

# A lionfish trap for use in Bermuda, with potential applications elsewhere

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# Lionfish in Bermuda

- 1999 – Bermuda finds first invasive lionfish outside U.S. waters
- 2003 – first lionfish reported from a commercial lobster trap
- **2008 – lionfish as regular bycatch in lobster traps;**
  - some lionfish in shallow water;
  - start of spearfishing culling programme
- **2009 – deep “tech divers” report lots of lionfish at 60m**
- **2013 – surveys of lionfish distribution (still mostly deep);**
  - camera observations of lionfish around lobster traps
- **2014 – first trapping season...**

# Lionfish bycatch in commercial lobster traps over the previous five seasons.

	<b>2010-11</b>	<b>2011-12</b>	<b>2012-13</b>	<b>2013-14</b>	<b>2014-15</b>
Total number offshore	200	371	487	1,235	1,140
Total number inshore	2	5	6	0	0
Percentage caught in September	60%	44%	35%	43%	73%



# Bermuda Trapping Project Goals

- Constraints:
  - Bermuda does not allow fish pots (since 1990)
  - Closed season for lobster April - August
- Standard lobster traps catch lionfish, SO:
  - Adapt lobster traps to catch more lionfish
  - Without catching more fish of other species
  - Try to reduce lobster catch so traps can be used in the summer

# Features of the Bermuda Spiny lobster trap

## Escape slot

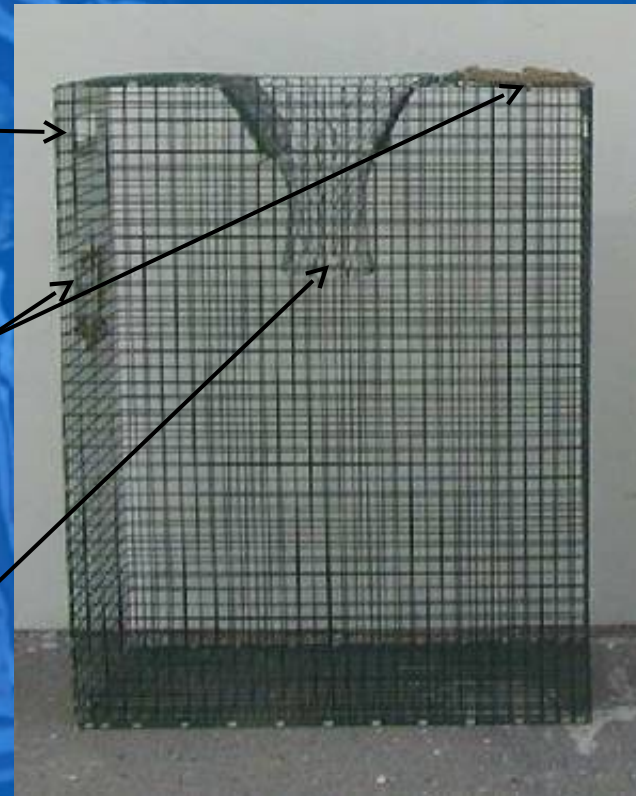
- Reduces bycatch of small fish

## Door and panel tied with biodegradable twine

- Reduces 'ghost fishing'

