



# Recent invasion of the Loxahatchee River estuary by lionfish, *Pterois volitans* / *P. miles*



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## Background and Objectives

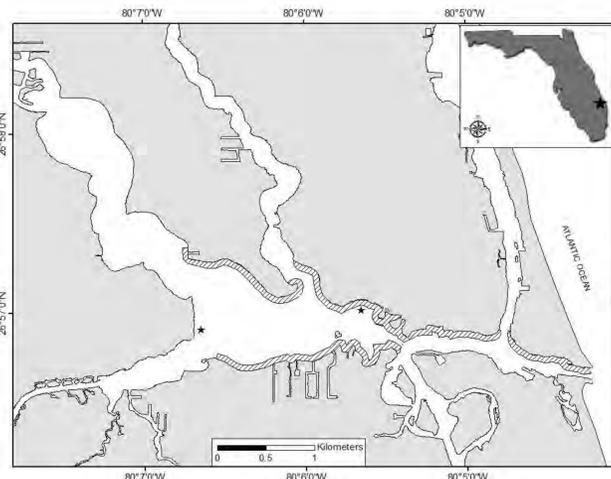
The rapid spread of invasive Indo-Pacific lionfish (*Pterois volitans* / *P. miles*) throughout the western Atlantic and Caribbean is emerging as a major ecological concern. Previously, invasive lionfish had been documented primarily in marine systems (e.g., coral reefs). We initially identified lionfish in the Loxahatchee River estuary (Jupiter, FL) in August 2010. This was the first documented estuarine intrusion of lionfish in the western Atlantic or Caribbean.

**Our goal was to determine how this invasion may affect estuaries in the future by:**

- Identifying size distributions, habitat preferences, and spatiotemporal abundance patterns of lionfish in the Loxahatchee River estuary in order to understand how the invasion is progressing
- Identifying movement patterns, site fidelity, and growth rates to determine how lionfish are utilizing estuarine habitats (i.e., are estuaries functioning as nurseries, or are lionfish utilizing these systems throughout ontogeny?)
- Identifying prey consumption by lionfish to understand how an invasive predator may affect native species (potentially through competition and/or direct predation)

**Fig. 1: Map of the lower Loxahatchee River estuary.**

Crosshatching indicates sections of shoreline where lionfish have been collected. We conduct quarterly lionfish eradications along the entire north shoreline, while the area delineated along the south shoreline is utilized for our tag/recapture study. Stars indicate the location of salinity and temperature monitoring stations.



## Methods

**1.) Quarterly eradication of all lionfish along the north shoreline of the river, from Jupiter Inlet to a point 4.5 km (~3 miles) upriver, including the lower reaches of the North Fork**

- Snorkel entire shoreline, collecting all visible lionfish using pole spears
- Location and habitat type of each capture site recorded
- All fish measured, stomachs removed for dietary analysis, otoliths extracted for ageing, tissue sample taken for stable isotope analysis

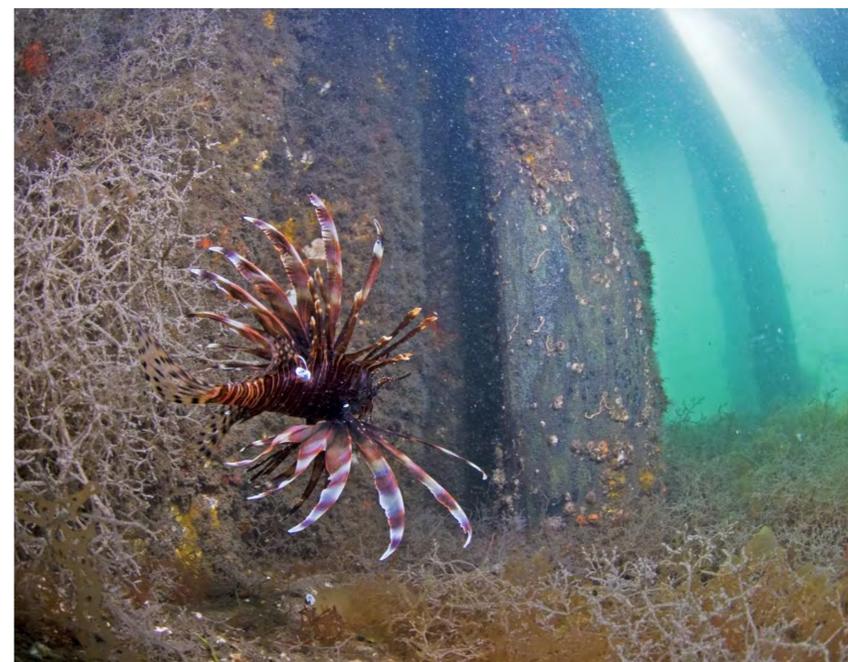
**2.) Monthly tag/recapture of all lionfish along the south shoreline of the river, from the railroad bridge to the mouth of the Southwest Fork**

- Lionfish collected using hand nets, measured, and tagged using numerical tags and color-coded beads
- Location, habitat type, and length recorded for each recaptured fish

