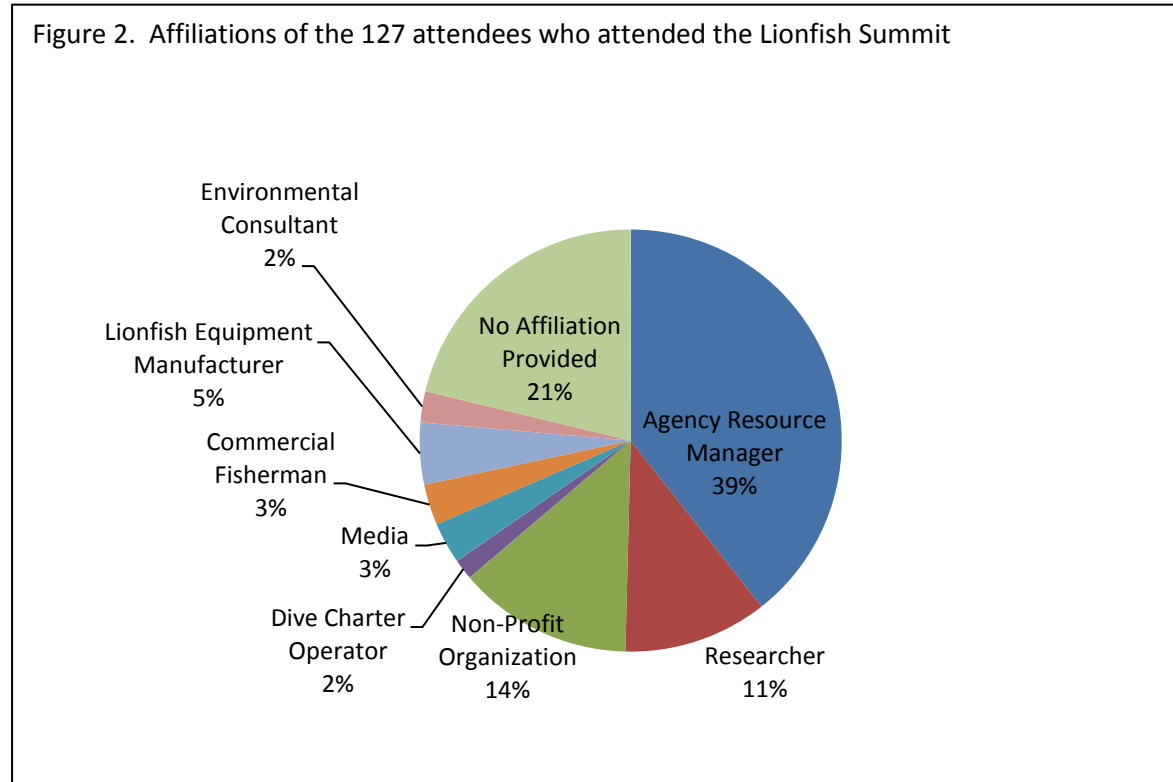


FWC organized and hosted a Lionfish Summit at the Cocoa Beach Hilton Oceanfront in Cocoa Beach, Florida, on Oct. 22-24, 2013. As noted, the goal of this summit was to develop a collaborative framework for partnering on future lionfish management that includes identification of research priorities, management actions and outreach initiatives. In order to accomplish this goal, researchers, managers and marine resource user

groups involved in lionfish control activities were invited to provide oral and poster presentations at the summit in an effort to inform participants of the work being done in Florida and elsewhere on lionfish. After these presentations, participants were asked to review and provide comment on the desired future conditions for lionfish in Florida. FWC also sought and received participant input on needs for lionfish research and management actions to support the desired future conditions through a series of facilitated discussions. Participants generated potential actions in a series of sessions that were ranked by stakeholders as to their relative importance. These actions were categorized as research, policy and regulations, control strategies,



education and outreach, and other actions. The Summit was attended by 127 people. These individuals represented local governments, SCUBA diving and spearfishing groups, commercial fishing organizations, National Parks, universities, marine environmental groups and the public (Figure 2).



A total of 28 presentations were given during the Summit: 15 oral presentations, and 13 poster presentations (Appendix C). The entire Summit was broadcast live by The Florida Channel, and is archived on The Florida Channel website at <http://thefloridachannel.org/>.

The following report is a compilation of the outcomes of this Summit. It represents the contributions of the participants as they relate to a collaborative framework toward lionfish control in Florida.

Stakeholder recommendations and comments on the draft FWC Desired Future Conditions

During the afternoon of the second day of the summit, following all of the oral and poster presentations presented during Day 1 and the morning of Day 2, attendees were asked to re-visit and provide comment on the draft Desired Future Conditions (Figure 1). The following comments and suggestions were provided.

- The desired future condition of “no negative impact” is not realistic. Define the minimum acceptable level of impact to native marine organisms and habitats.
- Consider adding a new desired condition: “A Florida where there are no further introductions of invasive species”;
- The desired future condition where FWC is exercising leadership and co-manages lionfish collaboratively with sister agencies, NGOs and stakeholders should also add academia, research, industry, and other states.
- The desired future condition where the presence of lionfish causes no negative economic impacts should also add the minimization of social impacts.

Prioritized stakeholder recommendations for research and management of lionfish

On the third day of the summit, the stakeholders, who had previously developed a list of research and management recommendations for lionfish in Florida, were asked to prioritize their recommendations. All recorded recommendations were posted along the walls in the meeting room, and each stakeholder present was provided six lionfish stickers to post on their priority recommendations. Stakeholders were directed to apply their stickers in any way they found appropriate next to their preferred priority recommendations.



All recorded recommendations and the results of this stakeholder prioritization process are provided in what follows:

Stakeholder Identified Lionfish Research Needs

(Stakeholder priority votes in parentheses organized by most number of votes.)

- #1) Continue research on development and application of lionfish specific traps. (19)
- #2) What is the effort required to maintain control on managed sites? (e.g. diver return frequency) (13)
- #3) Research on lionfish in estuaries needs to be a priority in Florida. (8)
- #4) What are the lionfish spawning triggers? Spawning behavioral research is needed. (4)
- #5) Determine how non-governmental organizations and citizen scientists can contribute to lionfish data collection? (3)

#6) How can social media/websites be better used to share information (e.g. removal efforts) among interested parties? (2)

#7) Identify lionfish specific baits for effective hook and line removal efforts. (2)

#7) Investigate the use of large scale artificial reef controls to examine lionfish impacts to animal communities and habitats. (2)

#7) How can we better use social media to publicize public workshops, training, removal needs, gear recommendations, etc.? (2)

#7) Can we figure out how many lionfish need to be removed from specific sites to mitigate their impacts? (2)

#8) Examine the potential for “mass destruction mechanisms” (e.g. biological control, poison, introduction of sterile predators). (1)

#8) What if anything is consuming eggs/larvae? (Are there larval or egg sinks that can be created for control efforts?) (1)

#8) Examine bioacoustic, pheromone, bioluminescent applications toward lionfish detection and attraction. (1)

#8) Can artificial reefs be designed that are less likely to attract lionfish but still serve other desired functions? (1)

#8) Are there chemical or other controls to prevent lionfish from further reproducing? (e.g. genetic engineering) (1)

When and where are lionfish aggregating to reproduce? (e.g. acoustic arrays) (0)

How can social media be used to assist in sharing biological materials among researchers from recreational divers? (0)

Can we create a threat index for native fishes? (0)

What are the effects to native fish from eating lionfish? (0)

Are lionfish having an impact on endangered and listed species (e.g. direct and indirect interactions with sea turtles)? (0)

Are sea turtles impacting lionfish populations? (0)

