

Gulf and Caribbean Research

Volume 32 | Issue 1

2021

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Recommended Citation

Blakeway, R. D., A. Q. Fogg and G. A. Jones. 2021. Oldest Indo-Pacific Lionfish (*Pterois volitans/P. miles*) Recorded From the Northwestern Gulf of Mexico. *Gulf and Caribbean Research* 32 (1): GCF11-GCF14.

Retrieved from <https://aquila.usm.edu/gcr/vol32/iss1/2>

DOI: <https://doi.org/10.18785/gcr.3201.01>

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GULF AND CARIBBEAN

R E S E A R C H

Volume 32
2021
ISSN: 2572-1410



Published by

**THE UNIVERSITY OF
SOUTHERN MISSISSIPPI**

GULF COAST RESEARCH LABORATORY

Ocean Springs, Mississippi

GULF AND CARIBBEAN FISHERIES INSTITUTE PARTNERSHIP

OLDEST INDO—PACIFIC LIONFISH (*PTEROIS VOLITANS/P. MILES*) RECORDED FROM THE NORTHWESTERN GULF OF MEXICO[§]

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KEY WORDS: age, marine sanctuary, coral reef, otolith, invasive species

INTRODUCTION

The Indo–Pacific lionfish (*Pterois volitans/miles*, herein referred to as lionfish) are the first marine teleost introduced that has spread throughout the Western Atlantic Ocean, Caribbean Sea, and Gulf of Mexico (GOM). Thought to be introduced from aquaria into coral reefs off Florida in the 1980s, lionfish pose a threat to ecologically, commercially, and recreationally important species throughout their range (Semmens et al. 2004, Morris and Akins 2009, Arias–Gonzalez et al. 2011, Green et al. 2012a, Albins and Hixon 2013). Lionfish were first reported in the GOM in 2009 (Aguilar–Perera and Tuz–Sulub 2010, Schofield 2010), and detected in the Flower Garden Banks National Marine Sanctuary (FGBNMS) off Texas in 2011 (Johnston et al. 2016a).

The Flower Garden Banks are considered among the healthiest reefs in the United States, exhibiting traits of resiliency to coral disease, bleaching, and other anthropogenic impacts that have dramatically disrupted other reef communities (Hickerson et al. 2012, Johnston et al. 2016b, Gil–Agudelo et al. 2020). Boasting more than 50% living coral cover, the East and West Flower Garden Banks support high fish biomass, com-

prised mostly of piscivorous fish species (Johnston et al. 2020).

This work describes some life history characteristics from lionfish in the northwestern GOM, which may have contributed to their spread in the region. Additionally, here we report the oldest documented lionfish from the Western Atlantic.

MATERIALS AND METHODS

During a 27–30 August 2018 research expedition, permitted divers armed with spears collected 745 lionfish from FGBNMS (Figure 1). Collected lionfish were measured in total length (TL, mm), placed in labelled bags, retained in a small freezer, and transported to the FGBNMS lab in Galveston, TX to weigh them to the nearest gram. A subset sample ($n = 122$) was sexed following the protocols of a gonad staging key (Green et al. 2012b) and aged through inspection of the lamination of opaque and hyaline bands from sagittal otoliths following methods of VanderKooy and Guindon–Tisdell (2003) and Fogg et al. (2019).

RESULTS AND DISCUSSION

Lionfish collected from the FGBNMS in 2018 ($n = 745$) ranged from 75–444 mm TL (mean \pm sd, 286.4 ± 54.8 mm TL; Figure 2). Length of the majority of lionfish captured (46%) ranged from 251–300 mm TL, while the fewest lionfish collected were < 150 mm TL or > 401 mm TL (i.e., 2% each; Figure 2). Lionfish total weight ranged from 4–1,153 g (mean 347.5 ± 208.1 g). Of the 122 otoliths collected for ageing, 12 were discarded due to poor cuts or over-polishing, and 2 readers agreed on 100 out of the remaining 110 otoliths (91%). Of the 100 lionfish otoliths aged, 33

