HO24 The behaviour of invasive lionfish on Caribbean reefs

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Two species of lionfish (*Pterois volitans* and *Pterois miles*) that are native to the Indo-Pacific have become invasive in the western Atlantic. Invasive lionfish were first recorded off the coast of Florida in the 1980s and are now found along the east coast of North America, in the Caribbean Sea and in the Gulf of Mexico. Lionfish invaded Honduras more recently, with the first individuals seen in 2009.

The hunting behaviour of lionfish, which involves flaring the pectoral fins, undulating the dorsal spines and occasionally blowing jets of water at prey, is unlike any other predator in the Caribbean. For this reason, native fish may not recognise lionfish as a predator, allowing lionfish to consume prey at much higher rates than native predators. This has led to declines in native fish abundance, richness and recruitment across the invaded range. Lionfish also negatively impact the feeding behaviour of herbivorous fish and may even have been the cause of a phase-shift from a coral-dominated to an algal-dominated reef in the Bahamas.

Lionfish occupy a range of habitats in the invaded range including coral reefs, seagrass, mangroves, estuaries and man-made structures. Lionfish are also found on deep reefs down to over 300 m and have been observed at a maximum depth of 250 m in Honduras. Lionfish are generally said to occupy structurally complex habitat, but the definition of complexity, and the scale at which it is measured, differs between studies. In the last two years Opwall has been researching lionfish habitat preference in more detail using recently developed 3D modelling methods. This year we will continue with the 3D modelling and may also be recording additional metrics of habitat complexity to gain a clearer picture of lionfish habitat preference.

In both their native and invaded range, lionfish are often found in pairs or small groups. Several papers have acknowledged this aggregating behaviour and mentioned the composition of these groups, but until Opwall started investigating it a few years ago there had been no papers dedicated to studying aggregation behaviour. We are now starting to understand why these groups might form but there is a lot of research still to be done.

Because of the negative effects that lionfish exert, and because they have no natural predators, they are currently managed by culling. Although complete eradication of lionfish in their invaded range is unlikely, studies have shown that local management efforts are effective at reducing lionfish density and allowing native species to recover. However, there are a few problems with current culling methods. Culling is mainly limited to shallow water (<30 m) due to the cost and training requirements of diving deeper. Culling may also lead to lionfish being less active and hiding deeper in the reef, making them more difficult to find. Lionfish traps are a possible alternative that will increase the depth limit of culling and reduce search times by divers, but these are only in the initial stages of development. By researching the ecology and behaviour of lionfish in Honduras, Opwall hopes to generate data that can be used to inform and improve lionfish management.

This project will be based in Tela, on the north coast of Honduras. Students will dive at La Ensenada, a nearshore reef system at depths of 3-10 m. La Ensenada is a typical Caribbean coral reef with low hard coral cover and high algal cover. La Ensenada has very low culling pressure and diver presence,

with culling restricted to the Opwall field season. This site is used for live lionfish collections as the shallow depths minimise pressure-related injuries to the lionfish and thus ensure that they exhibit natural behaviour in the lab.

Students on this project will take part in lionfish collection dives where we swim along the reef looking for lionfish. When a lionfish is spotted on the reef we record depth and number of lionfish in the aggregation, in addition to recording a range of behavioural and habitat variables. Students will then be actively involved with catching lionfish using nets and putting them into a drybag so that they can be transported back to the lab. It may be possible for students to do quick (five minute) observations of lionfish prior to catching them to look at things such as activity levels or associations with other species.

When we get the lionfish back to the lab we put them in a holding tank and allow them to acclimatise for 24 hours. We then use a second tank to conduct behavioural choice trials. The trial tank has a GoPro attachment above so that the trial can be filmed and later analysed. This enables lionfish behaviour and position in the tank to be recorded on a second-by-second basis. This year we will likely be conducting some habitat preference experiments, but it may be possible to add to this study or conduct short additional studies based on students' interests.

After lionfish have been used in the behavioural trials they are humanely culled and can then be dissected. We record a range of variables such as length, weight and sexual maturity. Students can choose to use any combination of in-water observations, lab experiments and dissections, provided their project is focused on lionfish behaviour.

Reading list

Albins, M. A. & Hixon, M. A. Worst case scenario: potential long-term effects of invasive predatory lionfish (*Pterois volitans*) on Atlantic and Caribbean coral-reef communities. Environmental Biology of Fishes 96, 1151-1157 (2013).

Albins, M.A. Effects of invasive Pacific red lionfish *Pterois volitans* versus a native predator on Bahamian coral-reef fish communities. Biological Invasions, 15(1), pp.29-43 (2013).

Andradi-Brown, D. A. et al. Depth-dependent effects of culling-do mesophotic lionfish populations undermine current management? Royal Society Open Science 4, 15 (2017).

Côté, I.M. et al. What doesn't kill you makes you wary? Effect of repeated culling on the behaviour of an invasive predator. PLoS One, 9(4), p.e94248 (2014).

Cure, K. et al. Comparative behavior of red lionfish *Pterois volitans* on native Pacific versus invaded Atlantic coral reefs. Marine Ecology Progress Series, 467, pp.181-192 (2012).

De León, R. et al. Effectiveness of lionfish removal efforts in the southern Caribbean. Endangered Species Research, 22(2), pp.175-182 (2013).

Fogg, A.Q. and Faletti, M.E. Invasive lionfish (*Pterois* sp.) agonistic behaviour observations. Bulletin of Marine Science, 94(1), pp.1-2 (2018).

Green, S. J., Akins, J. L. & James, A. Lionfish dissection: Techniques and applications (NOAA Technical Memorandum NOS NCCOS 139, 24 pp, 2012)

Schofield, P. J. Geographic extent and chronology of the invasion of non-native lionfish (*Pterois volitans* (Linnaeus 1758) and *P. miles* (Bennett 1828)) in the western north Atlantic and Caribbean Sea. Aquatic Invasions 4, 473-479 (2009).