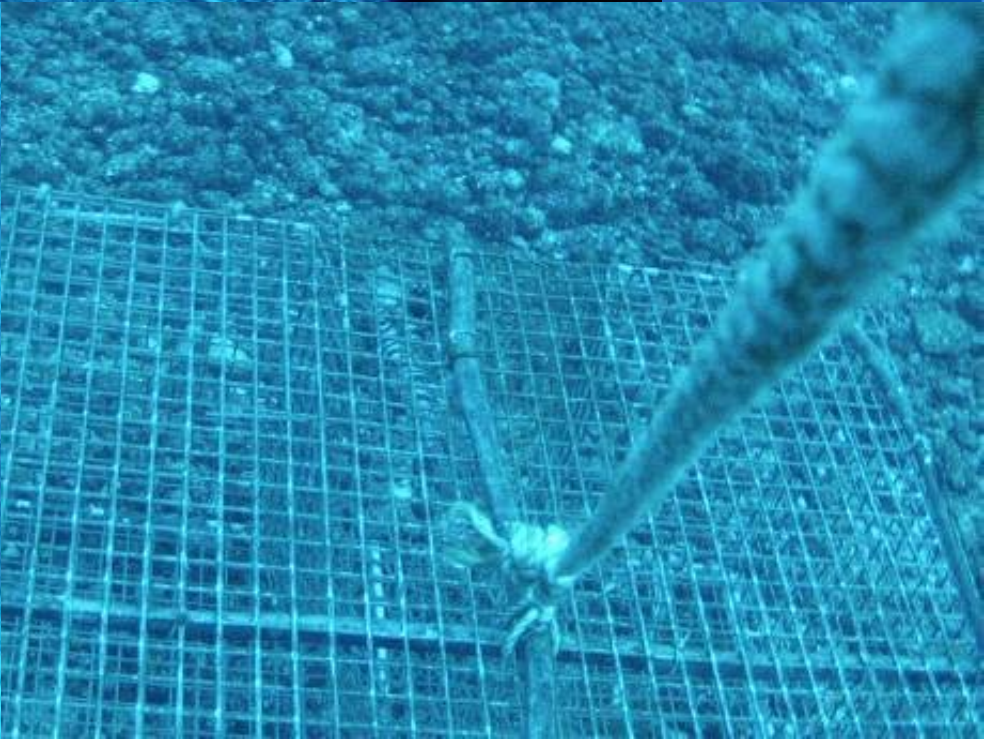
## Funnel opening fixed with 20cm ring

- Prevents large fish from entering
- Enables some small fish to exit