Can we feed lionfish eggs and juveniles to native fishes in hatcheries and then release those in the wild to see if they can teach other fish that behavior? (0)

How do natural lionfish population controls in the Pacific apply to the Atlantic? (0)

Are lionfish migrating to deeper depths as a result of removal efforts on shallower reefs? (0)

Are lionfish still being introduced to estuarine or marine waters through ballast water? (0)

Evaluate the effectiveness of different removal techniques. (0)

Stakeholder Policy and Regulation Recommendations

(Stakeholder priority votes in parentheses)

#1) Place a Bounty on lionfish: (13)

- reward would be increased bag limit on native species for recreational fishers; or
- a financial reward

#2) Develop a formal lionfish Management Plan. Write as an exotic species control plan not as resource management plan. (12)

#3) Create a protocol to allow private individuals to experiment with lionfish specific trap development. (9)

#4) Relax spear fishing regulations for bridges and jetties for the taking of lionfish. (6)

#4) Establish an impact fee for non-native marine species being imported into the state (as opposed to a ban). (6)

#5) Make lionfish part of the “Fresh from Florida” incentive program. (5)

#6) Lift regulations prohibiting the use of rebreathers for the taking of lionfish.(4)

#6) Reduce or eliminate importation of lionfish by creating a market for only lionfish captured in Florida for the aquarium trade. (4)

#7) Provide incentives for recreational divers to start spearing lionfish. (3)

#8) Provide a financial discount for commercial licenses for fishermen and wholesalers if they sell lionfish at market. (2)

#8) Reduce lionfish harvesting gear restrictions. (2)

#9) Sell licenses in Florida to spearfish lionfish in other countries and provide license fee revenues to participating countries. (1)

Restrict importations of species that have a high risk of becoming invasive. (0)

Create a lionfish spearfisher “certification” that would be recognized outside of Florida and in the larger Caribbean to remove lionfish from other countries’ waters. (0)

Ensure lionfish landings are recorded on trip tickets. (0)

Lionfish population control should be conducted as a state activity. (0)

Ensure product quality, including imports, for commercial sale of lionfish. (0)

FWC coordinates with interstate fishery management agencies (eg, SAFMC) and partners for international lionfish control. (0)

Stakeholder Control Strategy Recommendations

(Stakeholder priority votes in parentheses)

#1) Identify and prioritize sites for targeted lionfish removal efforts. (16)

#2) Create a Florida lionfish license tag and use acquired funds for lionfish control. (12)

#3) When lionfish get to X-density (to be determined), allow directed trap fishery. (8)

#4) Develop effective lionfish traps and identify deployment locations. (5)

#4) Monitor lionfish distributions in estuaries to determine invasion threats and develop population maps. (5)

#5) Hold funded regular removal events at priority sites (implemented by resource managers). (4)

#5) Create a commercial industry for lionfish. (food, curios, etc.) (4)

#6) Use public recognition, through social media, as motivation to mobilize people to spear lionfish. (3)

#7) Prohibit imports of lionfish for human consumption (no ciguatera imports). (2)

Develop an "Adopt a Reef" program at sites where lionfish can be regularly removed. (0)

Monitor effectiveness of all lionfish control programs. (0)

Lionfish population control should be conducted state-wide. (0)

Stakeholder Education and Outreach Strategy Recommendations

(Stakeholder priority votes in parentheses)

#1) Develop and post public service announcements at the Division of Motor Vehicle service centers, at movie theaters, on television and billboards, and keep the message repetitively active. (6)

#2) Add a link to the FWC webpage that goes straight to lionfish research. (4)

#3) Create a lionfish outreach program geared toward aquarium stores about not releasing non-natives. (3)

#4) Need to make sure outreach efforts are multi-lingual. (2)

#5) Encourage recreational harvest for personal consumption.(1)

#6) Engage dive masters, dive boat captains, etc. to provide information toward further research and monitoring. (1)

#7) Identify funding for a lionfish education team that is active on a state-wide basis. (1)

Ensure lionfish information and recommendations are accurate and fact-checked. (0)

Make informational signs about lionfish posted at marinas using PRIDE and RESPECT for production. (0)

Create a lionfish information business card. (0)

Provide information regarding public safety as it relates to lionfish handling, capture and consumption. (0)

Other Actions

#1) Develop an agency-led task force to manage the lionfish problem, with cooperation and coordination from all other agencies and municipalities. Task force should coordinate with the regional strategy for lionfish control in the wider Caribbean. (18)

Provide a mechanism to share lessons learned about lionfish rodeo successes and problems. (0)

Influence state and federal legislators to dedicate funding for lionfish control. (0)

Conduct regular lionfish summits. (0)

Next Steps

The FWC Lionfish Team will substantively evaluate every recommendation made at the Summit. At this point, the process for that evaluation is undetermined. However, it will include considering the anticipated outcome of each action combined with identifying the challenges and needs for implementation, and an evaluation of the possibility for unintended consequences, should there be any. As needed, the Lionfish Team will consult with outside experts regarding the recommendations. At the end of the evaluation, the Lionfish Team will provide its recommendations for implementation to Agency leadership.



For those recommendations that can be implemented with relative ease, especially in the Outreach category, the FWC will begin developing strategies and products. For example, improvements to the lionfish web presence will be made in the near future. In particular, the Lionfish Team will be contacting the presenters at the conference to request permission to post their documents on our website. We will also provide updated links to partner organizations' lionfish websites.

The Lionfish team will take the research recommendations and flesh them out in more detail. Once complete, the team will communicate these recommendations combined with the priority information to our partner agencies. We will also encourage these agencies to place these lionfish research needs into their announcements for proposals.

Ultimately, the Lionfish Summit and the next steps as described are just the beginning of what the FWC recognizes will need to be a sustained long-term effort. Our objective will be to pursue a combination of management, outreach and research activities that maximizes the likelihood of reaching and maintain the desired future condition for lionfish in the State of Florida.

Appendix A
Lionfish Summit Agenda

Lionfish Summit Agenda

October 22-24, 2013
Hilton Cocoa Beach Oceanfront

Hosted by the Florida Fish and Wildlife Conservation Commission

Goal: To develop a collaborative framework for partnering on future lionfish management actions that includes the following areas: research priorities, management actions and outreach initiatives. As part of this effort, we will provide an opportunity for stakeholder input.

Outcomes: Provide a clear understanding of actions and information gathered to date, receive and document stakeholder concerns, and develop potential efficiencies in managing lionfish throughout Florida waters.

Tuesday, October 22, 2013

11:00-2:00 Registration opens

11:00 -2:00 Poster presenters and trade show exhibitors put up displays

Session I: Summit Opening

Moderator: *Dan Ellinor*, Florida Fish and Wildlife Conservation Commission

2:00-2:30 **Welcome, Workshop Objective**

Dan Ellinor, Florida Fish and Wildlife Conservation Commission, Tallahassee

2:30-4:00 **The Lionfish Invasion – Where we are, Where we are going, and What’s in our way**

Lad Akins, Reef Environmental Education Foundation (REEF)

4:00-4:15 **BREAK**

4:15-4:40 **Cayman Islands, the Central Caribbean Marine Institute (CCMI) and Guy Harvey Ocean Foundation Lionfish Research Project**

Tony Fins, Guy Harvey Foundation

4:40-5:00 **Introduction of Desired Future Conditions for Lionfish**

Kent Smith, Florida Fish and Wildlife Conservation Commission

5:30-7:30 **Poster and Exhibits/Lionfish Tasting/Social [Cash Bar & Appetizers] (Sponsored by Guy Harvey Foundation)**

