

INSIDE JEB

Fish fin physique factor in food preferences



A gilded triggerfish (*Xanthichthys auromarginatus*) swimming in the flow tank. Photo credit: Andrew George.

Some fish are built for power, scything sleekly through the water, powered by their tails, while others simply potter around rippling their fins. But, the members of one superfamily, comprising triggerfish and filefish (known collectively as the Balistoidea), are able to switch effortlessly between the distinctive styles: rippling the dorsal and anal fins – located above and below the base of their tails – at low speeds, and switching to beating the tail powerfully to and fro when they shift up the gears for a high-speed swim. Yet, each species performs the switch from low to high speed in subtly different ways. Intrigued by the fishes' elaborate family tree and distinctive appearance, Andrew George and Mark Westneat from the University of Chicago, USA, wondered which aspects of their fin physique determine when they transition from one swimming mode to the other.

Selecting members of the superfamily spanning the entire dynasty, from the orange-spotted filefish (*Oxymonacanthus longirostris*) to the orange-lined triggerfish (*Balistapus undulatus*),

George filmed and observed the fish as they swam, gradually increasing the flow speed from 5 to 60 cm s⁻¹, until the fish could no longer keep swimming against the water. During that time, he recorded the speed at which the animals stepped up a gear and began to beat their tail fin back and forth. 'The most difficult part was controlling for variation in the fish's behaviour', says George, adding how every single filefish initially tried to avoid swimming, by gripping the grill at the front of the tank with their jaws. In addition, George carefully photographed and measured the area and shape of the animals' body and fins before painstakingly analysing the relationships between each fish's build and swimming performance.

Impressively, the fastest fish for its size was the tiny (9 cm long) red-toothed triggerfish (*Odonus niger*) – which clocked up a speedy 55 cm s⁻¹ – while the more sluggish bristle-tail filefish (*Acreichthys tomentosus*) and larger whitespotted filefish (*Cantherhines macrocerus*) trailed in at the more sedate speeds of 30 and 40 cm s⁻¹, respectively.

Comparing the swimming styles of the fishes, it was clear that the filefish rarely used their tailfins, preferring to use their dorsal and anal fins up to 94% of the time, while some triggerfish beat their tails almost 60% of the time. And when George compared the shape of the fishes' fins with their swim speeds, it was clear that those with the triangular fins were able to power swimming at higher speeds than those with rectangular fins.

However, the duo was surprised when they realised that the fish with rectangular anal and dorsal fins hit similar top swimming speeds (35–42 cm s⁻¹) to the more powerful-looking fish with triangular anal and dorsal fins before they added in their tail fins. In contrast, the fish with short rounded anal and dorsal fins turned on their tail beat over a wide range of speeds, from the slowest at 21 cm s⁻¹ up to 34 cm s⁻¹. And when they analysed the fishes' swimming styles relative to their fin sizes, it was clear that those with long chunky anal and dorsal fins rarely use their tail fins, while those with small stubby anal and dorsal fins use their tail fins a significant proportion of the time.

But what does this all mean for the fishes' lifestyles? 'The ecological pattern that popped out most clearly was that species with similar fin and body shapes tend to eat similar food', says George, pointing out that fishes with the highest swim speeds tend to consume plankton in fast-flowing water, while slower anal and dorsal fin-propelled fishes recruit their tail fin for a sudden burst of speed when dining on fast-moving fish and octopus snacks.

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