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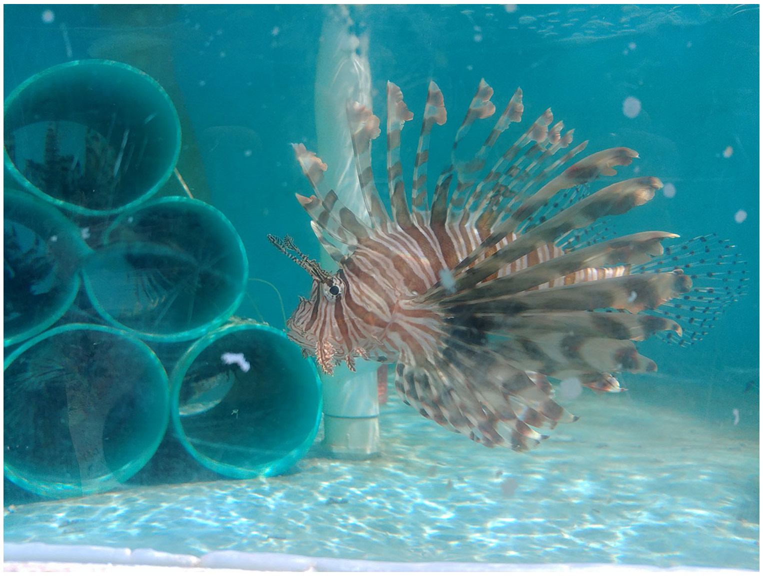
INSIDE JEB

Invasive lionfish have turbocharged digestive systems



A captive lionfish (*Pterois* spp.). Photo credit: Clay Steell.

Wreathed with delicate-looking fronds, lionfish (*Pterois* spp.) are a delight to behold in their natural habitat. 'They appear to just lazily swim very slowly around a reef', says Erika Eliason, from the University of California, Santa Barbara, USA. However, in the wrong place, they're an ecological catastrophe. Thanks to their voracious appetites, they have aggressively colonised the eastern Mediterranean Sea and western Atlantic Ocean, obliterating the small fish and crustacean populations upon which they dine, shattering local ecosystems. So when Clay Steell joined Steven Cooke's lab at Carleton University, Canada, to study the physiology of fish in The Bahamas, the ferocious predators seemed the ideal species to investigate. And Cooke quickly invited ecophysiologist Eliason to join the team as it was apparent that the fish's appetites lay at the heart of their success.

'That led us to wonder if they have a specialized digestive physiology that might enable them to eat large meals', says Eliason, who joined Steell at the Cape Eleuthera Institute, The Bahamas, to start investigating the fish. 'Clay was an excellent lionfish captor', she chuckles, recalling how they trapped the fish between two nets while SCUBA diving to avoid coming into contact with the animal's venomous spines. Back at the institute, Steell, Eliason and Travis Van Leeuwen waited until the lionfish were hungry before allowing the animals to stuff themselves on tasty silversides. Then they measured the lionfish's oxygen consumption as they digested the meals – ranging from 0.6% to 13.8% of their body mass – at 26°C and 32°C (winter and summer temperatures in The Bahamas), before converting the animals' oxygen consumption into the amount of energy they consumed during digestion. Fortunately, as Eliason recalls, the lionfish were remarkably relaxed in the respirometry chamber compared with the trout and salmon that she has worked with in the past. Steell then calculated the fish's metabolic rates after chasing the animals around a tank, to compare with the amount of energy they consumed when digesting a meal.

Amazingly, the lionfish put far more effort into digesting dinner than they exerted dashing around, consuming 1.7 times as much energy when digesting a large meal at 32°C as they did scurrying about. 'Lionfish have a physiology that prioritises feeding over movement', says Steell. And when the team compared the lionfish's diets at 26°C and 32°C, it was clear that the animals were able to consume almost 50% more during the summer months and digest it 45% faster.

Eliason suspects that the lionfish's venomous spines, which protect them from predators, may give them a head start over more benign local species because they do not need to hold energy in reserve to take evasive action when threatened; with those spines, nothing is going to take them on. And she is concerned that lionfish may become even more of a menace as temperatures rise and their turbocharged appetites become more voracious, allowing them to decimate local populations even more effectively as they grow ever faster.

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Steell, S. C., Van Leeuwen, T. E., Brownscombe, J. W., Cooke, S. J. and Eliason, E. J. (2019). An appetite for invasion: digestive physiology, thermal performance and food intake in lionfish (*Pterois* spp.). *J. Exp. Biol.* **222**, jeb209437. doi:10.1242/jeb.209437

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