Testing the Efficacy of Lionfish Traps in the Florida Keys

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Introduction

- Indo-Pacific Lionfish, *Pterois volitans,* pose a significant threat to Atlantic, Caribbean, and Gulf of Mexico ecosystems due to widespread predation on native species, prolific reproduction, and lack of controlling predators.
- Lionfish in mesophotic reefs are primarily removed as bycatch in local fisheries, such as the Florida Keys lobster trap fisheries, but often at catch rates too low to exert control over deep water populations.
- Objective 1: To improve design, deployment and retrieval strategy of the Gittings noncontainment lionfish trap (NCT) in order to reduce risk of species and habitat entanglement, reduce escapement rate of lionfish and increase successful deployment rate. The original NCT design aims attract lionfish to minimal structure while reducing the risk of mortality of bycatch and the potential for ghost fishing [1].
- Objective 2: To test the efficacy of the NCT trap and a modified lobster trap (MLT) design in capturing lionfish from mesophotic reefs in the Florida Keys. The MLT design was based previous research in the Florida Keys[2]

Trap Schematics and Modifications

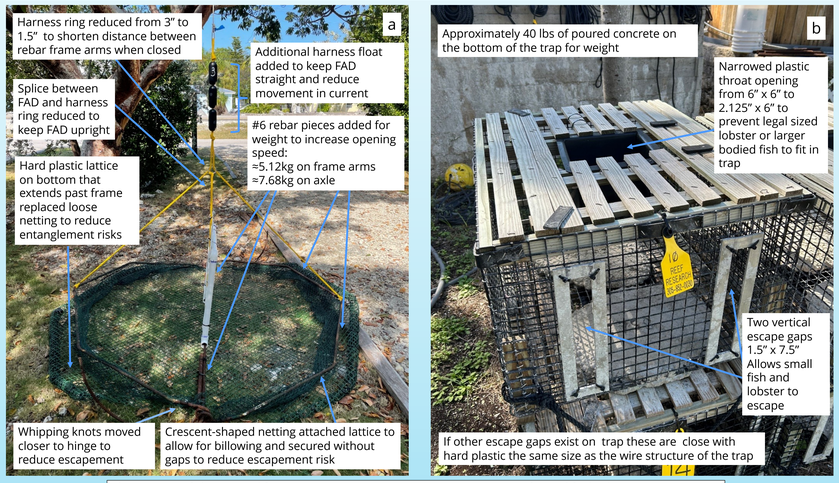

Figure 1. Lionfish trap modifications **(a)** Gittings Noncontainment Trap (NCT) **(b)** Modified Lobster Trap (MLT)

- Modifications to addressed previous issues described in a study in the Gulf of Mexico of sea turtle entanglement[3]
- A hard plastic lattice bottom reduced loose netting and entanglement risk. The hand-rolled edge is 6" from the end of the frame to reduce the chance of edges catching on the frame or inverting inside the frame if something crawled under the trap (ie. sea turtle)
- NCT issues addressed that have led to a failed deployments or retrievals in previous tests including escapement rate of lionfish in Gulf of Mexico study[4]
  - Surface floats – traps were almost all closed during deployment in high-traffic areas (due to catching or pulling on the line from the surface and/or lines were cut - adjusted to use subsurface floats (10m below)
  - Subsurface floats – float pulled the trap line upwards too much and does not allow trap to open properly
  - Weight – Increased weight allowed frame arms to open quickly (particularly important in high current or uneven bottom) and to increase drop rate and prevent sailing in high current
  - Reduced escapement gaps in frames and netting with improved hinge design, smaller ring size and closer stitches on netting

Methodology

Gear and Development Testing of NCT

- We observed the outcome of repetitive drops of trap modifications at different depth, habitat type, current, length of trap line, soak-time, subsurface and harness float designs and types.