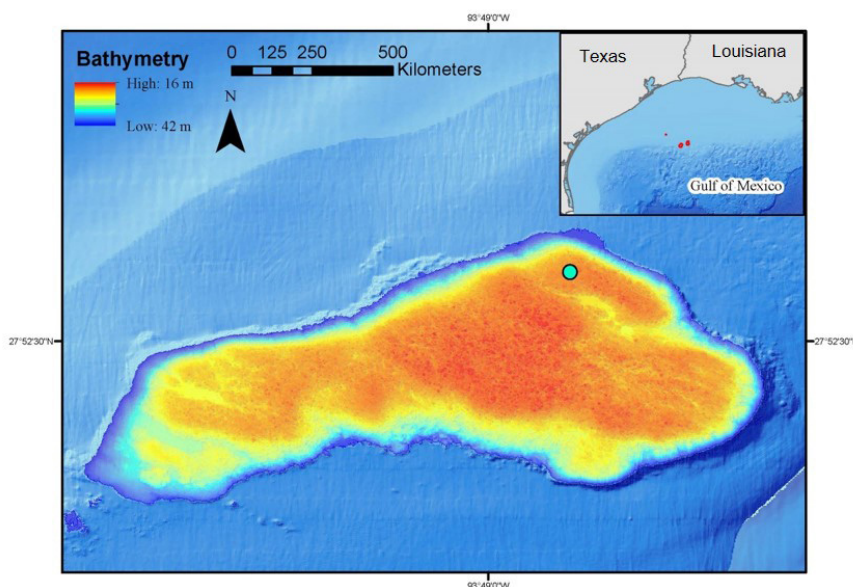


FIGURE 1. West Flower Garden Bank in Flower Garden Banks National Marine Sanctuary in the northwestern Gulf of Mexico, about 185 km offshore Galveston, TX. The circle indicates a mooring buoy at the bank where the 10 y old lionfish from this report was collected. Sources: NOAA/FGBNMS, USGS.

[§]This article is based on a presentation given in November 2020 at the virtual 73rd meeting of the Gulf and Caribbean Fisheries Institute.

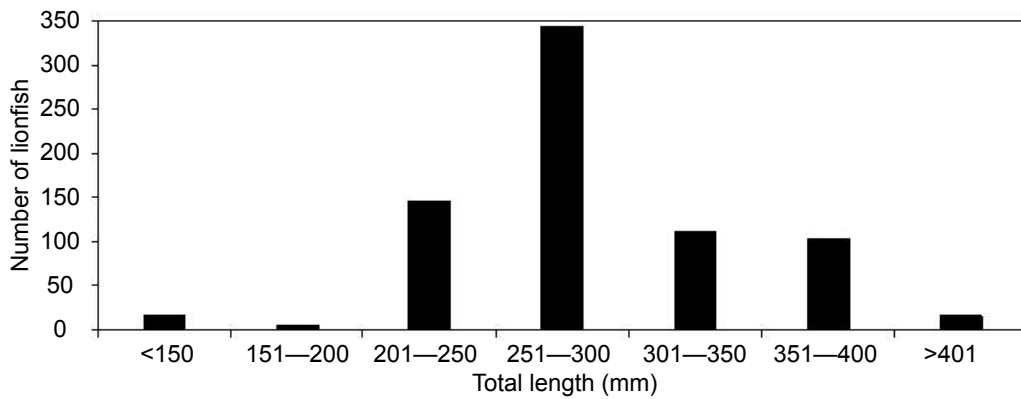


FIGURE 2. Length distribution of lionfish ($n = 745$) collected from the Flower Garden Banks National Marine Sanctuary in 2018.

were female, 65 male and 2 lacked developed gonads to determine sex. Ages ranged from 0–10 y, with the oldest being a 10 y male of 375 mm TL (805 g; Figure 3) collected from the West Flower Garden Bank (Figure 1).