***Posters will remain up until the end of the Summit.**

Wednesday, October 23, 2013

7:00-8:15 Registration open

7:30-8:15 Morning refreshments (**Sponsored by Guy Harvey Foundation**)

Session II: Lionfish Research Session

Moderator: *John Hunt*, Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, Marathon, FL

8:15-8:25 **Welcome, Session Objectives – *John Hunt***, Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, Marathon, FL

8:25-8:45 **Effects of the invasive Pacific red lionfish on Atlantic coral-reef fish communities**

Mark A. Albins, Oregon State University, Corvallis, OR

8:45-9:05 **Assessing the Efficacy of Lionfish Removals**

Thomas K. Frazer, University of Florida, Gainesville, FL

9:05-9:25 **Lionfish in the Loxahatchee Estuary: The first documented estuarine invasion by Indo-Pacific lionfish (*Pterois volitans* / *P. miles*) in the Western Hemisphere (Loxahatchee River, Florida).**

Emily Dark, Antioch University, Keene, NH

9:25-9:45 **Lionfish Research in the Florida Panhandle Region.**

William F. Patterson III University of South Alabama, Mobile, AL

9:45-10:00 **BREAK**

10:00-10:20 **Assessment of the Introduced Indo-Pacific Lionfishes (*Pterois volitans* and *P. miles*) in Everglades and Dry Tortugas National Parks, Florida.**

Vanessa McDonough, Everglades and Dry Tortugas National Parks, Key West

10:20-10:40 **The spread of the Pterois Invasion; Southward, Northward.**

RJ de Pedro Muñoz, Proyecto Pterois, San Juan, Puerto Rico

10:40-11:00 **A better understanding of the lionfish invasion in Biscayne National Park through studies of invasion trends, recolonization rates, habitat affiliations, gut content analyses, and new capture methods.**

Vanessa McDonough, Biscayne National Park, Homestead, FL

11:00-12:00 **Group Discussion: Identify Future Research Needs for Florida.**

Moderators: *Kent Smith/Keith Mille*, Florida Fish and Wildlife Conservation Commission, Tallahassee, FL

12:00- 1:30 LUNCH (On your own)

Session III: Potential Management Actions

Moderators: *Keith Mille/Kent Smith*, Florida Fish and Wildlife Conservation Commission

1:30-1:45 **Management and Stakeholder Contribution Overview-Introduction of Afternoon Activities**
Kent Smith, Florida Fish and Wildlife Conservation Commission, Tallahassee

1:45-2:05 **Florida Saltwater Spearfishing and Lionfish Survey**
Candy Hansard, Emerald Coast Reef Association, Niceville, FL

2:05-2:25 **Creating a Commercial Market**
Bill Kelly, Executive Director, Florida Keys Commercial Fisherman's Association, Marathon, FL

2:25-2:45 **Lionfish Management in Florida**
Alan Peirce, Florida Fish and Wildlife Conservation Commission, Tallahassee

2:45-3:00 **BREAK**

3:00-3:30 **Discussion of a Preferred Desired Future Condition**

Moderators: *Kent Smith/Keith Mille*, Florida Fish and Wildlife Conservation Commission, Tallahassee, FL

3:30-5:10 **Potential Management Actions (Brainstorming)**

Moderators: *Kent Smith/Keith Mille*, Florida Fish and Wildlife Conservation Commission, Tallahassee, FL

3:30-4:00 Policy and Regulation

4:00-4:30 Control Strategies

4:30-5:00 Education and Outreach

5:00-5:10 Other Actions?

5:10-5:30 **Summarize Day 2 and Framing Day 3**

Moderator: *Kent Smith*, Florida Fish and Wildlife Conservation Commission, Tallahassee, FL

5:45-7:45 **Social** - Pool Deck [cash bar, pasta & carving stations]

(Sponsored by Guy Harvey Foundation)

Thursday, October 24, 2013

Session III (Continued): Potential Management Actions

Moderator: *Keith Mille/Kent Smith*, Florida Fish and Wildlife Conservation Commission

8:30-9:00 **Summary of List of Actions needed to achieve Desired Future Condition**
Kent Smith, Florida Fish and Wildlife Conservation Commission

9:00-9:30 **Review Desired Future Conditions and Actions. Do the actions proposed help us meet our Desired Future Condition?**
Keith Mille, Florida Fish and Wildlife Conservation Commission

9:30-10:00 **Identification of the Most Important Management Actions Needed to Achieve the Desired Future Condition**
Kent Smith, Florida Fish and Wildlife Conservation Commission

10:00 10:15 **BREAK**

10:15-10:30 **Discussion of Actions**

10:30-11:00 **Coordination/Next Steps**

11:00 **Closing Remarks and Evaluations**

Dan Ellinor, Florida Fish and Wildlife Conservation Commission, Tallahassee, FL

ADJOURNED

Appendix B

FWC Presentation on Lionfish Management Efforts

FWC Presentation on Lionfish Management Efforts

Alan Peirce and Alicia Wellman

The Florida Fish and Wildlife Conservation Commission's lionfish programs and management involves several agency Divisions and Offices including the Habitat and Species Conservation Division, the Marine Fisheries Management Division, the Fish and Wildlife Research Institute, the Office of Community Relations and Division of Law Enforcement.

With the understanding that FWC has no ability to eliminate lionfish from Florida waters, the agency has undertaken a number of initiatives to increase public awareness about lionfish, remove regulatory barriers and create incentives to encourage lionfish control efforts by the public. FWC is hopeful that this Lionfish Summit will provide new ideas and help to direct future management and control initiatives.

Outreach and Education to increase public awareness

Events: Division of Marine Fisheries Management staff provides information to the public during dozens of outreach events each year. FWC also included lionfish on the cover of the January 2013 Florida Saltwater Recreational Regulations publication, which is a primary tool for communicating with millions of recreational anglers. Feature articles on lionfish have been included in the last three issue of the regulations publication.

Web Page: Maintained a lionfish webpage with photographs, history of the invasion, ecological concerns, regulatory changes to encourage control, frequently asked questions and answers, handling safety information, basic medical treatment for lionfish stings, and reporting information.

T-Shirts: Designed, produced and distributed 500 Lionfish Control Team T-shirts that were provided to participants in lionfish derby's and contest winners. The sleeve of the shirt includes a Lionfish QR Code that allows smart phone users to link directly to the FWC Lionfish Page for additional information.

Brochures: Produced, printed and distributed 12,500 Lionfish Brochures targeted to recreational and commercial divers.

Tank Decals: Designed and printed 5,000 Dive Tank Decals that are being distributed to dive shops throughout Florida.

Derby Support: Provided support for lionfish derbies including \$6,000 in monetary support for three derbies hosted by REEF in 2013. DMFM Staff also participated in the Northeast Florida Lionfish Derby in Jacksonville Beach.

Roundup Events: Nonnative Fish Roundups were held to increase public awareness of the impacts and potential impacts of releasing nonnative species into the wild.

Mobile App: FWC staff is currently developing a mobile application for phones that will allow users to document their lionfish catch, record key information and share this information with FWC.

Social Media: FWC is also using social media platforms to communicate with the public including Facebook, Flickr, Twitter, Instagram, and others. A live twitter chat on lionfish was held during March of 2013 and reached over 30,000 individual twitter accounts.

Removing Regulatory Barriers

In 2012, Executive Director Nick Wiley established Executive Order 12-12, which eliminated the recreational license requirement when harvesting lionfish with handheld nets, pole spears, Hawaiian slings or any spearing device specifically designed and marketed for lionfish. The Order also eliminated the default recreational bag limit of 100 pounds per day for lionfish. In August 2013, the Executive Order was replaced by Florida Administrative Code 68B-5.006, which made the provision in the Executive Order part of Florida rules.

