Pterois volitans (Red Lionfish)

Family: Scorpaenidae (Scorpionfish)
Order: Scorpaeniformes (Mail-cheeked Fish)
Class: Actinopterygii (Ray-finned Fish)

Fig. 1. Red lionfish, *Pterois volitans*.

[http://www.aquaportail.com/fiche-poisson-550-pterois-volitans.html, downloaded May 2015]

TRAITS. The red lionfish *Pterois volitans* features a laterally compressed, heavy body that is banded with distinctive vertical stripes, which vary between white or cream and red to brown-black (Fig. 1); in coastal populations, the fish are usually darker. There are two large whiskers (mandibular appendages) that protrude from either side of the mouth (Marini, 2008). Lionfish generally possess mouths with gapes of 2.3-3.7cm (Costello et al., 2012). On the back there are at least 13 elongated fin spines, of which 10 are generally venomous, containing acetylcholine - a powerful neurotransmitter and neuromuscular toxin. The pectoral fins are very long, and there are also colourless dorsal, anal and caudal fins that are often spotted (Fig. 2). The body length is usually up to 38cm; the maximum recorded size is 47cm (Harrell, 2015) and 1.2kg. Juvenile lionfish feature comparatively long, individually-sheathed pectoral fin rays that have numerous ocellae, which disappear as they age (Hix and Hix, 2009). Lionfish in the Caribbean also include another invasive species, the common lionfish *Pterois miles*.

DISTRIBUTION. Arriving in Trinidad and Tobago in late 2010 (Ema.co.tt, 2013), *P. volitans* is a native of the Pacific Ocean (Fig. 3), now classed as an invasive species in the Caribbean Sea and Atlantic Ocean (Invasive Species Executive Order No. 13112). The rapid spread in the Caribbean (Fig. 4) is due in part to its natural, pelagic larval distribution by ocean currents and rapid population growth. Availability of prey and thermal tolerance are considered to be the only limiting factors involved in the future distribution of *P. volitans*.

HABITAT AND ACTIVITY. *Pterois volitans* can be found in all marine habitats that span the Atlantic from southeast United States right down to the Caribbean Sea. Habitats are limited only by their thermal tolerance (10-30°C). Lionfish thrive in sheltered, low wave energy environments (Anton et al., 2014). As with most predatory fish, the lionfish's behaviour is usually crepuscular, meaning it is influenced by ambient light and it is therefore generally inactive during the daytime and most active during the periods of dusk and dawn (Cure et al., 2012). Apparently, within the

invasive range in the Atlantic, *Pterois volitans* are now becoming more diurnal feeders, feeding during the day (Cure et al., 2012).

FOOD AND FEEDING. *Pterois volitans* are voracious fish predators (Arias-González et al., 2011), an apex, generalist predator (Fig. 5). Native Caribbean organisms that are preyed upon are gravely endangered, since they do not possess a shared evolutionary history, which would encourage the prey to adapt and develop appropriate defensive measures. The list of species of fish (more than 35) and crustaceans (over 15) found within stomachs of lionfish in the Atlantic is extensive (Valdez-Moreno et al., 2012). Lionfish are capable of consuming daily 2.5-6.0% of their body weight, and demonstrate long-term fasting abilities of up to 12 weeks.

REPRODUCTION. With a lifespan of approximately 16 years in the wild, *P. volitans* reach maturity at lengths of 10cm in males and 18cm in females (Costello et al., 2012), generally a year after hatching. Reproduction is sexual, with external fertilisation of up to 15,000 mucus-encapsulated eggs. Females can spawn every 4 days (Myfwc.com, 2015). Larvae emerge 36 hours after fertilisation; it takes 2-3 days for the larvae to become competent swimmers (Masterson, 2007).

BEHAVIOUR. *Pterois volitans* uses two approaches to foraging; slow stalking and sit-and-wait ambush, then it attempts to corner the prey by chasing it into a crevice and restricting its movement by spreading its pectoral fins. Often on approaching prey, it also exhibits "blowing behaviour" whereby it spews jets of water towards its prey, which distracts the prey. Lionfish tend to be solitary outside of the reproductive season, and their spines provide defence against predators. Juveniles swallow their prey whole and have ocellae on their dorsal and caudal fins which appear as eyes to predators and serve as a protective measure.

