Trapping Lionfish in Bermuda, Part II: Lessons Learned to Date

Atrapar Pez Leòn en las Bermudas, Parte II: Conocimientos Aprendidas hasta Ahora

Piégeage les Poissons-Lion aux Bermudes, Partie II: Connaissances Apprises à ce Jour

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ABSTRACT

In Bermuda, invasive lionfish are concentrated in deeper waters (30 - 60 m) inaccessible to volunteer cullers, but are regularly caught as bycatch in commercial lobster traps at these depths. Bermuda does not allow 'fish pots', so the Department of Environmental Protection is working to modify standard lobster traps to increase lionfish catch and reduce the catch of spiny lobster, while maintaining low levels of finfish bycatch. Using insights from camera observations of commercial lobster traps, two iterations of trap designs and protocols were tested. Experimental traps were monitored using GoPro cameras with Cam-Do controller cards and deepwater ScoutPro housings. Modifications tested included: shading the traps; varying the funnel type (including various wire funnel designs, and side- and top-mounted plastic funnels); and varying baiting practices (including use of decoy baits). Shading the traps increased lobster catch while decreasing lionfish catch. Use of dead bait increased bycatch of all types significantly but, for a given trap design, lionfish catch was similar across baiting strategies. In the low-relief habitat at 60 m, the structure of the trap alone appears sufficient to attract lionfish. The presence of escape gaps reduced finfish bycatch significantly, while lionfish were retained. Lionfish "hot spots" were an important influence on catch rates. Optimal set time was 10 - 14 days. Traps with wire funnels terminating in a black 7" ring are being tested further alongside the deepwater commercial lobster fishery. With lobster bycatch reduced, a lionfish trap fishery could potentially operate during the summer closed season, but may not be cost-effective in isolation.

KEY WORDS: Lionfish, lionfish trap, Bermuda

INTRODUCTION

In 1999, Bermuda was the first location outside of the USA to detect invasive lionfish. The lionfish population is expanding in terms of both numbers and distribution, but is concentrated in deeper waters (30 - 60 m) that are inaccessible to volunteer cullers. However, lionfish have been caught as bycatch in commercial lobster traps since at least 2003, and regularly since 2008. Lionfish bycatch occurs predominantly in the deeper 'offshore' traps which are set outside the reef line at depths of 40 - 80 m during the first half of the September - March lobster fishing season (Table 1). The Department of Environmental Protection is working to develop a lionfish-specific trap for commercial fishers to facilitate large-scale, long-term removal of this invasive species from deeper waters. This approach is necessary because Bermuda banned 'fish pots' in 1990.

Table 1. Lionfish bycatch in Bermuda's commercial lobster trap fishery over the past five seasons.

	2009-2010	2010-2011	2011-2012	2012-2013	2013-2014
Lionfish caught offshore	608	200	371	487	1,235
Lionfish caught inshore	6	2	5	6	0
Factors affecting lionfish bycatch in the lobster fishery	All traps offshore Sept - Nov	5 out of 12 traps allowed inshore from the beginning of September			

The goal is to modify the traps and deployment protocols used by the commercial lobster fishery in order to increase the catch of lionfish, reduce the catch of spiny lobster, and maintain the low levels of finfish bycatch for which this standardized trap was developed. Such a trap would be used alongside the offshore commercial lobster fishery during lobster season, and could potentially be used during the summer as well if lobster bycatch can be sufficiently reduced so as to avoid putting egg-bearing female lobsters at risk.

Using insights from camera observations of commercial lobster traps (Pitt and Trott 2013), two iterations of trap designs and deployment protocols were tested. Observations of 'sheltering' behaviour suggested that shading the traps might enhance the feeling of protection they provide and entice more lionfish inside. The 'investigating' behaviour observed suggested that lionfish may be deterred from entering the traps when they see the white PVC ring that holds the funnel open (Figure 1), so alternatives included removing this ring or replacing it with something less conspicuous. However, there were concerns that removing the ring would result in unacceptable levels of finfish bycatch. Observations of lionfish 'perching' on top of the traps (Figure 2), together with information from the Florida spiny lobster fishery (Lad Akins, Reef Environmental Education Foundation, personal communication), suggested that a top mounted funnel might also work to capture lionfish. Further, if shelter is an important attractant for lionfish, then unbaited traps might still catch lionfish while attracting less bycatch.