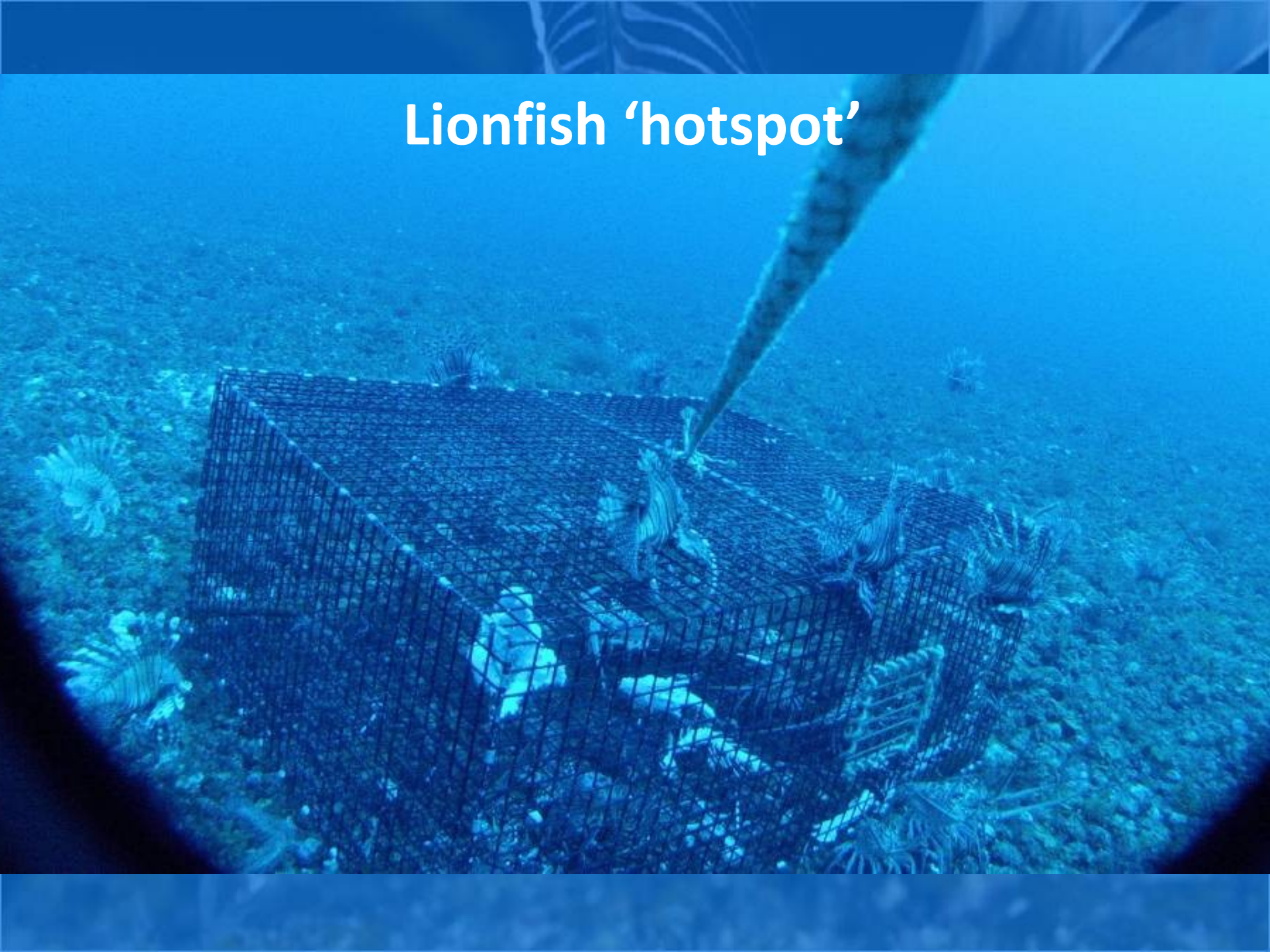


# Camera observations of lionfish and lobster traps





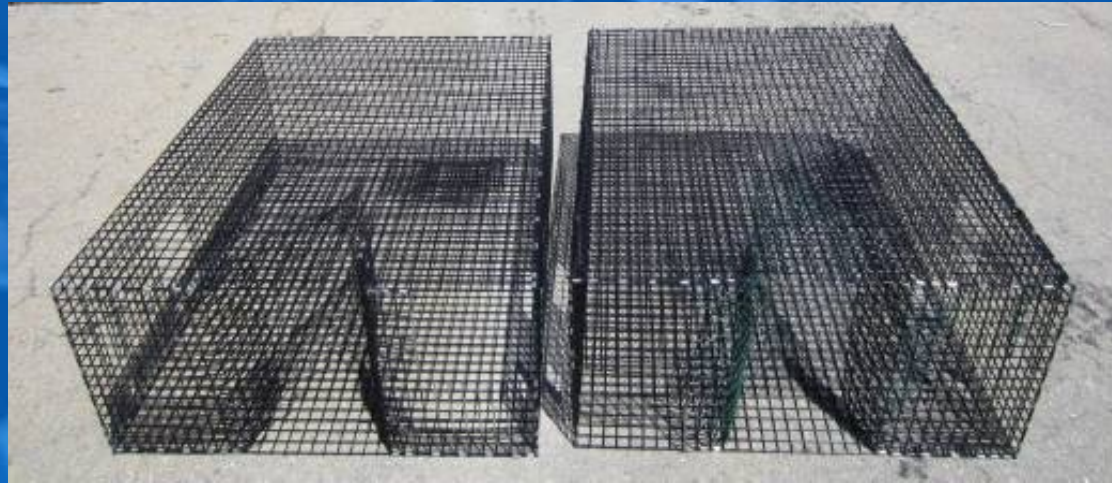
# Lionfish 'hotspot'





