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Scientific Note

Brief description of prey selectivity and ontogenetic changes in the diet of the invasive lionfish *Pterois volitans* (Actinopterygii, Scorpaenidae) in the Mexican Caribbean

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Abstract. Stomach contents were analyzed from 109 individuals. A total of 4 Genera and 14 Species were identified. Crustaceans accounted for %N=67.39% , %IRI= 86.37% of the total identified taxa and Teleosts %N=32.61% (%IRI = 13.63%). An ontogenetic change was observed in *P. volitans* diet.

Key words: invasive species, Mexico, Caribbean Sea, feeding ecology, Scorpaenidae

Resumen. Breve descripción sobre la selectividad de presas y cambios ontogénicos en la dieta del pez león invasor *Pterois volitans* (Actinopterygii, Scorpaenidae) en el Caribe Mexicano. Se analizaron contenidos estomacales de 109 individuos. Se identificaron un total de 4 géneros y 14 especies. Los Crustáceos representaron un %N=67.39%, %IRI = 86.37% y los Teleosteos un %N=32.61% (%IRI = 13.63%). Se observó un cambio ontogénico en la dieta de *P. volitans*.

Palabras clave: especies invasoras, México, Mar Caribe, ecología alimentaria, Scorpaenidae

The Indo-Pacific lionfish [*Pterois volitans* (Linnaeus 1758) and *P. miles* (Bennett 1828): Family Scorpaenidae] is the first non-native marine fish to establish in the North Atlantic (Schofield, 2009). The native range of *P. volitans* originates in the Pacific Ocean, from southern Japan to Micronesia, Australia, The Philippines, a great part of Oceania, and east of French Polynesia. Morris & Whitfield (2009) reported that the first collected organism dates back to the mid 1980´s. Nowadays, this species is rapidly extending throughout the Caribbean Regions (Albins & Hixon, 2008) and some areas of the Gulf of Mexico (Aguilar-Perera & Tuz-Sulub, 2010). Since November 2010, the fish has established along the U.S. Atlantic coast, Central and South American Caribbean Regions, and the Gulf of Mexico (Schofield, 2010). It is a territorial species and has nocturnal activity; during the day it stays inactive and hidden in reef cavities. The lionfish feeds on small fish and Crustaceans and is capable of rapidly adapting to new prey (Whitfield et al., 2003). Albins and Hixon (2008) presented the first evidence of the Indo-Pacific lionfish reducing the recruitment of native Atlantic fish. Very little work has been performed in the Mexican Caribbean, therefore there is limited information on the dietary preferences of the *P. volitans* population in the region. Quantification of the feeding ecology of the lionfish through the measurement and detailed investigation of consumption rates and prey selectivity will permit a more informed assessment of the impacts of their predation on local reef fish communities (Morris et al., 2008).

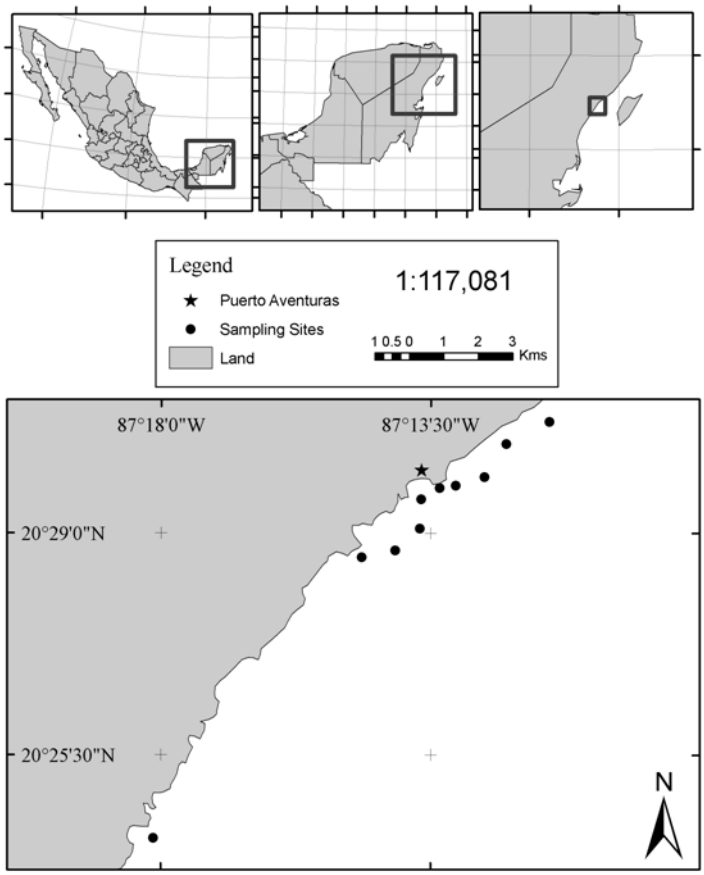

Figure 1. Map of the study area and sampling sites (black circles) off the coasts of Puerto Aventuras, Mexico.