GENERAL METHODS

GoPro Hero2 cameras with external controller cards from Cam-Do and deepwater ScoutPro HH2 housings from Group B (Figure 3) were used to monitor the behaviour of lionfish in and around the experimental traps, using the time lapse protocols described in Pitt and Trott (2013). The GoPros were set to the widest field of view and programmed to take time-lapse photographs at a rate of one picture per second when the camera was switched on. The external controller card plugs into the HDMI port and was programmed to switch the camera on for 5 seconds every 15 minutes. The series of 5 images was adequate for detecting fish movement, including swimming form and direction. The housing was attached with cable ties to the float line approximately 4’ above the trap in order to give a view of the surrounding area as well as the inside of the trap.

Figure 1. Standard wire commercial lobster trap funnel, held open by a white PVC ring.

EXPERIMENTAL TRAPPING, PHASE 1: SPECIFICATIONS AND RESULTS

Based on input from commercial fishermen, three traditional wire funnel types were tested in the first phase of the experiment: a flexible wire funnel, a wire funnel constrained by a wired *selvage edge*, and a drop funnel (Figure 4). Six traps of each type were constructed, half of which were shaded with plastic mesh (Figure 4), for an initial total of 18 experimental traps. Over the course of 9 deployments, the traps were fished with three types of dead bait and then with small plastic fish decoys as an attractant. Following the advice of the fishermen, the fish escape gaps that are a key feature of the standard lobster traps were wired closed for 2 of 3 deployments with dead bait and 3 of 6 deployments with decoys. All fishing took place in depths of approximately 60 m.

Figure 2. ‘Perching’ behaviour.

A total of 76 lionfish were caught from all funnel types over 9 deployments during Phase 1. The flexible wire cone had the best overall catch rate (0.8 lionfish per trap), followed by the *selvage edge* (0.5 lionfish per trap) and then the drop funnel (0.4 lionfish per trap). Shading decreased lionfish catch for all funnel types, and increased lobster catch for the flexible cone and *selvage edge* funnels. However, lionfish *hot spots* were an important influence on catch rates, with the greater densities in these locations resulting in disproportionately high catches for certain individual traps, and it was not feasible to move the traps around enough to account for this. The use of dead bait produced greater levels of bycatch, while lionfish catch was similar or greater with decoy baits. However, even the wire of the *selvage edge* funnel did not adequately prevent large finfish species such as groupers from entering the traps. With the many factors at play during this phase, the low number of replicates, coupled with trap losses, prevented a more extensive analysis of the data.

Figure 3. GoPro Hero2 camera with Cam-Do external controller card and Group B ScoutPro HH2 housing rated to 5,000 feet.

This phase of the experiment demonstrated the importance of incorporating escape gaps into the trap design, as having the gaps open reduced finfish bycatch significantly, from an average of 13 fish per trap to less than 1 fish per trap on average. However, as had been previously demonstrated by the lionfish bycatch in the commercial lobster traps, lionfish are still retained when escape gaps are present. Body width measurements of lionfish specimens acquired through both trapping and spearing (Figure 5) indicated that a 4cm wide escape gap would retain lionfish effectively, while providing an opportunity for other finfish to exit the trap. This is slightly narrower than the 5.5cm escape gaps in the standard lobster traps. The size distributions illustrated in Figure 5 also suggest a gear recruitment effect. However, the size distribution of trapped fish is similar to that of fish speared at the same depth (W. Corey Eddy, University of Massachusetts – Dartmouth, personal communication), indicating that the trap catches are representative of the wider population at those depths.