APPLIED ECOLOGY. On account of its exotic appearance and dangerous allure *Pterois volitans* is a highly desired ornamental curiosity within the aquarium trade. As exotic pets, lionfish are robust and grow at an alarming rate, increasing their size from a small 5cm juvenile (average size of baby lionfish sold to keepers) to more than 30cm. This may result in keepers being caught unprepared for their eventual size (Hix and Hix, 2009) and releasing the hardy adult pet into the wild, with the introduction of the species into non-native environments. The species may also be unintentionally transferred by humans within ship ballast water. Due to their exceptional adaptability, lionfish in the Atlantic are classed as invasive, meaning that they cause grave ecological or economic harm to a non-native environment (Oceanservice.noaa.gov, 2015). In the case of *Pterois volitans* this is as a result of their negative impacts to native reef fish communities. Lionfish are also directly dangerous to humans, due to their venomous spines (Fig. 6), which can cause extreme pain. Many countries have established innovative and traditional methods of controlling the lionfish population. Traditional methods such as ban on imports, bounties and promoted culling (spear fishing) have encouraged developments in the preparation and serving of lionfish meat and products. But the lionfish is also adapting to this and becoming more wary of culling exercises (Zielinski, 2014). The complete elimination of the species within the Atlantic is therefore unfeasible with current methods of control (Issg.org, 2010).

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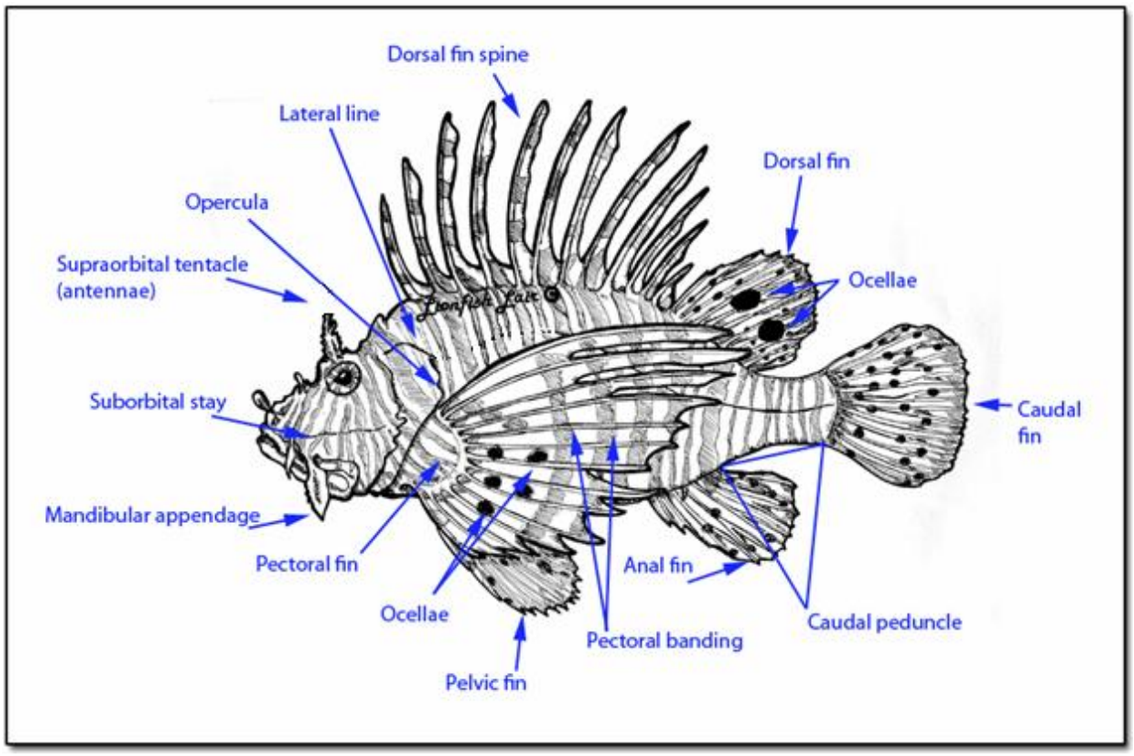
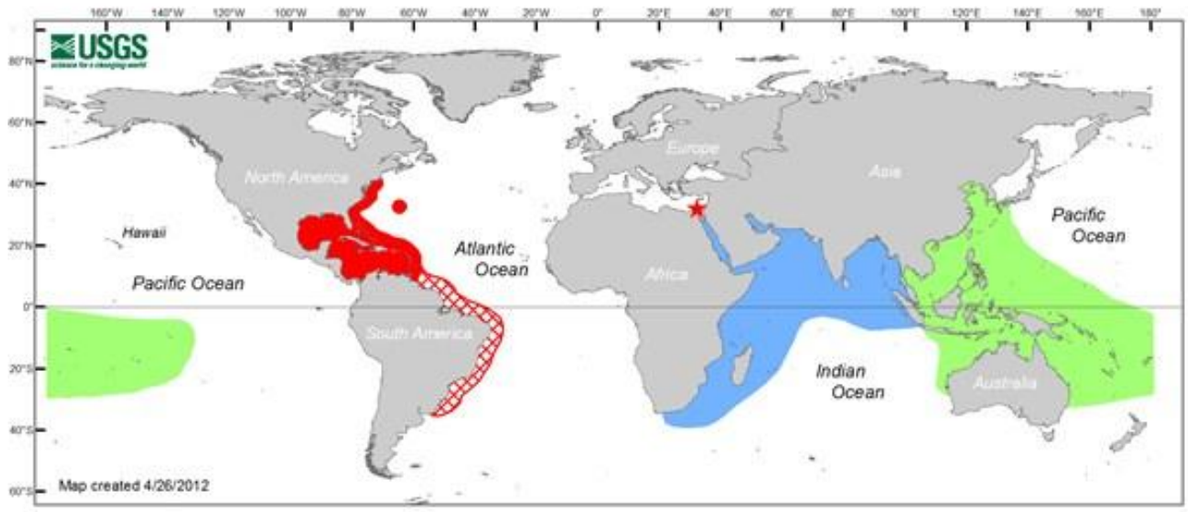