Interagency Coordination and Communication:

FWC shares data and information with state and federal partner agencies to help evaluate and monitor changes in lionfish distribution. FWC is also working with federal and state partners on the National Invasive Lionfish Prevention and Management Plan. FWC also planned and coordinated the 2013 Lionfish Summit to review ongoing research and management efforts, identify future research needs, and identify future management opportunities.

Appendix C
Abstracts
(Alphabetically)

The Lionfish Invasion – Where we are, Where we are going, and What’s in our way

Lad Akins, Director of Special Projects

Reef Environmental Education Foundation (REEF), Key Largo, FL

The invasion of Indo-pacific lionfish into the western Atlantic has been described as one of the worst ecological disasters to face the region’s marine environments. Unfortunately, the impacts of the invasion remain hidden under the ocean’s surface and are not readily apparent to the general public, regulators and politicians. Much misinformation and many myths color the public’s perception of the invasion. Starting with the background of the invasion and introduction of invasive marine fishes in general, this interactive talk will bring us up to the current status of lionfish in the region, and will look forward into what we may expect in the future. Highlights will include the biology/ecology of lionfish, their impacts, control tools and techniques, current and upcoming research, and management strategies being used around the region. Special attention will focus on effective removal strategies and challenges to overcome including removal limitations, incentives, regulatory restrictions, research needs, coordination, maximizing effective use of limited resources, and funding.

Contact: Lad Akins, Director of Special Projects, REEF, P O Box 370246, 98300 Overseas Hwy, Key Largo FL 33037, (305) 852-0030 w, www.REEF.org, Lad@REEF.org

Oral Presentation

Effects of the invasive Pacific red lionfish on Atlantic coral-reef fish communities

Mark A. Albins

Oregon State University, Department of Zoology

Current Affiliation: Auburn University, School of Fisheries Aquaculture and Aquatic Sciences

Pacific red lionfish, introduced to Atlantic waters in the 1980s, have undergone a rapid range expansion and population explosion over the last decade. This invasive predator is now found across the Caribbean Sea, Gulf of Mexico, and southeastern coast of the United States. Lionfish are voracious fast-growing predators of small fishes, represent a novel predator type in the invaded system, and are reaching larger maximum sizes and substantially higher densities than they do in their native Pacific. While there has been much speculation regarding negative effects of lionfish on native species, few experimental studies have been carried out to examine them. I conducted a number of controlled field experiments on coral-reefs in the Bahamas to examine the effects of lionfish on native fish communities. Lionfish caused substantial reductions in the abundance and species richness of small native fishes including ecologically important functional groups such as cleaners, predators, and herbivores. Lionfish also had stronger effects on native prey and grew more than six-times faster than a similarly sized native predator, the coney grouper. These results indicate that the lionfish invasion may have long-term, broad-scale impacts on the structure and function of invaded communities.

Contact Information: Mark A. Albins, School of Fisheries Aquaculture and Aquatic Sciences, Auburn University, Gulf Coast Research and Extension Center, 8300 State Highway 104, Fairhope, AL 36532. Phone: 541-740-7747, Email: mark.albins@auburn.edu

Oral Presentation

Effective Management of Lionfish on Select Habitats in the Florida Keys

Benjamin Binder, Michelle Dancy and Alejandro Acosta

FWC / FWRI, Marathon, FL

Recent scientific findings have shown that full eradication of the lionfish population is essentially unfeasible due to both financial and logistical limitations. Aside from the financial burden associated with intensive wide-scale removals, lionfish have been found beyond recreational diving limits and traditional capture methods (i.e. hook and line, trapping and spearing) have not yet been effective in developing an extensive fishery for human consumption in the United States. Recognizing the importance of controlling the lionfish population and the difficulties associated with managing the species we have selected five different hard-bottom habitat types representative of the Florida Keys for targeted removal efforts. These habitats include Gulf of Mexico corals, solution holes, near-shore patch reefs, Hawks Channel patch reefs and forereef (10-30m depth) habitats. To date all oceanside locations (18 sites) have been selected, although exploratory dives are still required in the Gulf due to lower observed lionfish densities, and complications associated with locating suitable habitat. Once all sites have been selected we intend to measure lionfish recolonization rates after removal, as well as the fluctuations in species abundance and diversity at these locations. Additionally, we will use acoustic tracking technology and video monitoring to observe lionfish behavior and movement patterns on the selected sites. Data collected will aid in identifying key habitats affected by lionfish, their impact to the local fish fauna and will provide managers with guidelines to prioritize locations for lionfish management and inform stakeholders of effective control strategies.

Contact Information: Ben Binder, Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, 2796 Overseas Highway, Suite 119, Marathon, FL 33050 USA, Phone: 305-289-2330 x112, Email: Ben.Binder@MyFWC.com

Poster Presentation

Interactions Between the Caribbean Spiny Lobster, *Panulirus Argus*, and Invasive Lionfish, *Pterois Volitans*: Who Displaces Whom?

JOCELYN CURTIS-QUICK¹, ELIZABETH UNDERWOOD², STEPHANIE GREEN³, LAD AKINS⁴
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Canada

The Caribbean spiny lobster fishery is the most valuable in the Caribbean. There are concerns that invasive lionfish could affect the profitability of the industry, but ecological interactions between the two species are not well understood. Previous work found an inverse relationship between the number of lionfish and number of lobster in lobster traps (condos) but they could not assess whether this was caused by lionfish displacing lobsters or vice-versa. We examined the behaviors of lionfish and lobster competing for an artificial shelter. In experimental trials, lobsters were introduced to the arena 48 hours before the introduction of either a lionfish or a trophically equivalent native fish, the graysby grouper *Cephalopholis cruentata*. Reciprocal experiments (i.e., fish before lobster) and single-species control trials were also conducted. Lobsters spent significantly more time outside of the shelters and more time roaming when a lionfish was present, indicating the lobsters were displaced from the shelter. However, shifts in lobster behavior were not observed in the presence of the native graysby. These findings suggest that competition for shelter with invasive lionfish could negatively affect the abundance of lobsters found in condos, resulting in negative socioeconomic impacts for countries with large lobster fisheries such as The Bahamas.

Poster Presentation

Investigation of lionfish (*P. volitans/miles*) use of estuarine mangroves in the Indian River Lagoon, Florida, USA.

Emily Dark^{1,2} & Jeffrey Beal²

1 MS Candidate Antioch University New England, Keene, New Hampshire, United States of America, 2 Florida Fish and Wildlife Conservation Commission, Fort Pierce, Florida, United States of America

Since 2010 the invasive lionfish (*Pterois volitans/miles*) has been reported along man-made structures and mangroves in Florida's Indian River Lagoon (IRL), one of the most biodiverse estuaries in the US. Stressing the importance of mangroves as critical fish habitat, this study aims to examine the nature of this voracious predator's use of mangroves in the IRL. The objectives of this study are to examine site fidelity, micro-habitat characteristics, demographics and diet composition. This is done through a survey and tagging effort in Fort Pierce Inlet area, as well as the collection of specimens in mangroves throughout the IRL. Additionally, specimens are collected throughout the IRL in a variety of habitats and offshore in order to compare size frequencies, diet and reproductive capacity. The purpose of this study is two-fold: to provide valuable ecological data on lionfish in a recently invaded and biologically critical estuary and to provide baseline data for local research and effective removal strategies.