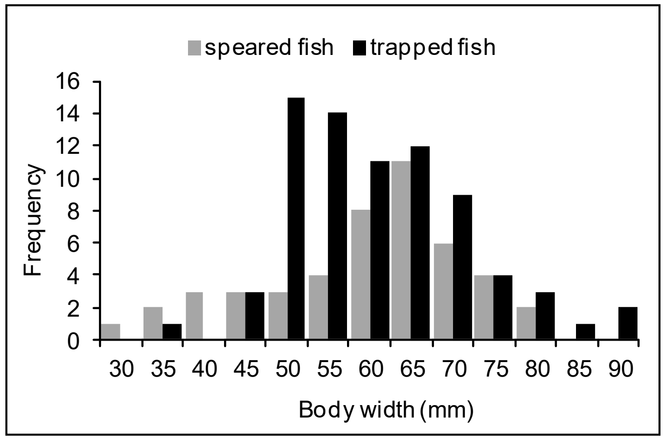

Figure 5. Body width distribution (mm) of speared versus trapped fish. (Category labels indicate upper limit of 5 mm size classes.)

EXPERIMENTAL TRAPPING, PHASE 2: SPECIFICATIONS AND RESULTS

The second phase of the experiment tested four trap designs that incorporated funnels with fixed openings (Figure 6). To standardize the opening of a wire cone without creating a visual obstacle, rings 7” (18 cm) in diameter were cut from a black plastic pipe. In addition, the standard black rectangular funnel used in the Florida lobster fishery was tested in three configurations:

i) As a vertical opening either on the end of the trap,
ii) or indented by 15” (38 cm),
iii) or double mounted as horizontal openings at the top of the trap, as they are in Florida, in an attempt to capitalize on ‘perching’ behaviour.

No additional shading was incorporated and only small plastic fish decoys were used as ‘bait’. The traps had two 4 cm wide escape gaps in opposite corners. Again, traps were fished in approximately 60 m.

A total of 121 lionfish were caught over 7 deployments during phase 2, primarily in the traps with the wire funnels with the 7” black ring (Table 2). These had an average catch of 3.4 lionfish per trap. The top mounted plastic funnels caught an average of 1.7 lionfish per trap (Figure 7), but catches in the vertically mounted plastic funnels were negligible even though underwater camera observations verified lionfish activity around each trap type. Further, observations of both lionfish and other predators *perching* on the traps for extended periods suggest that the structure of the trap itself is sufficient to attract fish in the low-relief habitat at 60 m. The traps were set for time periods ranging from 7 to 28 days, with catches increasing up to a certain point then declining again, presumably due to escapement or mortality. The best catches came from sets with a 10 - 16 day soak time.

Figure 4. Experimental design. Treatment level 1: No shade vs. Shaded; Treatment level 2: funnel variations.

