Investigation of the Lionfish Invasion along the Indian River Lagoon Region

Ernie Cowan at St Lucie Inlet State Park, May 2011

Jeff Beal, Marine/Estuarine Habitat
Emily Dark, Antioch Univ.
Indo-Pacific Lionfish

- Scorpaenidae
- 16 Species of lionfish
- Indian Ocean, Central and Western Pacific, Red Sea
- Tropical to subtropical on reefs, structured habitats

- Grow to 18 inches
- Weigh up to 3 lbs.
- Live 15 years

Photo: REEF
Lionfish Invasion of Space/Treasure Coasts

- Offshore hardbottom: widespread reports summer 2009

St Lucie Reef 2010

Sebastian reefs 2012

-Inshore reports as early as 2010 (Jupiter, Ft. Pierce);
- widespread reports summer 2012
Invasion History
Key issues

- Venomous vs. poisonous
- Venomous spines on dorsal (13), pelvic (2), anal (3) fins
- Treat wounds with non-scalding heat (30-90min) and painkillers
2 Caribbean species

Dorsal/anal rays

(10, 6)

7% of Carib popn

9 female mitochondrial haplotypes of *P. volitans*

Devil Firefish *P. Miles*  

(13, 7-8)  

93%

Red Lionfish *P. volitans*
Ecology

- Caribbean-wide, >70 prey species of fishes and invertebrates
  
- Bahamas reef study: reducing patch reef recruits up to 80%
  
- Bahamas reef studies: gobies, flamefishes, wrasses, basslets, shrimps
  
- NC reef study: small serranids, grunts, parrotfishes, jacks, shrimps
  
- Ft. Pierce 80ft reef: 25 found every 100ft
  
- Bahamas reef study: 75-95% reduction required to benefit native species
Reproduction

- Sexually mature at ~1yr (4.3in female; 3.5in male)
- Females spawn as frequently as every 4 days
- Clutch size up to 30,000 eggs
- Unpalatable floating egg mass
- Courtship observed
Tolerances

10°C isotherm at Rhode Island (juvenile death)
16°C isotherm at NC (feeding stops)

FL to NC at depths 50-100m, 2nd most abundant to scamp
Other issues

- Max. Caribbean size of 22in; native range 15in
- 0.5mm/day growth rate
- Caribbean densities 10x Indo-Pacific (40/100m$^2$ of reef)
  - Fish surveys (REEF, RVC, FDM, FIM)
- Ciguatera
- Mercury low
Reef Visual Census (RVC)

Stuart to Miami reefs in 2012: 870 cylinders showed 8% occurrence of lionfish
Known Predation
Cayman Tethering Experiment

Lionfish on an intensely culled reef
- 13X more likely to be eaten than those on rarely culled reef
- 30X more likely to be eaten than those in a seagrass bed

Size is important
-over 90% of lionfish 12cm or greater were eaten
Key removal issues

Hexarmor gloves, thick bag
IRL: Invasion of back reef habitats

- Inlets (outcrops)
- Manmade structures (seawalls, pilings, rip rap)
- Oyster reefs (Loxahatchee, St Lucie)
- Mangroves
- Lagoonal reefs (artificial, channel wall outcrops)
- Seagrass beds?
- Ontogenic shift? (ex.Turks and Caicos)
IRL Lionfish Megatransect protocol
Fall, 2012

- Goal: assess the general extent of estuarine invasion
- Conduct 300m transects encompassing manmade and mangrove habitats
- Complete individual transect sheets and submit to FWC
IRL Lionfish Megatransect Field Data Sheet

Date_________  Transect name_________________  Survey lead__________________________

300m transect boundary start_________________________________(lat/long or major landmark)

300m transect boundary end__________________________________(lat/long or major landmark)

