Northern Gulf of Mexico Lionfish: Distribution and Reproductive Life History Trajectories

Pez leon en el Golfo de México Norte: Distribución y Trayectorias de la Vida Historia de Reproducción

Etudes du Poisson-Lion dans le Nord du Golfe du Mexique: Distribution Géographique et Trajectoires de Vie Reproductive

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EXTENDED ABSTRACT

In 2010, non-native lionfish (*Pterois volitans, P. miles*) were first legitimately detected in northern Gulf of Mexico (GOM) waters. Since then, reports and collections of lionfish throughout the GOM have increased considerably showing that they are established in the region (Schofield 2010, Fogg et al. 2013) and have been detected in waters off of Texas as early as 2011. Lionfish have been shown to have negative effects on native reef fish communities (Albins and Hixon 2008) and that they are capable of surviving a wide range of environmental conditions, including low temperature (10°C) and low salinity (see Jud et al. 2011). Little is known about the reproductive biology of lionfish in their invaded range, however. The information that is available for non-native lionfish in the Atlantic Ocean (North Carolina and Bahamian waters) concludes that lionfish can spawn about every four days, year around (Morris 2009). That, coupled with their prolonged larval stage, can account for how quickly they have been able to invade the region. As part of a larger life history project, we describe here some aspects of lionfish reproductive life history in the northern GOM.

Our research relies heavily on the participation of recreational divers from different regions in the northern GOM, often in association with lionfish derbies. Lionfish have thus been collected opportunistically throughout this region by spearfishers (divers using pole spear or speargun, ~85%), commercial trawl operations (~2%), and during fishery-independent bottom trawl surveys (State and Federal groundfish surveys, ~13%). At a minimum, collection date, location, depth (m), and substrate associated with capture were provided with each specimen. Typically, when lionfish are processed, they are measured (mm), weighed (g), and the gonads are removed, weighted (g), and preserved in 10% neutrally buffered formalin for later histological and fecundity analysis. Since lionfish are collected across the GOM, and at times in large numbers, the examination of fresh specimens was not always feasible. Thus, some fish were frozen prior to data collection even though freezing may negatively impact reproductive biology analyses. Therefore, we evaluated the effects of freezing and formalin fixation on the wet weight (g) of gonadal tissue of lionfish.

Since March 2012, more than 3,000 lionfish ranging from 44 - 419 mm total length (TL) have been collected from three northern GOM regions (Figure 1). These regions are: southeast (Florida Keys to north 28.25°; 26.1%, mean = 230.7 mm, range = 90 - 409 mm); northeast (north 28.25° to west 88°; 57.9%, 216.0 mm, 57.8 - 409 mm), and west (west 88° to Mexican border; 15.9%, 254.4 mm, 44.5 - 419 mm). The large number of lionfish captured in a relatively short time period suggests continual, successful invasion of the northern Gulf of Mexico.

To evaluate the difference between fresh and frozen/preserved gonad weight, the right lobe fresh weight of 56 males and 72 females (15 developing, 57 spawning capable) was compared to the preserved weight (after freezing). There were no differences in weight by gender or gonad reproductive phase (paired t-test, all $p > 0.700$); thus, no adjustments are required if tissues are processed within three weeks of being frozen. This allows use of all collected specimens in analyses, as freezing and preserving fish does not have a significant effect on the gonad weight.

Gonadosomatic Index (GSI) values were calculated for both male and female lionfish to determine the reproductive season in the northern GOM (Figure 2A). Pooled GSI values from the southeast and northeast regions were significantly elevated for female lionfish from May through October ($p < 0.001$), peaking in July and August. In contrast, male lionfish region-pooled GSI values were not significantly different among months ($p > 0.05$), although they were generally elevated from May through October. Macroscopic inspection of ovarian tissue showed females in the spawning capable reproductive phase were present from April through November in the southeast and northeast regions (Figure 2B), corresponding with the GSI data. The presence of spawning capable females over an eight month period suggests reproduction is asynchronous within the northern GOM lionfish population . This is consistent with lionfish reproduction from other parts of their invaded range (Morris 2009). It will be important to further evaluate the reproductive life history in the northern GOM, including months where sample collections have been minimal, so that we may further understand the future impacts lionfish will have on the region.