Paired Design Deployments of NCT and MLT

- We deployed NCT and MLT on each site 15m apart in >30m depth in the sand at the edge of the reef or structure for a 3-day soak time
- 44% of paired traps had pot lights
- 43 different natural reef and artificial reef locations targeted across the Upper Florida Keys
- After deployment, divers tied off the subsurface float, recorded opening success (and opened traps if needed), and performed a roving diver lionfish survey, recording habitat type, trap depth, and max relief
- We deployed cameras with intervalometers above traps to record 30-seconds every hour
- We deployed a drop camera prior to retrieval to determine presence of lionfish or bycatch and escapement rate.
- We assessed the efficacy of the NCT and MLT as a function of catch-per-unit effort
- We compared bycatch between trap designs
- We monitored recruitment and habituation of lionfish and bycatch with videos

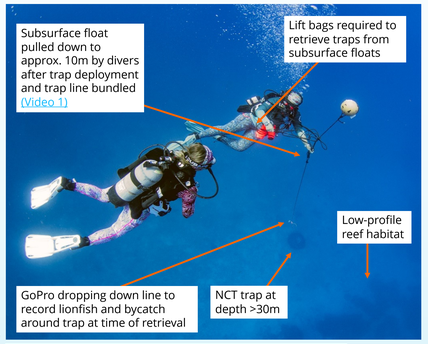

Figure 2. Description of NCT deployment method.

Figure 3 *(below left).* Deploying NCT port side of boat and then MLT on site.

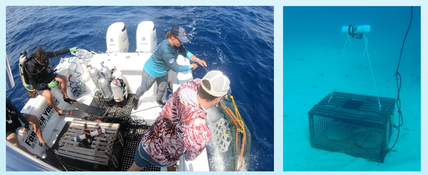

Figure 4 *(above right).* GoPro with intervalometer on float recording MLT.

Results and Discussion

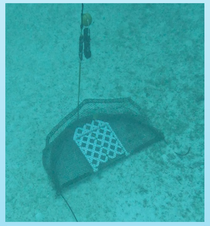

Figure 5 Failed NCT deployment. (Video 2)

Figure 6 Green Sea Turtle, *Chelonia mydas*, swimming inside NCT on top of hard plastic lattice

NCT Trap Modifications and Deployment Success

- Use of surface floats with NCT results in high risk of failure due to disruption and closing of traps during soak time when line is snagged in high traffic areas
- With subsurface floats only 18% (17 deployments) traps opened properly
- To use a subsurface float for paired testing, we deployed traps with the float at the surface and then divers tied the float down to 10m for each site. Divers then retrieved the traps with a lift bag (Fig 2).
  - With this adjusted method 79% (28 deployments) opened properly.
  - 2 of the failed deployments were due to traps hitting reef structure on bottom.
- Failure to open upon hitting reef structure was observed throughout the project depending on angle and relief and should be considered when choosing locations
- Adding balanced weight on the axle and frame was important to the successful opening of the NCT particularly in high current or with unlevel bottom
- NCT were also tested in a trawl with lobster traps and all NCT failed to open each time. Further work would be required to allow for a trawled deployment design
- NCT closed tightly and quickly with new modifications, however, escapement rate was not tested due to lack of recruitment.
- One lionfish was observed inside the NCT during retrieval, but it was not successfully captured due to the harness line twisting above the harness ring.
- No entanglements of sea turtles or other endangered species have occurred since the hard plastic lattice bottom replaced the loose netting, despite their presence in video footage (Fig 6).

Results and Discussion

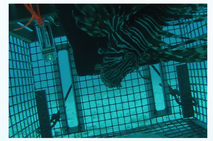

Figure 7. Lionfish caught in MLT with pot light

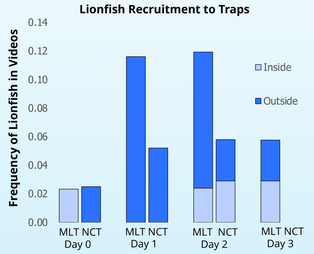

Figure 8. Lionfish recorded on video at MLT and NCT during 3-day deployment.