<table>
<thead>
<tr>
<th>LF #, TL</th>
<th>seawall</th>
<th>riprap</th>
<th>dock</th>
<th>mangrove</th>
<th>oyster</th>
<th>other</th>
<th>Captured Y/N</th>
<th>Location (lat/long, landmark)</th>
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Comments (on capture technique, etc)________________________________________________________
Previous record (e.g., USGS)
New IRL record 2012
New IRL 2013

Dots can represent multiple fish

Ponce Inlet
Volusia County
Veterans Park
11km south of Ponce Inlet

East Ocean Ave,
Edgewater, Volusia County
Canaveral National Seashore
Merritt Island NWR, Brevard County

23 captured fall 2013
Trident Basin
Sebastian Inlet
Brevard/Indian River Counties

50 taken from Seb. Inlet SP dock summer 2012
Roosevelt Bridge
12km upstream of St Lucie Inlet
Martin County
Hole in the Wall
St Lucie Inlet
Hobe Sound
Martin County
707 Bridge
14km south of St Lucie Inlet
14.5km north of Jupiter Inlet
5 psu, 6.5 km upstream of Jupiter Inlet

>300 hundred documented FIU
Indian River Lagoon

• More than 4,300 species of plants & animals
• 35 listed or endangered species
• Annual $75 million regional/national fisheries economy
• Temperate & Tropical Eco-tone
• Essential Fish Habitat
South Atlantic Fishery Management Council


- Management plans including research/monitoring

- Ecosystems-based approach to sustainable fisheries management
Overall Goals for the Indian River Lagoon

- Knowledge of the population (geography, demographics, dynamics of estuary/habitat use)
- Understanding their possible ecological effects (concern towards local fisheries, biodiversity)
- How can we possibly mitigate these effects? (ie., develop effective /strategic removal efforts)

“…predation may be a major structuring force shaping shallow water estuarine fish assemblages.”

Comparison of lionfish mean TL (mm)

Inshore (n=127)  
Lionfish TL (mm)  179.7

Offshore (n=151)  
Lionfish TL (mm)  211.5

* P<.005
Comparison of lionfish mean TL (mm)

Mangroves (n=68)  Other estuarine habitats (n=59)

Mangroves: 154.5 mm
Other estuarine habitats: 208.7 mm

P < 0.001
Mangrove lionfish (n=68)

Other estuarine lionfish (n=59)

Offshore lionfish (n=151)
<table>
<thead>
<tr>
<th>Size Class</th>
<th>Number of Lionfish</th>
<th>Gonad Stages</th>
</tr>
</thead>
<tbody>
<tr>
<td>55-120mm, n=7</td>
<td>7</td>
<td>Male spawning capable (n=7)</td>
</tr>
<tr>
<td>121-180mm, n=4</td>
<td>3</td>
<td>Male immature (n=1)</td>
</tr>
<tr>
<td>181-240mm, n=29</td>
<td>13</td>
<td>Female early developing (n=21)</td>
</tr>
<tr>
<td>241-300mm, n=15</td>
<td>7</td>
<td>Non-Determinable (n=28)</td>
</tr>
<tr>
<td>301-360mm, n=2</td>
<td>1</td>
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</table>
Gonad stages for mangrove lionfish (n=24)

- **Size Class 1** (55-120mm, n=11):
  - Female early developing: 11
  - Non-determinable: 0

- **Size Class 2** (121-180mm, n=6):
  - Female early developing: 2
  - Non-determinable: 4

- **Size Class 3** (181-240mm, n=7):
  - Female early developing: 0
  - Non-determinable: 3
Diet of all estuarine lionfish (n=89)

- Decapods: 53% by number, 18% by volume
- Teleosts: 47% by number, 72% by volume
Diet of lionfish in mangroves (n=38) vs. other estuarine habitats (n=51)
In the estuary, 92% of lionfish had food in their stomach at the time of capture.