Oral Presentation

Novel predator, novel habitat: A diet analysis and experimental test of the ecological effects of invasive lionfish in Florida Bay

Meaghan Faletti and Robert Ellis

Florida State University, Department of Biological Science

Since its introduction to the western Atlantic and Caribbean the Indo-Pacific lionfish (*Pterois volitans*) has undergone a population explosion which threatens the ecosystems it is invading. Determining the diet of invading lionfish among the various habitats where they are found is critical for understanding the ecological effects of the invasion. Our study combined a diet analysis and an experimental transplant experiment of lionfish found on the hardbottom habitats of Florida Bay. During June and July 2013 we collected and analyzed the stomach contents of lionfish ($n = 32$) associated with limestone solution-holes north of Marathon, FL. Prey found in collected stomachs was composed predominantly of teleost fishes, although we also found a significant number of crustaceans in the diet (38% by number). Of the identifiable teleost prey consumed, Gobiidae was the dominant prey item followed by Haemulon; palaemonid shrimp were the most common crustacean in the diet. For the transplant experiment we captured lionfish ($n = 4$) and released them at unoccupied solution holes. Prey communities were monitored by divers on SCUBA for six weeks and compared to solution holes where lionfish were already present ($n = 5$) and control holes without lionfish ($n = 9$). The presence of lionfish significantly reduced the number of juvenile fishes (< 5 -cm) after just 3 weeks, while the addition of lionfish to unoccupied holes reduced the number of Palaemonids by 41%. Our study of lionfish in Florida Bay adds to the mounting evidence on the ecological effects of this novel invasive predator.

Poster Presentation

Guy Harvey Ocean Foundation Lionfish Culling Study

Antonio Fins

Guy Harvey Ocean Foundation

Research funded by the Guy Harvey Ocean Foundation found that a sustained, targeted culling program can decrease the lionfish population in a specific area. The research was conducted by the Central Caribbean Marine Institute in Little Cayman in the Cayman Islands. The culling program targeted invasive Indo-Pacific Lionfish.

Over the span of a year, divers visited a specific area in Little Cayman on a weekly basis pulled anywhere from 30 to 100 lionfish out of the water. In addition, they performed quarterly lionfish and native fish density monitoring.

The conclusion of the study showed a greater drop off of lionfish in the culled areas as opposed to the non-culled areas, supporting the belief that sustained culling efforts can decrease the lionfish population.

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Oral Presentation

Assessing the Efficacy of Lionfish Removals

Thomas K. Frazer¹, Charles A. Jacoby², Morgan A. Edwards³, Patrick G. Gardner³,
Savanna C. Barry³, Kathryn E. Lohr⁴ and Carrie M. Manfrino⁴

Rapid range expansion by invasive lionfish generates legitimate ecological and economic concerns. Ecological concerns revolve around the direct and indirect effects from predation pressure exerted by hundreds of lionfish per hectare. For example, lionfish densities off Little Cayman Island have been reported to reach 450 fish per hectare off North Carolina, over 390 fish per hectare in the Bahamas and nearly 600 fish per hectare off Little Cayman Island. Socioeconomic impacts of the invasion have yet to be evaluated fully, but they include predation on and competition with early life-history stages of species supporting commercial and recreational fisheries and reduction in the attractiveness of popular dive destinations, which presently generate billions of dollars in annual revenue. Our initial research on the coral reefs off Little Cayman Island indicated that targeted removals reduced the densities of lionfish and shifted the size frequency distribution of survivors toward smaller fish whose stomachs contained less prey and fewer fish. Fewer lionfish and decreased direct and indirect effects on ecologically and economically important reef fishes represent key steps in protecting coral reefs. Our current focus is on assessing the effectiveness of sustained removals at an appropriate spatial scale through a replicated experiment documenting abundance and diversity of native fish. Our goal is to design cost-effective control programs that can be implemented using local resources.

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Oral Presentation

Florida Saltwater Spearfishing and Lionfish Survey

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The Emerald Coast Reef Association is conducting a survey of divers/spear fishermen/women. We believe the data collected will provide the FWC with valuable information to aid in the preparation of a viable Statewide Lionfish Population Control Program. The results of this survey will be shared and will include:

- Diving Location
- Frequency of lionfish sightings
- Approximate highest number of lionfish spotted on a single reef
- How often they spearfish lionfish when diving
- Lionfish sting pain intensity
- Rating Lionfish meat
- Situations that divers consider dive trip limiting factors
- Approximate number of dives per month, during summer months
- Wave heights that will be cause to cancel or postpone a dive trip
- Type of gas mixture most often used
- Type of Transportation used (Private, Charter, Shore dive)
- Length of private boat used
- Average Depth of dives
- Water depth of largest concentrations of lionfish witnessed
- Average number of lionfish killed each dive
- Why divers spearfish
- Why some divers don't spear lionfish
- What motivates divers
- Commercial license question
- Views on Control Methods
- Level of concern about the lionfish
- Priority of lionfish control

Oral Presentation

Lionfish in the eastern Pacific and Mediterranean; a cellular automaton approach to risk assessment

Matthew W. Johnston and Sam J. Purkis

Nova Southeastern University, National Coral Reef Institute

Lionfish (*Pterois volitans*/*P. miles*) have proliferated throughout the Atlantic and Caribbean since their introduction via the aquarium trade. The invasion is the most successful, complete, damaging, and swift marine introduction in history. *P. miles* has been documented twice from the eastern Mediterranean Sea, likely a Lessepsian migrant via the Suez Canal. As in the Atlantic, there is understandable concern that this species is also poised to become established in the Mediterranean. There is also concern that the lionfish may become introduced and proliferate (through aquarium releases, transport on floating debris, or passage through the Panama Canal in ship ballast water) in the eastern tropical and north Pacific. Through computational modeling (using a model developed while studying the historical Atlantic lionfish invasion), this study compares and contrasts the dynamics of random hypothetical introductions of lionfish into the eastern Pacific and Atlantic Oceans, as well as the Mediterranean Sea, in order to highlight differing invasibilities in all three regions. Connectivity between discrete regions (precincts) in all three regions is examined and settlement densities calculated. The study suggests that lionfish, which are successful invaders in the Atlantic, may not be as successful in the eastern Pacific and Mediterranean due to weak mesoscale connectivity, which reduces the rapid spread of lionfish larvae. Limited invasibility suggests that early detection and eradication measures may prevent an invasion of lionfish in the eastern Pacific and Mediterranean Sea. This study presents the first known prediction of the potential for establishment of lionfish in the eastern Pacific and Mediterranean.

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Poster Presentation

Lionfish in the Loxahatchee Estuary: The first documented estuarine invasion by Indo-Pacific lionfish (*Pterois volitans* / *P. miles*) in the Western Hemisphere (Loxahatchee River, Florida)

Zachary R. Jud^{1*}, Emily Dark², Craig A. Layman³

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²Antioch University, Environmental Studies Department

³North Carolina State University, Department of Applied Ecology

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Here we identify the first estuarine intrusion of lionfish (*Pterois volitans* / *P. miles*) in their invasive range. In 2010, we documented large numbers of lionfish occupying the Loxahatchee River (Jupiter, FL), the southernmost tributary of the Indian River Lagoon. Since August 2010, we have captured >300 lionfish in the system. Fish ranged from 23-185 mm SL (34-256 mm TL). Individuals have been observed as far as 6.6 km upriver from the ocean, in salinities as low as 8 ppt. We tagged 55 lionfish as part of a mark-recapture study to identify movement patterns, home range, and growth rates. Forty-four fish (80%) were recaptured at least one time, with an average time-at-liberty of 56 days (max = 197 days). In this system, which contained relatively patchy habitats, lionfish exhibited extremely high site fidelity. Of the recaptured individuals, 56% remained at their exact tagging location, and 74% moved <10 m. Mean growth rate for all recaptures was 0.46 mm/day, with some individuals exceeding 0.78 mm/day. Since estuaries are already highly threatened, and provide critical habitat for numerous commercially, recreationally, and ecologically important species, establishment of lionfish in these ecosystems is of particular concern. Salinity tolerance observed in the Loxahatchee suggests that many other Florida estuaries (including the IRL) may be at risk for colonization. While lionfish research has progressed at a rapid pace in other ecosystems, we feel that the inherent difficulties associated with detecting and observing lionfish in estuarine systems has hindered our understanding of this aspect of the invasion.