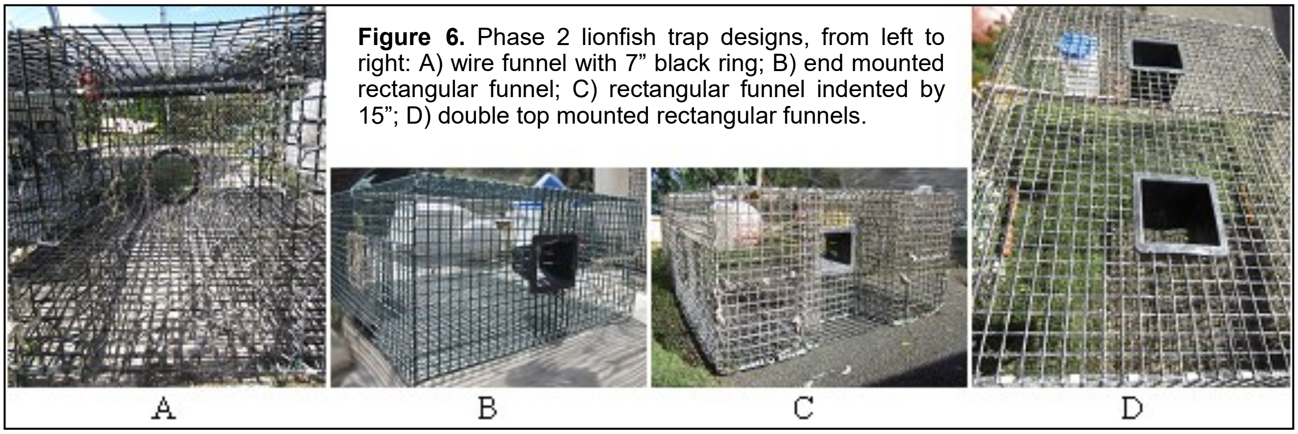

Figure 6. Phase 2 lionfish trap designs, from left to right: A) wire funnel with 7" black ring; B) end mounted rectangular funnel; C) rectangular funnel indented by 15"; D) double top mounted rectangular funnels.

NEXT STEPS

Lobster fishermen participating in the 2014-2015 commercial lobster fishery were each offered one trap fitted with a wire funnel terminating in the 7" black ring, to be fished alongside their lobster traps in the offshore fishery. Terms and conditions associated with the trap required that it be deployed according to the protocols developed during the experimental period, such that no dead bait is to be used and soak time should be between 7 and 14 days. Six lobster fishermen volunteered to incorporate the lionfish traps into their offshore lobster sets. Since the lobster season started, a number of fishermen have reported significant lionfish bycatch in their standard lobster traps as well.

Further testing of trap designs and deployment protocols will take place in 2015. The rationale for this is twofold. The promising results from the double top mounted funnels (Figure 7, Table 2) indicate that a top loading funnel design has the potential to catch lionfish effectively with minimal bycatch and therefore warrants further development. In addition, the large lionfish catches at the start of each lobster season indicate a buildup of lionfish in these deeper areas during the summer months when there is no trapping. The increase in lionfish numbers is undoubtedly impacting the ecosystem there and their presence in the lobster traps negatively impacts lobster catches, so some removal of lionfish during the summer months is important both ecologically and economically. The intention is to continue testing the 7" black ring funnels and to test several top loading funnel designs as well. With lobster bycatch reduced, a lionfish trap fishery could potentially operate during the summer closed season, but it remains to be seen whether it could be cost-effective in isolation.

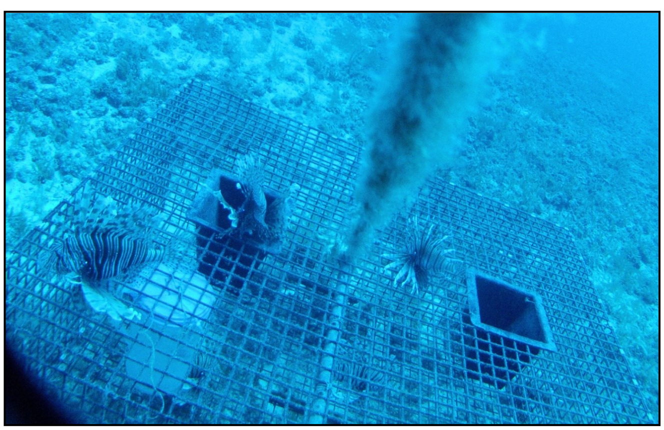

Figure 7. Lionfish interacting with trap fitted with two top mounted funnels.

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Table 2. Average catch (CPUE) of lionfish, lobster and other finfish for the various funnel configurations.

Funnel Type	7" ring	Indented rectangle	Side rectangle	Two top funnels
Total number of hauls	26	15	15	12
Mean lionfish catch	3.4	0.5	0.1	1.7
Mean lobster catch	2.0	0.0	0.0	0.1
Mean finfish catch	2.4	0.9	0.1	0.3