# Phase 1: Trap Types Tested

No shade vs. Shaded



Funnel with no ring

Funnel with wire oval ring

Drop funnel

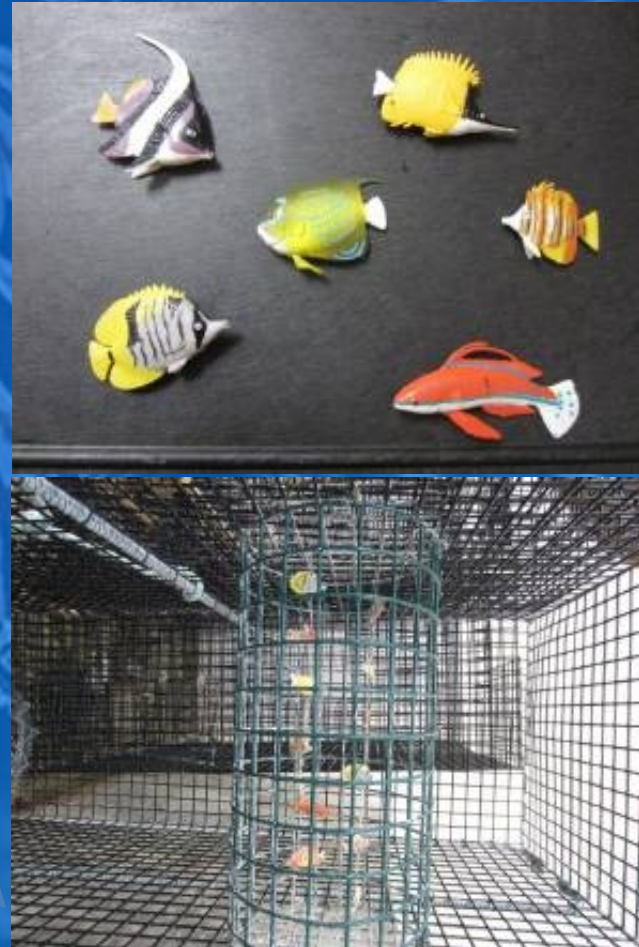




# Bait / Attractants

1. Typical 'dead' bait
  - Wired fish racks
  - Oily baitfish in bags
  - Larger baitfish

## 2. Small plastic fish



# Phase 1: Lessons learned

- Trapping offshore is difficult January through March!
- Shading traps catches more lobsters / fewer lionfish
  - Lionfish may be attracted to conspecifics already in the trap, which would be less visible with the shading mesh
- Escape gaps are vital for reducing bycatch
  - Lionfish are still retained, especially if the gap width is reduced to 4cm
- Dead bait increases bycatch
- Lionfish catch similar with dead bait and plastic fish decoys
  - The trap structure itself may attract fish in the low-relief habitat at 60m
- Unconstrained / poorly constrained funnels permit large fish to enter the trap
  - Larger groupers in the bycatch are a management concern
  - Very large fish damage the traps
  - Constrained funnel designs are needed



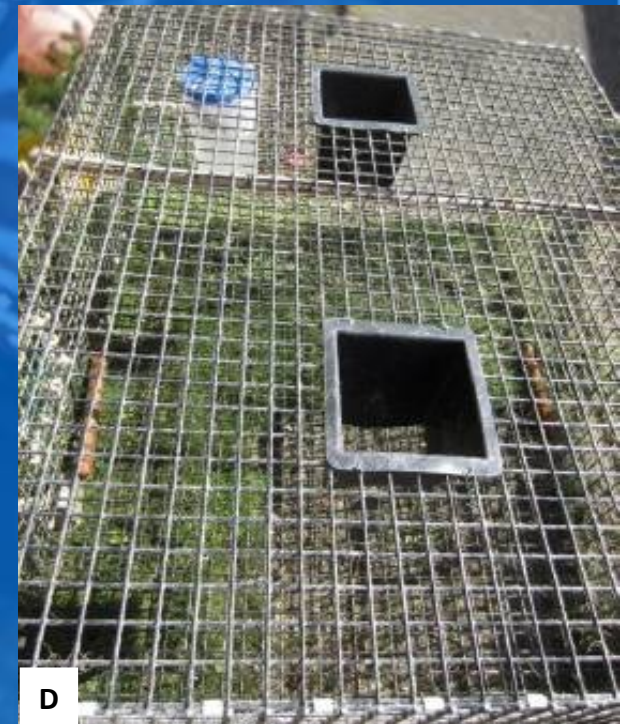
# Phase 2: Trap Types Tested

B) end mounted rectangular funnel



B

double top mounted rectangular funnels



D

C) rectangular funnel indented by 15"



C

wire funnel and 7" black ring



A



# Bait / Attractants

Small plastic fish















# Trapping Experiment Phase 2 Results

- 121 lionfish caught in total, 75% in traps with 7" rings
- Catches ranged from 0 to 13 lionfish per trap
- Some very large catches at 'hot spots'
- Best catches with soak times of ~10 days
- ➔ Density-dependent trapping / conspecific attraction
- Top loading funnel caught less bycatch
- No large groupers in the bycatch

Average catch (CPUE) of lionfish, lobster and other finfish.