Oral Presentation

A COMMERCIAL FISHING INDUSTRY PERSPECTIVE ON LIONFISH IN THE FLORIDA KEYS (FKCFA)

Capt. Bill Kelly, Executive Director, Florida Keys Commercial Fishermen's Association, P.O. Box 501404, Marathon, Florida 33050, 305-619-0039

Mr. Pete Johnson, President, Johnson Communications, Inc., P.O. Box 12398, Scottsdale, Arizona 85267, 480-951-3654

Commercial fishermen engaged in the spiny lobster and stone crab trap fisheries in the Florida Keys have had a front row seat on the lionfish invasion which is believed to have its origins in South Florida. Harvest of lionfish is now commonplace on both sides of the island chain and they are routinely harvested throughout the islands. Commercial trap fishermen have been steadily engaged in cooperative research efforts focused on lionfish and are anxious to develop and implement a trap fishing program targeted at containing the spread of lionfish and promoting responsible harvest of the species as a consumer product.

Capt. Bill Kelly, Executive Director of the Florida Keys Commercial Fishermen's Association headquartered in Marathon, Florida has fished recreationally and commercially in the Gulf of Mexico, South Atlantic and Bahamas for 38 years. Bill has served on numerous advisory panels to the Gulf and South Atlantic Fishery Management Councils and currently holds seats on the SAFMC Habitat and Mackerel AP's and the GMFMC Spiny Lobster AP. Bill was a featured speaker at Managing Our Nation's Fisheries 3 addressing Annual Catch Limits and the Magnuson-Stevens Act in 2013 held in Washington, DC.

Oral Presentation

CREATING PUBLIC AWARENESS AND MARKETING CONCEPTS FOR LIONFISH (JOHNSON COMMUNICATIONS)

Established in 1983, Johnson Communications, Inc. is a responsive, international, marine media relations and marketing agency based in Scottsdale, Arizona. Johnson Communications maintains one of the largest computer data bases of fishing editors, writers and marine manufacturers in the world. The company also has strong ties with the largest purveyor of frozen seafood products in the United States. These relationships provide unique opportunities to encourage the harvest of lionfish and enormous marketing potential as a nutritious and healthy product for the consumer. Creating consumer demand is essential to the successful development of a viable harvesting regimen to protect our marine environment.

Pete Johnson has represented many diverse clients and organizations including: The Billfish Foundation, International Game Fish Association, Rolex, Sea Ray, Yamaha, Mercury Marine and Mercury's Redbone Celebrity Tournaments. Prior to establishing Johnson Communications, Pete served as a well-respected television sportscaster for Tampa's Channel 13 and as a newsman for UPI, the Miami Herald and St. Petersburg Times. Pete's background includes extensive work with another invasive species; the eradication of the red, imported fire ant across 16 states in the South and Southeastern United States.

Poster Presentation

Lionfish Bycatch in the Florida Keys Commercial Spiny Lobster Fishery

Dominique Lazarre¹, Lad Akins², David Die¹, and James Morris³

¹ University of Miami, Rosenstiel School of Marine and Atmospheric Sciences, Miami, FL, 33149 ² Reef Environmental Education Foundation, Key Largo, FL, ³ NOAA, Center for Coastal Fisheries and Habitat Research, Beaufort, NC, 28557

The emergence of lionfish as a bycatch species in deep water fishing grounds of the commercial spiny lobster fishery indicates a need to extend the efforts to monitor and cull lionfish present to deep water habitats. Catch data was collected from a commercial lobster vessel to determine the geographic distribution, length frequency, catch rates of lionfish, as well as the potential impacts on lobster catch rates. Locations and depths were recorded for each trap sampled; and each organism caught was identified and measured. Lionfish were present in 21.4% of the traps; with mean catch rate of 0.38 fish/trap. Mean catch rates of legal lobsters decrease from 1.82 to 0.59/trap when lionfish are present. Traps provide a low effort/high yield option for culling lionfish in deeper waters that are not targeted by normal removal efforts. While this method could be helpful in reducing lionfish numbers, lionfish presence leads to reduce lobster catch rates, negatively impacting fisher profits.

Poster Presentation

A better understanding of the lionfish invasion in Biscayne National Park through studies of invasion trends, recolonization rates, habitat affiliations, gut content analyses, and new capture methods.

Vanessa McDonough, Ryan Fura, Christina Vilmar, and Kristian Rogers

Biscayne National Park, Homestead, FL

Lionfish were first documented within Biscayne National Park in June of 2009, and this invader is now commonly observed throughout different areas and habitats within the park. Since the invasion began, park biologists have engaged in a variety of research, monitoring, and removal efforts to better understand how to best manage this species. This presentation will summarize some of the key findings of these efforts so far, including habitat preferences and affiliations of lionfish, dietary patterns as they relate to lionfish size, and recolonization rates of lionfish at different targeted removal areas, as well as presenting an underway study to assess the efficacy of a novel trap designed to target lionfish. Altogether, the findings of these studies are guiding park management of the invasion, including the determinations of when, where, and how frequently to conduct removal activities.

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Oral Presentation

Lionfish Research Underway in Atlantic and Caribbean

Maia McGuire¹, LeRoy Creswell², Dorothy Zimmerman³

Three research projects are underway at Florida Sea Grant that will test methods to control the invasion of the exotic lionfish in the Atlantic and Caribbean. The research projects focus on developing methods for local removal to help state agencies, managers and conservation organizations address the invasion problem in a time of limited resources. Funding for the research projects is provided by the National Oceanic and Atmospheric Administration through a regional research and outreach effort involving the Sea Grant programs of North Carolina, South Carolina, Georgia, Florida and Puerto Rico.

The largest of the three research projects attempts to identify the most cost-effective methods to fish down lionfish numbers so native fish populations can recover and stabilize. Researchers will use volunteer spear divers to capture lionfish at different frequency rates from five selected areas off southeast Florida, while monitoring changes in the numbers of prey-sized native fishes. The project team includes Chris Stallings (University of South Florida), Mark Albins (Auburn University), and Craig Layman (Florida International University).

The second project evaluates the effectiveness of using divers and snorkelers competing in fishing derbies and rodeos to reduce lionfish numbers in Puerto. The project team includes Richard Appeldoorn (University of Puerto Rico) and Matthew Craig, director of San Diego-based MTC Associates.

The third project, conducted by the Reef Environmental Education Foundation, will try to determine which is the most effective of three lionfish removal techniques – derbies, traps, or continuous removal. REEF is comparing and contrasting results on coral reefs in selected locations in South Florida and the U.S. Virgin Islands.