Fig. 2. Key anatomical features of the lionfish.

[From Hix and Hix (2009)]



Map of native range of *Pterois volitans* (green) and *P. miles* (blue) adapted from Schultz (1986) and Randall (2005). Star in Mediterranean Sea denotes Lessepsian migration of *P. miles* via the Suez Canal (Golani and Sonin 1992). Non-native range of *P. volitans* and *P. miles* in the Americas is shown in red (from Schofield et al. 2012). Predicted future distribution of lionfish along coastal South America is shown in red hatching (Morris and Whitfield 2009).

Fig. 3. Map of the native (green), invasive (red) and projected (red hatching) range of *Pterois volitans.* (Blue shows the native range of the lionfish *P. miles*, also found in the Caribbean.)

[http://myfwc.com/wildlifehabitats/nonnatives/marine-species/lionfish/, downloaded May 2015]

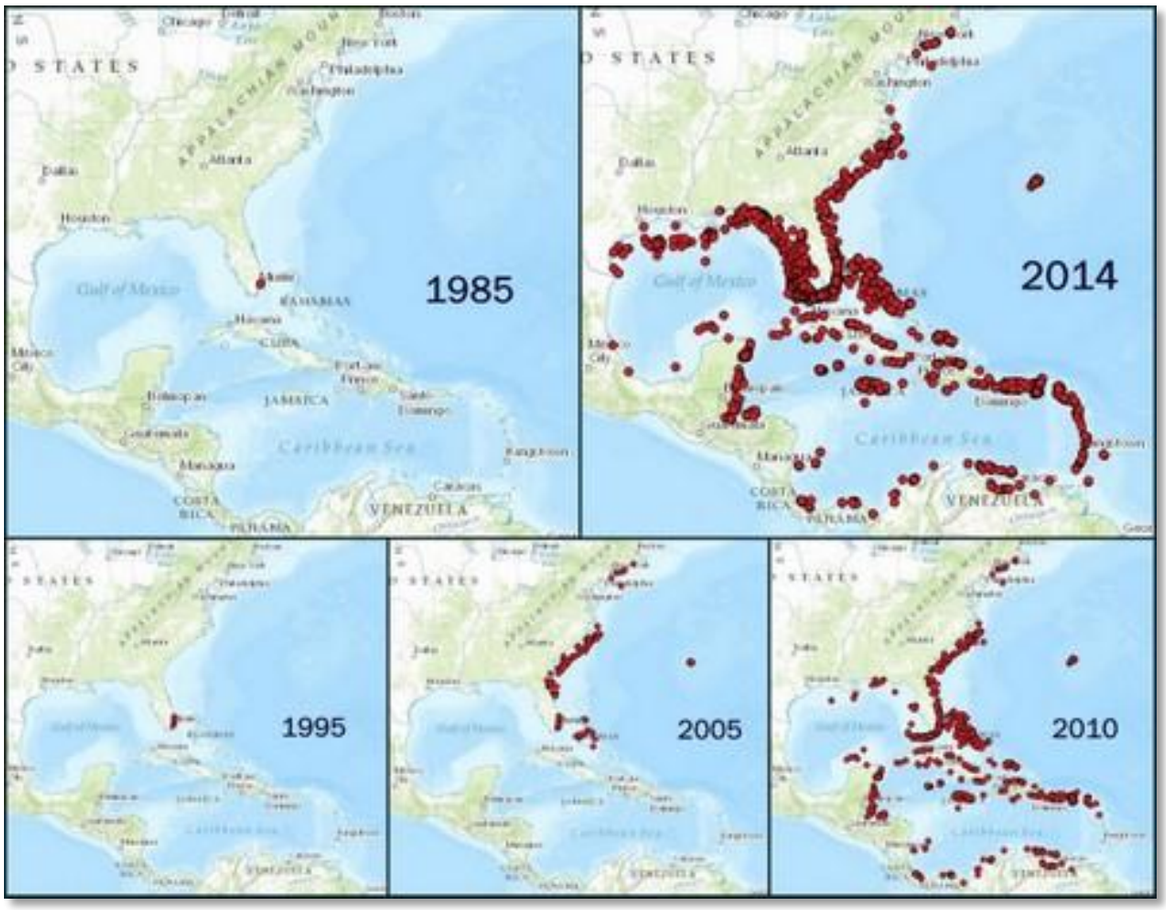


Fig. 4. The spreading lionfish distribution in the Caribbean.

[http://myfwc.com/wildlifehabitats/nonnatives/marine-species/lionfish/, downloaded May 2015]