Funnel Type				
Total number of haul				
Mean lionfish catch				



# Trapping alongside the lobster fishery

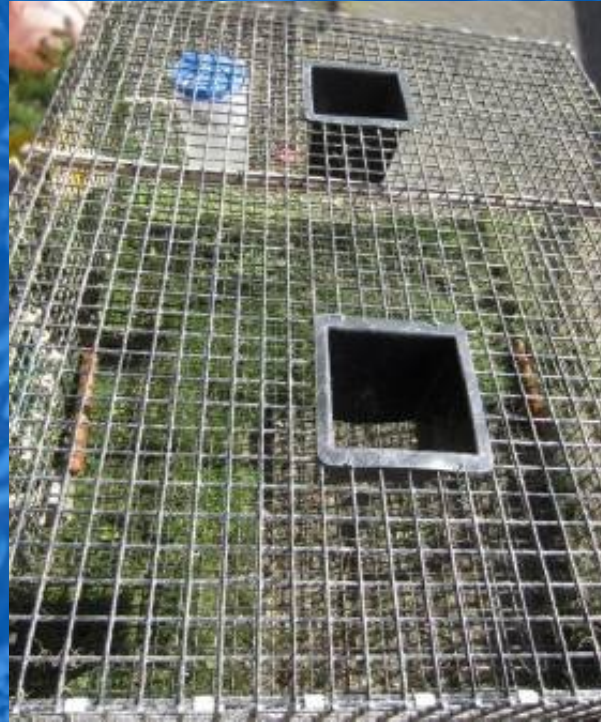
- Two commercial lobster fishers each operated a lionfish trap with a 7" ring funnel alongside their lobster traps from September through December of 2014
- Small plastic fish decoys used as attractants
- Average catch (CPUE) was 1.7 lionfish per trap
  - CPUE began to decline in December
  - Bycatch CPUE for the lobster fishery as a whole declined exponentially from 1.3 to 0.1 over this 17 week period
- Catches varied from 0 to 5 lionfish per trap
- ➔ Role of lionfish density and conspecific attraction in efficient trapping

# Phase 3: Trap Types

wire funnel and 7" black ring



double top mounted rectangular funnels



double top mounted ramp funnels



top entry, vertical exit





# Bait / Attractants

1. No bait

2. Plastic lionfish



# Phase 3 Results

- Catches much lower than in 2014
  - Heavy culling activity inshore of the trapping area during the preceding months
- Catches ranged from 0 to 6 lionfish per trap
- CPUE for 7" ring funnels still double that of the top rectangles
- Both top-loading funnels designs produced similar results
- Bycatch rates / composition similar to 2014

Average catch (CPUE) of lionfish, lobster and other finfish.

Funnel Type			
Total number of hauls			
Mean lionfish catch			
Mean lobster catch			



# Commercial Trapping - Summer 2015

- A commercial fisher operated 6 each of the 7" ring funnel and the top-loading rectangle designs at depths of 52 - 80m
  - Half the traps of each design had plastic fish decoys
  - Some sets had fish racks ('soft' bait) in all traps as well
- Record-keeping issues, especially for bycatch
- The fisher strongly preferred the 7" ring funnel design
- Average catch (CPUE) of at least 2.9 for 7" ring funnels
  - CPUE possibly up to 3.5 with decoys, up to 5.5 with 'soft' bait
- Adding 'soft' bait increased overall CPUE (and bycatch of medium-sized fish)
- Catches ranged from 0 to 17 lionfish per trap
  - Role of hot spots in efficiency
  - Importance of understanding distribution to target trapping
  - Average catch (CPUE) declined over the 6 weeks of trapping

# ICRI's Regional Control Strategy

- Incorporates recommendations on lionfish / invasive species from:
  - The International Coral Reef Initiative (ICRI)
  - Convention on Biological Diversity, Aichi Target 9
  - The Global Environment Facility Project “Mitigating the Threat of Invasive Alien Species in the Insular Caribbean”
  - The Caribbean Environment Program, Cartagena Convention and SPAW Protocol
- Aims to ensure a co-ordinated approach to minimize lionfish impacts
- Complements the lionfish best practices manual (Morris 2012)
- Recognises that eradication is unlikely **BUT** local control is possible
- ➔ **Objective 4:** Implement effective / efficient lionfish control programs
  - Strategies and tools for lionfish control depend on local variables and spatial scale
  - Prioritising areas for control / setting density targets helps direct resources
  - Collaboration with stakeholders promotes buy-in / enhances removal resources
  - **Focuses on sharing knowledge of removal tools and techniques**