The present study took place off the coast of Puerto Aventuras, Quintana Roo (Mexico), located 300 km northeast of Chetumal and 80 km southwest of Cancun. A total of 33 SCUBA dives were performed in 10 different sites during summer (May-August), 2010 (Figure 1). All dives were performed in the morning at depths between 5 m and 40 m. All specimens were captured using a net and numbered collection bottles (n=109). Fish were immediately frozen after capture. Total length (Tl ± 0.01 cm) was measured on every specimen. Then, stomachs were extracted from all organisms to identify the contents; males and females were pooled together due to the difficulty of sexing immature organisms. Stomach content analysis was performed with a total of 71 stomachs because 38 stomachs were found to be empty. From those 71 stomachs, only 45 had identifiable contents. Each dietary item was identified to the minimum possible taxon. To ensure sample size, an accumulation plot using Shannon's diversity index, $H'_{(\ln)}$ (with 50 randomizations in the dataset) was performed. The occurrence (%O), frequency (%N), gravimetric index (%W), index of relative importance (IRI), and pondered index of relative importance (%IRI) were calculated for each dietary item. %W was not calculated for some items due to their small size. For these items, IRI and %IRI were calculated using a %W = 0%, enabling us not to overestimate any item's IRI and subsequently its respective %IRI. In order to identify ontogenetic changes in stomach contents composition, stomachs were divided into total length classes (C = 8), obtained by using Sturghes Rule. Two dietary categories (Crustaceans and Teleosts) were established based on item identification.

As Figure 2 shows, sampling asymptote was achieved. A total of 92 dietary items were identified (14 species and 4 genera) (Table I), accounting for $H'_{(\log e)}$ = 1.93 for overall stomach contents. *Lysmata spp.*, *Mysidium spp.*, and *Callinectes sapidus* were the only Crustaceans found (%IRI = 86.37%). Teleosts represented the remaining %IRI (13.63%), with *Apogon* spp. being the most represented fish. Using total length classes (now referred to as Tlc) to analyze stomach composition by groups allowed us to observe ontogenetic changes in dietary preferences (Figure 3)

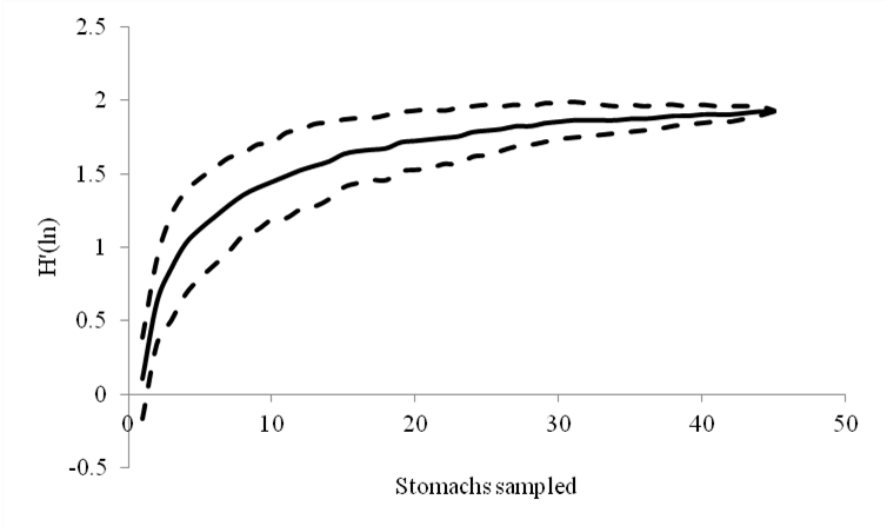

Figure 2. Diversity accumulation plot for stomachs of *Pterois volitans* (continuous line) and standard deviations (dashed lines).

Table I. Stomach content analysis parameters.