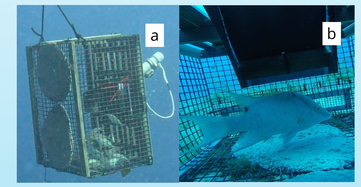

Figure 9. Common bycatch captured **(a)** 17 Tomtates, *Haemulon straitum*, in MLT **(b)** one Hogfish, *Lachnolaimus maximus*, in MLT

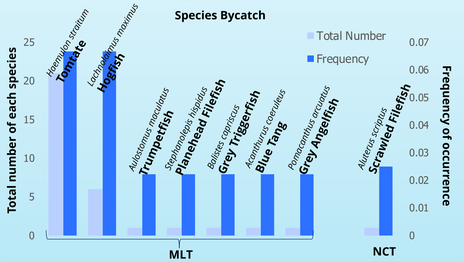

Figure 10. Frequency of bycatch species and total number of each species in MLT and NCT

- Only one lionfish was caught in MLT (45 traps) during paired design deployments and zero in NCT (40 open traps)
  - The capture site was sand and only had one lionfish surveyed
- Lionfish were present at 67% research deployment sites
  - Average 3.4 lionfish sighted per 5 minutes

Lionfish Recruitment

- 22% of MLT (4% with pot lights) and 7% NCT (2% with pot lights) had lionfish in video during deployment
- Only one MLT had two lionfish in a video at a time
- Low habituation rate - Only 1% NCT and 7% of MLT recruited lionfish for more than one day (or more than 2 hours)
- Day 2 (or Day 1) may be the better day for retrieval of traps based on limited data of the lionfish in videos and inside the traps

Bycatch

- 22% MLTs had bycatch, 3% of NCTs had bycatch
- Only one hogfish, *Lachnolaimus maximus*, embolized and died
- Bycatch were most commonly caught on sites with very low relief, sand or hard bottom
  - A few artificial sites had bycatch
- Pot lights didn't attract more bycatch than traps without lights
  - 40% of traps with bycatch had pot light
  - One MLT with a pot light captured 17 Tomtates, however another MLT without a pot light captured 13 Tomtate

Conclusion

NCTs deployment success rate may be a limiting factor in its effective use for a lionfish fisheries. However, more importantly, this project has found that the traps (NCT and MLT) tested may not be effective in recruiting and removing a high percentage of lionfish from these natural reefs. Even the deep, low-relief reefs of the Florida Keys may provide too much refuge to recruit lionfish to traps. The abundance of lionfish on site did not appear to affect capture or recruitment success, but this is worth examining further. Overall, a substantial number of traps, like the large fleet deployed by the Florida Keys lobster fisheries may be required to catch significant amounts of lionfish in a season from mesophotic reef habitats and make an impact on their population.

Citations

[1]Gittings S.R. 2016. Encouraging Results in Tests of New Lionfish Trap Design. Proceedings of the 69th Annual Gulf and Caribbean Fisheries Institute. 69:206-214
[2]Hagedorn S., Hutchinson E., and Matthews, T. 2019. Modification of a lobster trap to catch invasive lionfish (*Pterois spp.*). 72nd Annual Gulf and Caribbean Fisheries Institute Conference.
[3]Harris HE, Garner, SB, Tarnecki JH, Gittings SR, Chagaris DD, et al. 2023. Three trap designs evaluated for a deepwater lionfish fishery. Frontiers in Marine Science, 14(4), 1-12. https://doi.org/10.3389/fmars.2023.1121642
[4]Harris HE, Fogg AQ, Gittings SR, Ahrens RNM, Allen MS, et al. 2020 Testing the efficacy of lionfish traps in the northern Gulf of Mexico. PLOS ONE 15(8):e0230985. https://doi.org/10.1371/journal.pone.0230985

Acknowledgements

The project is funded through NOAA's Saltonsall-Kennedy Grant Program and all activities were conducted under the Florida Keys National Marine Sanctuary (FKNMS) Permit. Thank you to the knowledge and help from Florida Keys Commercial Lobstermen, Forever Young Charter Company, and the local Florida Keys community and REEF staff.