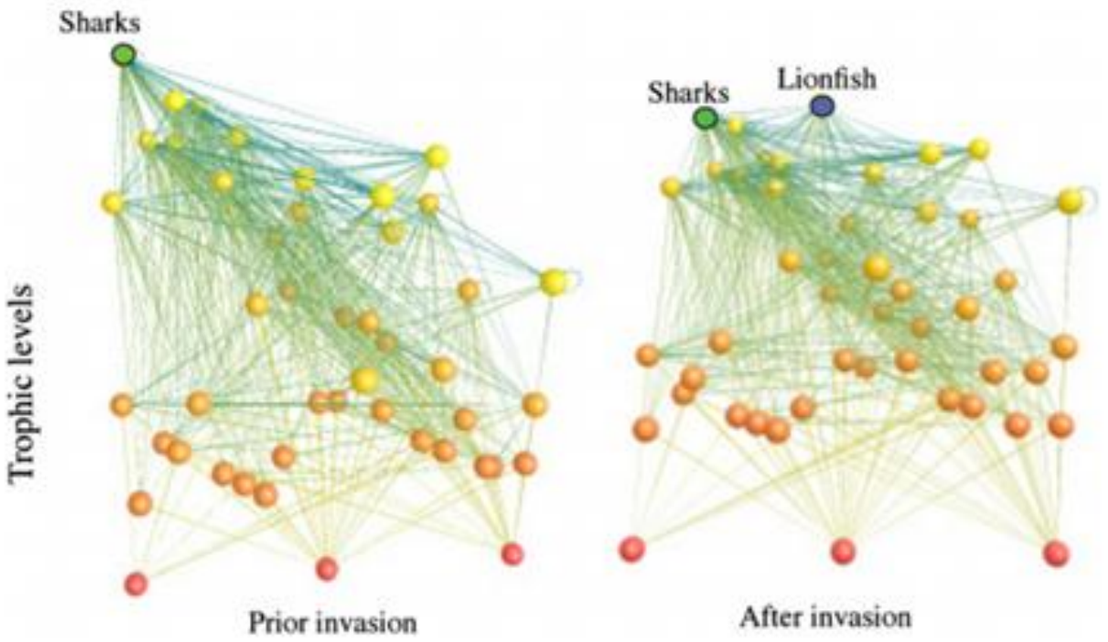


Fig. 5. Food webs for a reef in the Gulf of Mexico before and after the invasion of *P. volitans.*

[From Arias-González et al. (2011)]

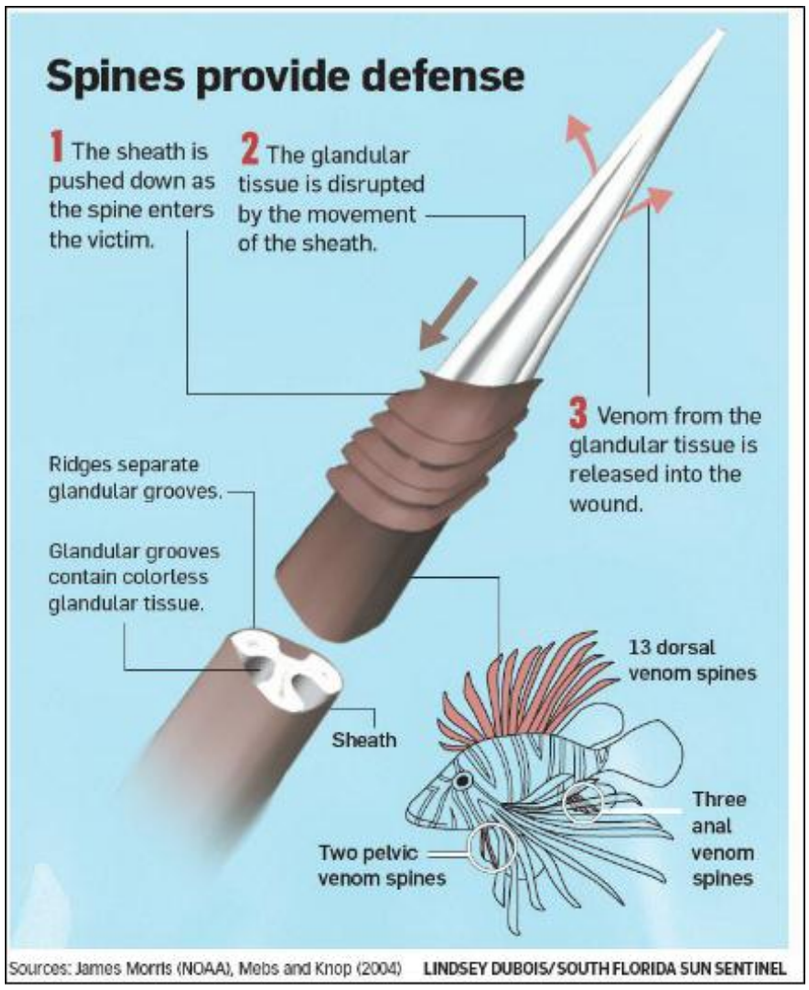


Fig. 2. Diagram of the structure and action of the lionfish spine.

[From Morris (2012)]