Poster Presentation

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Strategies for Management of Artificial Reefs in the State of Florida

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Encompassing 34 of 35 different coastal counties spread along 1,357 miles of ocean fronting coastline (846 miles fronting the Gulf of Mexico and 511 miles fronting the Atlantic Ocean), Florida manages one of the most diverse, and most active artificial reef programs in the United States. Because of the extent of coastline and the statewide local involvement in reef activities, the Florida Fish and Wildlife Conservation Commission (FWC) program is a cooperative partnership with local coastal governments to manage diverse artificial reef habitats and differing user groups, utilizing variable funding sources. In response to long-range planning initiatives, in 2003 the FWC completed a long-range Artificial Reef Strategic Plan to serve as a blueprint for both the FWC and the local coastal government reef programs. Representing the broad range of public interests in artificial reefs throughout Florida, the plan is comprised of guiding principles, goals, and objectives that optimize biological and economic benefits, provide policy guidance, support research and data collection, pursue additional funding opportunities, provide a framework for public education and outreach, and provide guidance for operational planning at the state, regional, and local levels of artificial reef construction and monitoring. As of September 2013, the FWC Artificial Reef Program reports a total of 2,830 artificial reef deployment locations state-wide, with 1,903 deployments located along the Gulf coast, and 927 located along the Atlantic coast. Artificial Reefs are about evenly divided between state and federal waters (1,373 located in state waters, and 1,457 located in federal waters), and range from 4 feet in depth to 414 feet (average depth 65 feet). Artificial reefs are a component of the large ecological landscape of reef fish habitat across Florida. The Florida Artificial Reef Program is interested in cooperative efforts directed at understanding lionfish biology, research, and management that may help direct some aspects of long-range artificial reef research, monitoring, and planning in the context of meeting Florida's strategic artificial reef plan goals.

Poster Presentation

The spread of the Pterois Invasion; Southward, Northward

RJ de Pedro Muñoz, Proyecto Pterois, San Juan, Puerto Rico

The spread of the Pterois invasion is commonly considered to be a Southward migration of voracious lionfish in search of abundant food and warmer water, aided by prevailing currents. The reality is far more complex than this simple and widespread misconception. The Northward migration of Pterois from the widely accepted source off the coasts of Florida, prompted by their continuous search for food and made possible by the species' adaptation to colder climates, is well documented. Our group, Proyecto Pterois, is studying natural processes that may enable a steady Northward migration of lionfish from the invaded tropical West Atlantic, Caribbean, and Gulf of Mexico. This migration direction would defeat isolated efforts to manage the Pterois population by trying to eliminate them from specific geographic locations, in Florida or anywhere. Our study also focuses on government intervention that might be required, as well as community participation and communication, to overcome the conditions that enable constant repopulation caused by reverse migration from all invaded areas. Three factors with significant influence to enable this "migration conveyor" are Deep Ocean Circulation, the Gulf of Mexico's Loop Current, and waves and currents caused by hurricane activity. Pterois egg sacs, larvae, and possibly juveniles may be pushed Northward by any of these. Those conditions require constant coordination of impact assessments and control metrics across all invaded areas to properly evaluate the effectiveness of invasion management efforts. The Pterois invasion requires effectual "geo-spanning" coordination to implement successful short-term measures and long-term solutions.

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Oral Presentation

Lionfish Research in the Florida Panhandle Region

William F. Patterson III, Kristen A. Dahl, and Joseph H. Tarnecki

Pacific lionfish became established off eastern Florida in the late 1980s but were not observed in the northern Gulf of Mexico until 2010. Prior research funded by FWC and FWRI resulted in extensive pre-invasion data on reef fish community, size, and trophic structure that have enabled the lionfish invasion off northwest Florida (nwFL) and its impacts on native reef fishes among natural and artificial reefs to be documented. Current lines of research include examining lionfish impacts on native reef fish community and trophic structure on natural versus artificial reefs; examining differences in reef fish behavior and movement dynamics on reefs with lionfish present versus ones where lionfish have been removed; examining effects of lionfish density on their diet and growth; and, examining recolonization rates of lionfish on reefs where they have been removed by spearfishing. Results to date indicate lionfish densities are two orders of magnitude higher on nwFL artificial versus natural reefs, and densities of small demersal planktivorous and invertivorous fishes are inversely related to lionfish density. Lionfish on artificial reefs have broader diets than on natural reefs, including a higher percentage by mass of non-reef fishes and benthic invertebrates. Post-removal, adult lionfish begin recruiting back to cleared artificial reefs on short (days to weeks) time scales. The isolated nature of study reefs indicate adult lionfish do travel across open substrate to recruit to new habitats. Additional results and ongoing research will be presented in the context of understanding and minimizing lionfish impacts.

Oral Presentation

Using Surveys of Recreational Lobster Fishers to Obtain Information Regarding Their Activities Associated with Lionfish

William C. Sharp, Florida Fish and Wildlife Conservation Commission, Marathon, FL

Beginning in 1991, the Florida Fish and Wildlife Conservation Commission (FWC) has conducted annual surveys of recreational spiny lobster permit holders to estimate annual recreational spiny lobster landings and fishing effort during Florida's Special Two-Day Sport Season and the first month of its regular lobster fishing season. We also use these surveys to collect additional information from this user group that is potentially relevant to both state and federal fishery managers. Since 2010, our surveys have included questions to collect information about lionfish. Specifically, we have sought to estimate lionfish encounter rates by recreational lobster divers and to understand their actions when they encountered it. Additionally, we sought to gauge the effectiveness of burgeoning outreach efforts designed to inform users of the state's marine resources of the potential deleterious effects posed by the proliferation of lionfish. In 2012, the FWC implemented temporary rule changes, made permanent during 2013, governing the take of lionfish to help facilitate their removal. The 2013 survey included questions to ascertain the effectiveness of the FWC's outreach efforts to inform stakeholders regarding these rule changes. We will present a summary of our survey results of our 2010 through 2013 surveys. We will detail the changes in the proportion of lobster fishers that reported observing lionfish, responses by those survey recipients to lionfish encounters, and a summary of responses to questions designed to evaluate their awareness of the recently implemented rule changes.

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Poster Presentation

Fishing down an invasive species: determining the effort necessary to reduce local lionfish populations and mitigate their effects

Christopher D. Stallings, Mark A. Albins, and Kara R. Wall

University of South Florida, College of Marine Science, St. Petersburg, Florida

The current high densities of invasive lionfish on Atlantic and Caribbean reefs pose a serious threat to the integrity of native ecosystems, making it is necessary to develop and implement active lionfish management actions. While complete eradication is an unrealistic goal, efforts to control local lionfish populations may be useful for mitigating their effects in particularly valuable and/or sensitive areas. With strict limits on the funding and resources available to deal with the lionfish invasion, it is critical that managers have access to meaningful estimates of the level of effort required to reduce local lionfish populations and to mitigate their effects. To address this problem, we have implemented a controlled field experiment with four levels of removal frequency using a before-after-control-impact design on ledge habitats off SE Florida. Response variables include catch per unit effort, total abundance, and biomass of lionfish and total abundance, biomass, and species richness of prey-sized native fishes. Changes in these response variables over time will be compared among the removal treatments to determine what level of effort is necessary to reduce local lionfish populations and mitigate their effects on native species. The results of this study will allow effective and efficient allocation of resources necessary to mitigate the lionfish invasion on Florida reefs. It will allow local managers to avoid the twin pitfalls of under- and overinvestment in control efforts and will provide general guidelines for managers in other areas tasked with managing the lionfish invasion.