Earlier research reported a maximum age range of lionfish from 4.5–9 y in the Western Atlantic (Barbour et al. 2011, Edwards et al. 2014, Dahl et al. 2019, Eddy et al. 2019, Fogg et al. 2019), while our study found a maximum age of 10 y. Fogg et al. (2019) argued that truncated age structure (i.e., high number of young individuals) of lionfish in the GOM could be a result of a stabilizing population, in which a maximum age was not likely determined. Variation in the maximum age estimates between our study and those by Dahl et al. (2019) and Fogg et al. (2019) from the GOM may be attributed to the different sampling periods, in that our study occurred later in the invasion progression (samples collected in 2018 vs. 2012–2015 for Fogg et al. 2019 and 2010–2017 for Dahl et al. 2019). Other explanations for the observed variation in age can be different environmental factors and regional differences in prey availability and lionfish density. In Bermuda, Eddy et al. (2019) reported much larger, older lionfish, which is common for most marine teleosts in temperate regions (Luckhurst et al. 1992, Robertson et al. 2005) but may also be from a lack of sampling smaller, younger lionfish in that study. It is possible that continued sampling in the northern GOM will reveal larger, older lionfish over time as the invasion stabilizes.

Lionfish were first reported in FGBNMS in 2011 (Johnston et al. 2016a); however, based on our report, it appears that lionfish invaded this region in 2008, 3 years prior to their first observation, which is consistent with invasion estimates from

other regions in the northern GOM (Dahl et al. 2019, Fogg et al. 2019). As lionfish show strong site fidelity (Akins et al. 2014) and limited spatial travel as adults (Cote et al. 2013), it is likely that the lionfish collected in our study were introduced through larval dispersal (e.g., Kitchens et al. 2017). This delayed detection of lionfish in FGBNMS is expected, as there is often a lag associated with invasive species expansion, therefore most go undetected until their densities increase and they spread spatially (Crooks and Soule 1999).

An annual long-term monitoring program within the FGBNMS has been implemented since 1989 to examine trends in benthic and fish communities, offering an invaluable time-series dataset that is used to identify threats that may result in temporal and spatial shifts within the reef systems (Johnston et al. 2020). However, these data only identify changes within long-term monitoring sites (1 ha), which leaves the majority of the coral reefs unassessed (0.4 km² total cover at West Flower Garden Bank). For example, the lionfish reported in our study was collected outside of the West Flower Garden Bank long-term monitoring site.

The ecological impacts of the lionfish invasion are concerning, as lionfish can cause substantial reductions of native reef fish (34–99% of prey-sized fish biomass) in a relatively short period (Green et al. 2012a, Albins 2015). It is unknown what impacts lionfish are having at FGBNMS, if any. Given the offshore, secluded nature of the sanctuary, absence of reef-wide monitoring, and serendipitous collection of such an old lionfish, it is clear that more investigations are necessary to construct a full age structure and to determine direct impacts lionfish may be having on native organisms in this protected region.

FIGURE 3. Mounted and polished sagittal otolith section of a 10 y old lionfish (*Pterois volitans/miles*) collected from the Flower Garden Banks National Marine Sanctuary, northwestern Gulf of Mexico, in 2018. White dots indicate annuli, determined through patterns of opaque and hyaline bands.



ACKNOWLEDGEMENTS

We thank Ripley's Aquarium, Texas Lionfish Control Unit, and the *M/V Fling* for contributing funds for the research expedition. We also greatly appreciate all of the volunteer divers (22 removal, 8 scientists) that participate on these cruises, and especially R. Bowman, as her team collected the lionfish referred to in this report. We thank and acknowledge M. Johnston with FGBNMS as the cruise coordinator and overall science lead for this expedition. No Animal Use Protocol (AUP) was required for this study, as determined by Texas A&M University's Animal Welfare Assurance Program Institutional Animal Care and Use Committee. Lionfish collected from FGBNMS was a permitted activity, under permit number FGBNMS-2018-002. No endangered or protected species were involved in this study.

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