KEY WORDS: Invasive, Lionfish, *Pterois*, reproduction, Gulf of Mexico

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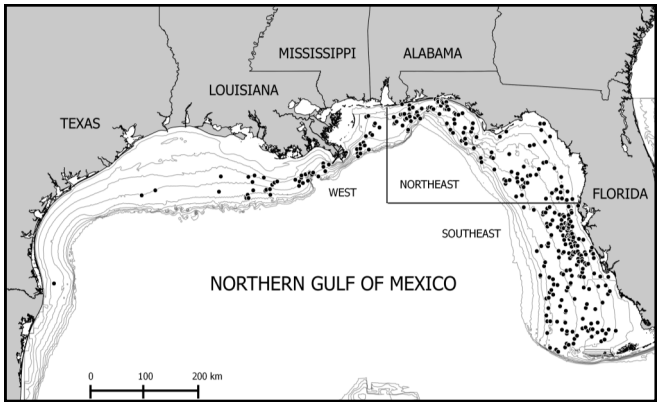

Figure 1. Locations where lionfish (*Pterois* sp.) were collected in the northern Gulf of Mexico through October 2013. Regions are defined as southeast (Florida Keys to north 28.25°), northeast (north 28.25° to west 88°), and west (west 88° to Mexican border). Depths of collections ranged from 3 - 103 m.

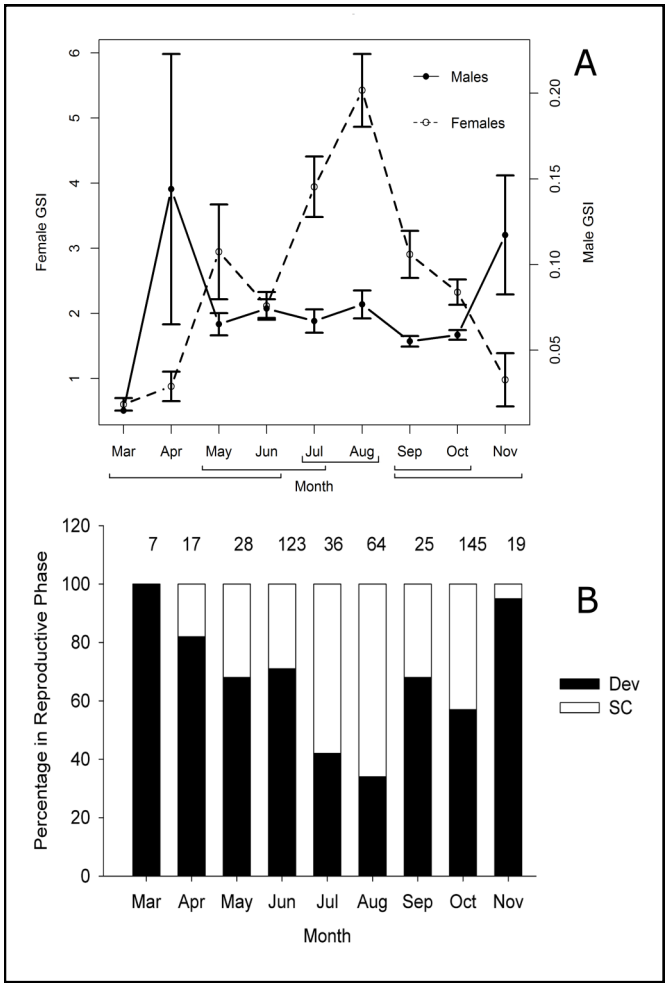

Figure 2. Reproductive parameters of lionfish from the northeast and southeast regions in the northern Gulf of Mexico collected between March 2012 and October 2013. **A.** Monthly (mean ± SE) Gonadosomatic Index (GSI) values for male and female lionfish. Sample sizes ranged from 1 (March) to 151 (October) for males across months whereas for females it ranged from 7 (March) to 145 (October). The horizontal lines below the X-axis represent female GSI value homogeneous subsets based on Tukey b post-hoc test after a significant ANOVA. March males were not included in data analysis. **B.** Percentage of reproductively active females in ovarian phases based on macroscopic inspection. Numbers indicate sample size for each month. Dev—developing; SC—spawning capable.