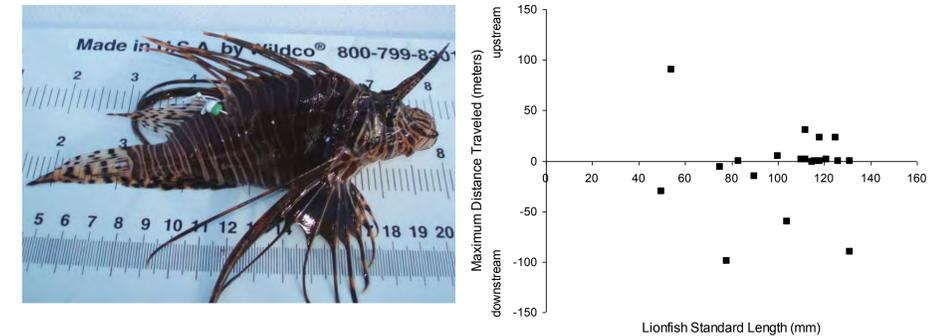
## Results and Discussion

**Fig. 2: Lionfish size range.**

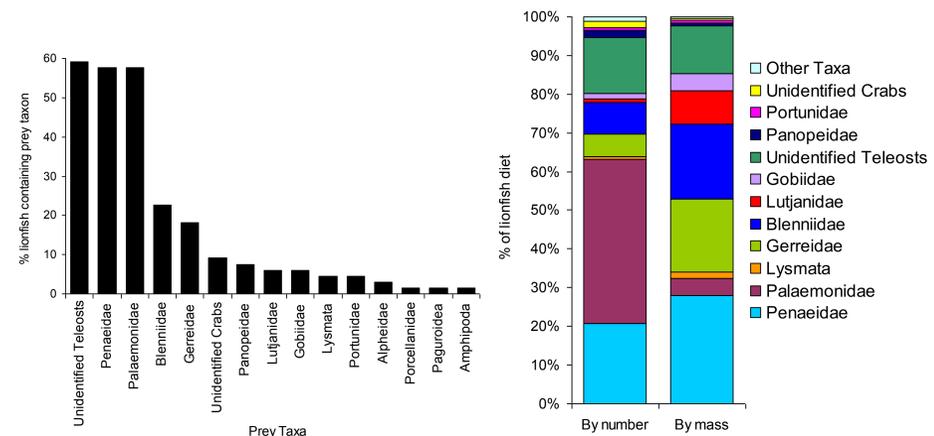
Between August 2010 and January 2011, 140 lionfish were captured in the Loxahatchee River. Fish were located as far as 4.5 km (~3 miles) from the ocean. Standard lengths ranged from 23-174 mm (0.9-6.9"), corresponding to total lengths of 34-254 mm (1.3-10"). Larger lionfish were captured between August and October, while most of the individuals captured between November and January were considerably smaller. This suggests that our routine lionfish eradication efforts may be controlling population growth at the local scale.



**Fig. 3: Lionfish utilizing human-made habitat.** Lionfish were strongly associated with human-made habitats in the estuary. All of the lionfish we captured were found resting on or hovering near anthropogenically created structures, such as dock pilings, sea walls (above), rock piles, and submerged debris.



**Fig. 4: Tag/recapture data.** A total of 27 lionfish were tagged between September and November 2010 (left). Twenty were recaptured at least once (74%), with some individuals being recaptured as many as five times. Most lionfish were recaptured in very close proximity to their original tagging site (right). Several individuals remained in the same location for more than four months, suggesting high site fidelity in the Loxahatchee River estuary. While a complete eradication of lionfish is not possible, high site fidelity may allow for local population control at small spatial scales. This is particularly important for ecologically or economically valuable habitats, such as estuaries (nursery value) or popular SCUBA diving sites on coral reefs (economic and ecological value).



**Fig. 5: Stomach content analysis.** Diet analysis was carried out on 71 lionfish from the Loxahatchee River. Of these, 66 contained prey items (93%). This value is higher than typically observed in predatory fishes, suggesting that lionfish feed almost continuously. Fifteen prey taxa were identified in lionfish stomachs. Unidentified fishes, penaeid shrimp, and palaemonid shrimp were the prey taxa found in the greatest number of lionfish stomachs (left). Overall, 88% of lionfish stomachs contained shrimp, 79% contained fishes, 23% contained crabs. Stomach contents were numerically dominated by shrimp, and gravimetrically dominated by fishes (right). Although the impacts of lionfish in estuarine systems have not yet been identified, we have shown that lionfish do consume economically important fish species (e.g., juvenile snapper). As lionfish grow larger and more abundant in the estuary, additional interactions with native species may occur (e.g., competition for resources)

## Future Directions

- Continue quarterly lionfish eradication efforts along the north shoreline of the river to better characterize habitat use, population fluctuations, distribution, diet, and growth
- Continue lionfish tagging study along the south shoreline of the river to further identify movement patterns, site fidelity, habitat use, and growth rates in the estuary
- Increase our sampling area to include points further upriver
- Identify larger ecosystem-level effects that lionfish may have in estuaries