# Potential Applications Elsewhere

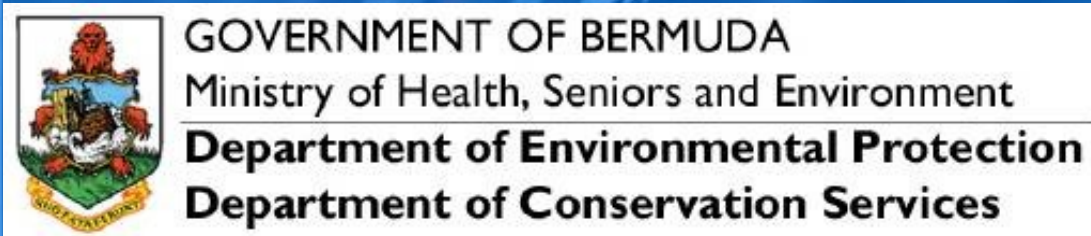
- Deeper areas where diver culling is not possible / practical and fish trapping does not already exist
- No fishing areas – select or adapt a design based on priorities
  - MPAs
    - MPAs identified as priority areas for removal
    - culling by divers is depth-limited and there is no other fishing activity
    - low bycatch is important
  - Ciguatera areas and contaminated areas (e.g. chlordecone/POPs)
    - cannot eat the lionfish
    - **BUT** trap removals can be a cost-effective way to control the population / reduce export of larvae with minimal impact on other species
- **Limitations:**
  - Not practical for reef wall habitats (need relatively flat bottom)
  - Heavy duty traps suitable for deep deployment require a winch
  - In deep areas, barotrauma impacts successful release of bycatch

# Conclusions

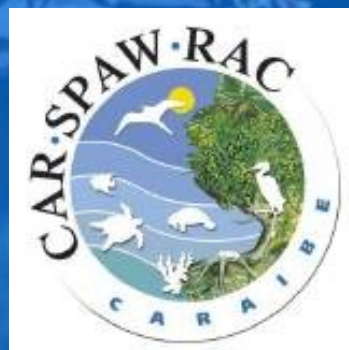
- Promising results – it is possible to trap lionfish efficiently
- Two trap designs with slightly different properties could be used to suit different goals
  - 7” black ring funnel maximises lionfish catch when bycatch is less of a concern
  - Top-mounted rectangular funnels catch lionfish less efficiently, but bycatch is very low
- Knowledge of lionfish distribution is key to efficient / effective trapping
- A combined removals strategy incorporating diver culling, dedicated lionfish trapping and regular fishing is needed to cover all habitats and seasons



# Thanks to funders and collaborators, and everyone who helped on the boat



# Thanks to the workshop sponsors and organisers





# Trapping Gear Suppliers

- Heavy duty traps (more durable than wire hex mesh)
  - Ketcham Supply ([www.lobstering.com](http://www.lobstering.com))
  - Templates of heavy vinyl clad mesh in various dimensions
- Florida style lobster funnels:
  - Atlantic and Gulf Fishing Supply Corp ([www.atagulf.com](http://www.atagulf.com))
  - Item #TRPFLO, US\$1.72 each
- Small plastic fish
  - [www.amazon.com](http://www.amazon.com)
  - Learning resources set of 60 in a tub, ~ US\$20
- Plastic lionfish
  - [www.amazon.com](http://www.amazon.com)
  - Various suppliers, US\$6-8

# Deep Water Cameras for Monitoring

- GoPro Hero 2 or 3
- Scout Pro HH housings by Group B Inc.
  - [www.groupBinc.com](http://www.groupBinc.com)
  - Rated to 5000' / 1500m
- Cam Do external controller
  - [www.cam-do.com](http://www.cam-do.com)
  - Time lapse intervalometer
    - Turns off the camera between bursts to extend battery life
    - Plugs in to HDMI port





# Deep Surveying Equipment

- SeaViewer Drop Cameras ([www.seaviewer.com](http://www.seaviewer.com)):
  - SeaDrop has various analog and digital HD options
  - Real time viewing to 90m in HD, deeper with analog
  - Digital recording using Black Magic Hyperdeck DVR
  - Battery or mains – Built-in lighting option available