Species	**%O**	**%N**	**%W**	**IRI**	**%IRI**
*Lysmata spp.****	29.58	43.48	21.76	1929.54	77.49
*Mysidium spp.****	9.86	21.74	–	214.33	8.61
Apogon spp.	8.45	10.87	4.47	129.64	5.21
Stegastes partitus	2.82	2.17	37.56	111.91	4.49
Mycteroperca venenosa	1.41	1.09	19.37	28.82	1.16
Liopropoma carmabi	2.82	2.17	4.77	19.56	0.79
Epinephelus spp.	2.82	2.17	2.98	14.52	0.58
Malacoctenus trinagulatus	2.82	4.35	–	12.25	0.49
*Callinectes sapidus**	1.41	2.17	2.68	6.84	0.27
Canthigaster rostrata	1.41	1.09	3.28	6.15	0.25
Gonodactylus smithii	1.41	1.09	0.89	2.79	0.11
Thalassoma bifasciatum	1.41	1.09	0.89	2.79	0.11
Cryptotomus roseus	1.41	1.09	0.60	2.37	0.10
Pterois volaitans	1.41	1.09	0.45	2.16	0.09
Gobiosoma prochilos	1.41	1.09	0.30	1.95	0.08
Chromis multilineata	1.41	1.09	–	1.53	0.06
Gramma loreto	1.41	1.09	–	1.53	0.06
Ophioblennius atlanticus	1.41	1.09	–	1.53	0.06
Total	74.65	100.00	100.00	2490.21	100.00

Identified dietary items and their occurrences (%O, non additive), frequencies (%N), gravimetric index (%W), index of relative importance (IRI, non additive), and pondered index of relative importance (%IRI) among all stomachs. Items marked with an asterisk (*) are Crustaceans, non-marked are Teleosts. Items with no %W, IRI and %IRI were too small to be weighted.

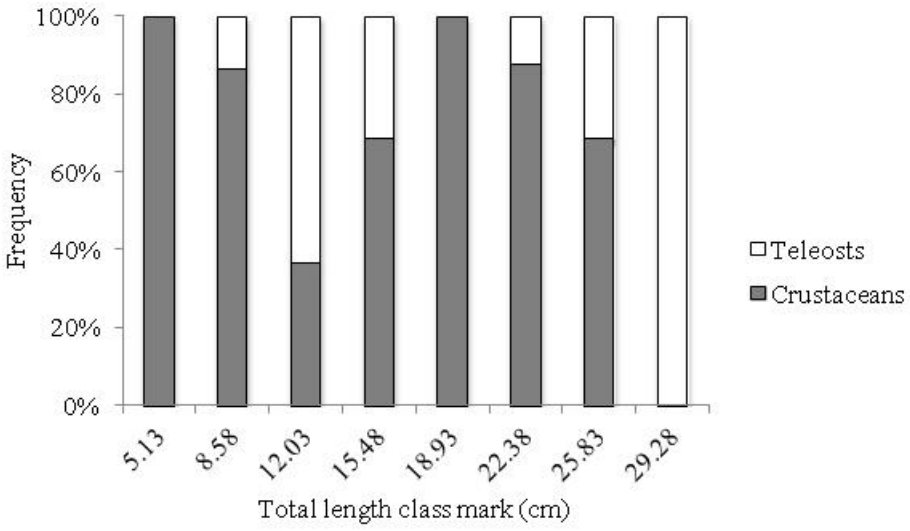

Figure 3. Relative stomach content composition according to the total length class mark.

Stomachs belonging to the smallest Tlc (5.13 cm) contained only Crustaceans (*Mysidum spp*.). Teleost contents increased their appearance on 8.58 cm and 12.03 cm Tlcs, where small fish (*Apogon spp. Malacoctenus triangulatus, Ophioblenius atlanticus, Canthigister rostrata, Cryptotomus roseus, Epinephelus spp, Gobiossoma prochilos*, and *Gonodactylus smithii*) have a higher representation. On Tlc 15.48 cm and 18.93 cm, Teleosts were replaced by the larger Crustacean *Lysmata spp*. On Tlcs ≥ 23.38 cm larger Teleosts were consumed (*Apogon spp., Liopropoma carmabi, Stegastes partitus, Chromis multilineata, Gramma loreto, Mycteroperca venenosa*, and *Pterois volitans*); Crustaceans were also consumed having *Lysmata spp.* and *C. sapidus* present for Tlc 23.38 and exclusively *Lysmata spp.* for Tlc 25.83 cm. The largest class mark, Tlc 29.28 cm contained only Teleosts.

P. volitans have previously been identified to be one of the main predators in coral reef systems. It feeds mainly on Crustaceans, other invertebrates, and fish (including its own species) (Fishelson, 1977). Results presented in this paper are similar to those reported by Morris and Akins (2009) in the Bahamas. This work shows that *P. volitans* have a preference over *Lysmata spp.* and *Apogon spp.* Previous studies have documented an increasing preference for fish consumption with increasing lionfish age (Harmelin-Viven & Bouchon, 1976; McCleery, 2012). In this study, ontogenetic changes in stomach contents were also observed by comparing Tlc´s and assuming that larger organisms were also older. Nevertheless, *P. volitans* showed ontogenetic shifts with Tlc, alternating stomach content compositions for different sizes. Crustaceans were the main prey in stomach contents, suggesting that this group is the most affected by the introduction of this predator in the studied region.

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