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Poster Presentation

Preliminary analyses of population age structure and growth of *Pterois volitans* in the coastal waters of northeast Florida

Swenarton, MaryKate¹, Johnson, Eric G.¹; and Green, Mickhale^{1,2}

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The Indo-Pacific lionfish (*Pterois volitans*) is an established predatory marine invader in the western Atlantic, Gulf of Mexico, and Caribbean Sea. Scientific investigations on the impacts of lionfish have been focused predominantly in tropical ecosystems, and research has been focused between south Florida and North Carolina is largely absent. Generally, fish life history parameters, especially growth rates, vary with a suite of environmental (i.e., temperature), biological and ecological (i.e., prey availability) factors; as a result, the population dynamics of lionfish will vary regionally and among ecosystems. This research aims to provide baseline data on the population dynamics of lionfish in a new biogeographical region, including accurate age, growth, and demographics. Approximately 1,000 lionfish were caught between May and August 2013 off the coast of Jacksonville in coordination with local tournaments. Length frequency analysis revealed a bimodal population distribution with rapid growth rates. Analysis of sagittal otoliths from lionfish is ongoing and will be used to validate age and in growth modeling. These data will be used to determine lionfish: (1) size at age, (2) growth rates in the region and to make inferences regarding lionfish population age structure. This project will fill key knowledge gaps on population dynamics of lionfish in northern Florida and provide information on age and growth of lionfish necessary to managers attempting to mitigate the ecological impacts of lionfish in this region.

Poster Presentation

Temporal and spatial dynamics of the lionfish (*Pterois* spp.) invasion of the eastern Gulf of Mexico as determined from complimentary trawl and camera surveys

Theodore S. Switzer, Sean F. Keenan, Christopher J. Stafford, Sheri L. Parks and Derek M. Tremain

Affiliation: Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, 100 8th Avenue SE, St. Petersburg, FL 33701

The recent lionfish invasion of the Western Atlantic has been extensively documented in both the popular media and the scientific literature. Much of the information synthesized to date has been obtained via diver-based surveys, so there is likely a depth-related bias to the current understanding of the temporal and spatial dynamics of the lionfish invasion. To examine these potential biases, we examined data from two independent but complementary fisheries-independent surveys initiated in 2008 on the West Florida Shelf (10 – 110 m): a broad-scale summer trawl survey in offshore waters from Pensacola to the Dry Tortugas and a regional underwater camera and trap survey of reef habitat off of Tampa Bay and Charlotte Harbor. Lionfish were first observed in the trawl survey in 2010, when two individuals were collected off the southwest Florida coast. In 2011 and 2012, where 40 and 29 lionfish were collected, respectively, the distribution of lionfish continued to expand northward through the Florida panhandle. A dramatic increase in the abundance (391 individuals) and distribution of lionfish occurred in 2013. Although 2013 video data are not yet available, similar patterns are evident from camera surveys of reef habitat through 2012. Evidence from these complementary surveys suggests that lionfish first colonized deeper habitats (> 30 m) before subsequently moving into shallower waters. Information from these long-term, multispecies surveys will provide valuable insight into the spatial and temporal dynamics of the lionfish invasion and allow us to assess potential ecological consequences of increasing lionfish abundances in the future.

Poster Presentation

Total mercury levels in invasive lionfish, *Pterois volitans/miles* (Scorpaenidae), from Florida waters

Derek Tremain and Kelli O'Donnell

Indo-Pacific lionfish, *Pterois* spp., are opportunistic carnivores that have established invasive populations in the southeastern United States, Bahamas, Caribbean, and northern coast of South America. Because lionfish have few natural predators in their invasive range, a proposed option for controlling populations and limiting ecological damage is to establish directed fisheries for the species and promote their consumption by humans. Carnivorous marine fishes, however, can contain high levels of mercury, a toxic, heavy-metal pollutant that can cause neurological and behavioral impairment in humans. We analyzed total mercury levels in dorsal muscle tissue from 260 lionfish collected along Florida's Gulf and Atlantic coasts. Fish were collected from offshore waters corresponding to four coastal regions—the southeast Atlantic, the Florida Keys, the southwest Gulf, and the Florida panhandle. Fish ranged in size from 63 to 262 mm standard length (mean = 153 mm), and mercury levels ranged from 0.01 to 0.34 mg/kg (mean = 0.07 mg/kg). The mean mercury level in fish larger than 180 mm standard length, which are commonly represented in Florida's commercial fisheries, was 0.09 mg/kg. There was a positive linear relationship with fish length in all regions. Mercury levels did not differ between males and females but there were differences among regions, with the greatest concentrations seen in fish from the Florida Keys and highest bioaccumulation rates from the southwest Gulf study region. Mercury levels in lionfish were similar to those in marine and estuarine species that fall under Florida's least restrictive consumption advisory levels for the general human population.

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Poster Presentation

Assessment of the Introduced Indo-Pacific Lionfishes (*Pterois volitans* and *P. miles*) in Everglades and Dry Tortugas National Parks, Florida

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Our project assessed the presence and distribution of Indo-Pacific lionfishes (*Pterois miles* and *P. volitans*) in Everglades (EVER) and Dry Tortugas (DRTO) National Parks waters, removing lionfish from both parks. Our goal is to minimize ecological impacts of a detrimental invasive species to natural resources while simultaneously improving visitor experience and reducing threats to park visitors who utilize the parks' marine resources. Their rapid establishment and potential adverse effects on these ecosystems is of great concern as they pose a serious threat to reef communities, which is in conflict with management goals, particularly those developed for DRTO's Research Natural Area, a no-take, no-anchor marine reserve. We conducted timed in-water surveys to search and capture lionfish and calculate catch per unit effort. At DRTO, 141 timed surveys (1493 min total search time) were conducted at different sites, resulting in removing 78 lionfish. At EVER, 31 timed surveys (1019 min total search time) were conducted and 12 lionfish removed. These relatively small numbers of lionfish removed from our parks suggest that (1) the presence of large predators, such as snapper, groupers, and sharks, may be influencing lionfish numbers at DRTO, and (2) lionfish are present in Florida Bay, in areas of seagrass and hard bottom, despite limited reports. We hypothesize that the presence of larger, more abundant predators at DRTO is keeping the lionfish population numbers low. In EVER, lionfish were found in shallow water habitats such as seagrass beds, suggesting that lionfish are invading nontraditional habitats.

Oral Presentation

Appendix D
Attendee Reviews

Attendee Reviews

Lionfish Summit evaluation forms were offered to all who attended the event.

There were 38 forms submitted to the FWC. Below are highlights from the evaluation.

The percentages on the summary sheets are based on the total number of responses provided for each category. The number of responses in Category NA was included. The percentages without the Category NA included in the total are in parentheses.

There were six questions about the success of the overall format of the Summit and 86-95% (86-97%) of respondents Agreed or Strongly Agreed that the format was done well.

There were four questions about the first day workshop presenters and 66-92% (76-100%) of the respondents rated the speakers as Good or Excellent.

Overall ratings for the seven research presenters who spoke on day two ranged from 64-97% (69-100%) of respondents indicating they were Good or Excellent.

The group discussion on day two rated 92% (97%) Good or Excellent; the management speakers ranged from 74-94% (82-97%) Good or Excellent; the desired future condition and brainstorming sessions were rated 80%(87%) and 86%(94%) respectively Good or Excellent and the social was rated 78% (100%) Good or Excellent.

The overall ratings for the four summary discussions on day three ranged from 77-88% (93-97%) Good or Excellent.

The most useful comments centered around the value and relevance of the presentations and posters.

There were quite a few comments under the “Do you plan to make changes” comment. Some had to do with re-evaluating research ideas or getting new ones after speaking with attendees or hearing presentations. Others said they were going to catch more lionfish, while there were some comments on new outreach/education efforts based on what they had learned at the Summit.

There were quite a few comments in the “Please provide additional comments” section that cover many topics from Summit content/format changes to the number of sticky dots. There was a lot of positive feedback for FWC on how the Summit was organized and run.

There were a couple of comments that suggested if we invited well informed members of various stakeholder groups to develop a “plan” that could then be presented to the general public. Other format suggestions included giving speakers and question askers more time, perhaps even reducing the number of speakers to allow for more time.

Appendix E
Attendee List

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