Offshore?!
Habitat

Where did we find the lionfish in the mangroves? (n=73)

- In the roots: 36%
- Under peat bank: 33%
- <1m off roots: 14%
- >1m off roots: 18%

- Average depth = 1.6m
- Within 5km of inlets
- 90% Erosional vs. 10% depositional
- Average growth for 5 fish was .39mm/day (0.41 inches /month)
Fidelity

Is it worth it for us to look in the mangroves? YES

27 Tagged fish April-Sept 2013

17 were ‘recaptured’ at least once (63%)

One fish was seen in same spot for 92 days

7 total fish were seen in same spot for over 50 days
Found at all 5 IRL inlets (and in mangroves at 4 of 5)
Mangrove Food Web

- sunlight
- rainfall runoff (nutrients)
- leaf litter & decomposers (detritus)
- herbivores & detritivores (molluscs, yellow-eyed & grey mullet, adult parore & crustacea)
- scavengers (whelks, crabs)
- herbivorous insects
- small predators (tripelins, small flounder, small eels, whelks)
- planktivores (yellow-eyed mullet, smelt)
- phytoplankton (with tidal flow)
- zooplankton
- filter feeders (molluscs & crustaceans)
- large predator fish
- birds (shags, herons)
- humans

Sediments
- Larvae
- Adults
- Phytoplankton

Flood
- Detritus
- Nutrients
- Larvae

Ebb
- Sediments

http://protectfireefs.wordpress.com/2012/01/17/mangrove-habitats-are-important-to-maintaining-healthy-coastal-ecosystems/
Lionfish diet in the mangroves
(N=14)
How do lionfish fit in?
- Influences on our estuary’s fish assemblages/communities

Abiotic factors - large scale

Biotic factors - small scale

Predation & Competition

Habitat use
Resource exploitation
Biological interactions

“...predation may be a major structuring force shaping shallow water estuarine fish assemblages.” – R. Baker & M. Sheaves (2005)

Small local patches may appear highly structured by the abundance of superior competitors or local effects of predators. - Beets 1997
The good news

- >300 seen in Loxahatchee River, 132 elsewhere within IRL
- 73 of 132 in mangroves
- Early in estuarine invasion
- Strong site fidelity
- Highly motivated IRL natural resource community
- Native predation...a learned behavior
- Opportunities for applied research
- They taste yummy!
FWC 2012-13 Harvest Order 8.3.12

• No recreational fishing license required for pole spear, Hawaiian sling, lionfish-specific device, hand held net
• Harvest with hook and line or as bycatch in other legal gear for commercial or recreational fishing
• No limit for commercial or recreational harvest
• Does not allow spearing in prohibited areas

1. Within 100 yards of a public swimming beach, any commercial or public fishing pier, or any part of a bridge from which public fishing is allowed

2. Within 100 feet of any part of a jetty that is above the surface of the sea – except for the last 500 yards of a jetty that extends more than 1,500 yards from the shoreline

3. Within prohibited areas (e.g., State Parks, by county ordinance) or with prohibited gears (explosives, fish traps, certain nets)
Major Stakeholder Recommendations:

Research:
1) Continue research on development and application of lionfish specific traps
2) What is the effort required to maintain control on managed sites? (e.g. diver return frequency)
3) Research on lionfish in estuaries needs to be a priority in Florida

Policy:
1) Place a Bounty on lionfish: reward would be increased bag limit on native species for recreational fishers; or a financial reward
2) Develop a formal lionfish Management Plan
3) Create a protocol to allow private individuals to experiment with lionfish specific trap development
How can I help?

www.mcacreefs.org

July 12, 2014, Stuart

2012 largest specimen 15.25in TL

www.treasurecoastlionfishsafari.com

June 7, 2014, Ft. Pierce

Sebastian event?
How else can I help?

Log sightings in USGS database
http://nas.er.usgs.gov/sightingreport.asp

Also report sightings within the IRL estuary to:
jeff.beal@myfwc.com  edark@antioch.edu

Provide tagged carcasses frozen for lionfish taken from the IRL estuary

Please do not remove lionfish from mangroves at Ft Pierce and St Lucie Inlets

For additional information, visit My FWC.com
Thanks

Marine Cleanup Initiative, Inc.