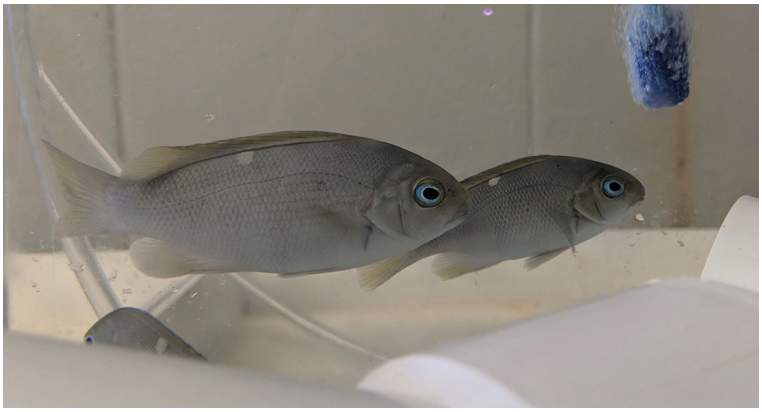
INSIDE JEB

Diet alters how opaleyes cope with heat



Juvenile opaleyes in a tank at the University of California, Santa Barbara, USA. Photo credit: Terra Dressler.

When the water gets hot, cold-blooded (ectothermic) animals have three choices: move on somewhere else, wait a few generations for their descendants to come to terms with the new situation, or modify their own physiology quickly to cope in the warm conditions, a process known as acclimation. As option one isn't always viable and option two is more long term, most ectotherms must do their best to get on with life; but those changes usually comes at a price. 'To undergo a successful acclimation response, ectotherms require energy and nutritional building blocks obtained from their diet', says Emily Hardison from the University of California, Santa Barbara (UCSB), USA. So how much of an impact does an ectothermic fish's diet have on its ability to weather warm water? Knowing that some ectotherms naturally change their diet as the temperature rises, Hardison and PI Erika Eliason, also at UCSB, wondered whether a switch from a carnivorous diet to a brine shrimp and seaweed diet for omnivorous opaleyes (*Girella nigricans*) – which supplement their carnivorous diet with algae in warmer water – might affect their ability to cope in hotter conditions.

Collecting young opaleyes from the Santa Barbara Harbor, USA, in spring 2019, Hardison provided the animals with a new home in the lab where she kept half of the fish in comfortable 12°C water, while the remaining had a warmer existence at 20°C. Then, she divided the cool fish into two additional groups, one fed a diet of brine shrimp with seaweed and the other fed brine shrimp alone, and repeated the process with the warm water fish. After keeping the four groups of fish in their respective situations for 3 weeks, Hardison and Eliason, with Krista Kraskura, Jacey Van Wert and Tina Nguyen (all from UCSB), then tested the fish's fitness and physiology to find out how well their carnivorous and omnivorous diets had helped them to prepare for life in warm water.

Not surprisingly, the hearts of the warm water fish coped better with high temperatures than the hearts of fish from the cooler conditions, but the fish didn't seem to benefit from the more varied diet. The carnivores were just as fit as the omnivores and they were both able to sprint at the same high speeds when chased around the tank. If anything, the hearts of the fish from hot water that had supplemented their diet with seaweed didn't fare as well as the hearts of the fish that only feasted on brine shrimp. In addition, the resting metabolic rate of the algae-supplemented fish was higher, probably because their digestive systems had to work harder to digest the more diverse diet. But, even though the change in diet didn't seem to benefit any of the physiological qualities that Hardison and colleagues had monitored, that doesn't mean that other aspects of the animals' physiology – such as their gut flora and swimming ability – do not benefit from an alteration in diet as the temperature rises. And, the ability to switch diet as it gets hotter may allow more adaptable animals to survive situations that would be more risky for less versatile diners, if, for example, the food supply suddenly changed thanks to a predator moving in or a particular prey species dying off.

One thing is sure, the diet an ectothermic animal consumes definitely impacts their physiology – with specific physical traits reacting to temperature changes in subtly different ways depending on the diet – making diet a key component that physiologists must take into account when investigating how individual ectothermic species react and adapt to our increasingly changing climate.

10.1242/jeb.243659

Hardison, E. A., Kraskura, K., Van Wert, J., Nguyen, T. and Eliason, E. J. (2021). Diet mediates thermal performance traits: implications for marine ectotherms. *J. Exp. Biol.* **224**, jeb242846 doi:10.1242/jeb.242846.

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