believes that the origin of the catfish’s wink has more to do with sure give-away. Having given the fish a thorough eye test, Douglas blends in well with the background, while a huge black pupil is a way that a small camera aperture sharpens up a shot. He wondered might be able to compensate for the lenses aberrations, in the same reasoning that maybe this catfish just had bad eyesight. If the large lens produced a fuzzy image, the focusing power of a small pupil might be able to compensate for the lenses aberrations, in the same way that a small camera aperture sharpens up a shot. He wondered if the cat fish’s contracting pupil could have evolved to correct poor vision, so he decided take a look inside the fish’s eye to see how good its lens was.

Douglas’ went to his local tropical fish shopp, and chose ten fish, thinking he’d chosen ten suckermouth armoured catfish. But when he showed them to specialists at London’s Natural History Museum, he discovered that he had a complete mixture of species (some barely known to science) that included a few suckermouth armoured catfish. Once they’d separated the impostors from the real armoured catfish, Douglas and his colleagues, Julie Corrigan and Shaun Collin, began tested the fish’s eyesight by looking for optical aberrations in the lens. They also videoed the fishes’ slowly contracting pupils with an infrared camera to see if the pupil’s final size correlated with the quality of the lens. But the lens turned out to be as good as any other wide-eyed fish! The pupil wasn’t correcting for poor eyesight, so what else was it doing?

When Douglas looked at the fish’s life style, he realised that most winking fish are bottom dwelling creatures. He explains that when you see the catfish in its natural environment, the contracted pupil blends in well with the background, while a huge black pupil is a sure give-away. Having given the fish a thorough eye test, Douglas believes that the origin of the catfish’s wink has more to do with camouflage than correction.

Human eyes don’t work so well when we are submerged, because we rely on the cornea and the lens to focus light onto the retina, but under water the cornea’s ability to focus light is lost. The fish has overcome this optical disadvantage by evolving a high-powered lens, but does the lens produce a high quality image too? Douglas reasoned that the few species that developed a contracting iris must have had a very good reason to go down this evolutionary path. After testing a variety of optical theories, he has come to the conclusion that the suckermouth armoured catfish’s contracting pupil evolved to provide concealment (p. 3425).

Suction feeding is accomplished by an explosive expansion of the cheeks, with water flowing in like air sucked into a bellows. Changes in the fish’s head structure induce the sudden suction pressure, but attempts to measure the bone movements using high-speed video recordings failed, because the skull obscured the view of these moving bone structures. Since looking at the mouth from the outside wasn’t working, the researchers decided to poke around inside instead.

Eschewing Jonah-esque tactics, the scientists decided to sow six crystals in the roof, tips and joints of the mouths of the North American largemouth bass Micropterus salmoides. These 2 mm wide piezoelectric ceramic grains emit high-frequency ultrasound pulses when jostled and receive ultrasound signals as well.

By using devices called ‘sonomicrometers’ connected to the crystals with wire, Sanford and Wainwright could precisely measure distances between all the crystals by recording the time it took for signals to pass from one crystal to another. With the aid of pressure monitors embedded between the nostrils and the eyes, the scientists caught the first glimpses of how exactly the flexing mouth cavities of the bass trigger drops in pressure.

Five voracious 25 cm long bass were tossed goldfish to eat and the team watched the pressure drop. The aggressive predators gulped down their hapless prey during a 205 ms long feeding cycle that generated a ferocious 5.2 kPa of suction. Defying any known predictions, the scientists found that the suction pressure peaked 24 ms into each gulp, about 30 percent faster than anticipated, and well before the mouth cavity gaped fully open 45 ms later. Such fast drops in pressure would be key if the fish was trying to snare an escaping victim, Sanford said, and has tremendous implications for the power output of the mouth cavities expanding muscles.

First developed in medicine to study length and shape changes in heart muscle, Sanford explains that sonomicrometry is now helping animal functional morphologists study how muscles and ligaments change shape during bird flight and fish swimming. And now it has helped refute a few ideas of how the cheeks expand – instead of puffing up into a circular shape, they mash into a flattened ellipse. These findings contradict earlier electromyographic data of muscle electrical activity, highlighting how complex the anatomical relationships that govern mouth cavity pressure must be.
Ceratodictyon spongiosum has taken the alternative approach, and draped a sponge around its branching fronds. Davy and his colleagues in Sydney wondered how these allies manage their nutritional trade, and are teasing apart the nutritional network that binds the partners together. In this issue of the *J. Exp. Biol.* they report that the sponge is able to satisfy its algal partner’s hunger for nitrogen when other algae go hungry (p. 3505).

Sponges are the most fantastic filter feeders. They can strain the last crumbs of food, even from the clearest of waters, to supply themselves with the essential proteins that they need to sustain life. Algae, on the other hand, depend on a supply of dissolved inorganic nitrogen from their environment. But if your environment includes a symbiotic partner, the nutritional equation becomes more difficult to calculate. Davy and his colleagues weren’t daunted by the difficulties of untangling the relationship between the seaweed, Ceratodictyon, and its symbiotic partner, the sponge Haliclona cymiformis, even though neither species can survive alone in the wild.

Davy relocated his lab bench to the Great Barrier Reef to be close to the symbiotic partners’ home, venturing out into the island’s lagoon to collect fresh samples of the associated organisms for each day’s experiments. First he decided to measure how much nitrogen each partner needed to maintain the duos combined daily growth rate of 0.83%. After measuring each partner’s nitrogen content, he found that the sponge needed 0.167 mg N g⁻¹ day⁻¹ to sustain its growth rate, while the alga needed 34% less. Davy knew that the sponge could probably filter enough plankton from the sea to satisfy its nitrogen demands, but there was little chance that the reef waters dissolved nitrogenous compounds could keep pace with the alga’s growth. Was the sponge supplementing the alga’s ‘diet’?

He measured the amount of ammonia that the sponge excreted by ‘switching’ the alga off. Davy plunged the alga and its sponge partner into darkness, to stop the plant photosynthesising and absorbing the sponge’s waste nitrogen. Meanwhile the sponge continued excreting waste nitrogen that the scientists could measure to see if the sponge’s excretion rate would keep pace with the alga’s growth rate. Davy was pleased to see that the nitrogen budget balanced; the sponge produced more than enough ammonia to satisfy the alga’s demands.

Davy emphasises that this is still very preliminary work. He adds that ‘there are still many things that we don’t know about nitrogen fluxes and metabolism in this symbiosis’. But one thing’s for sure, the alga is certainly satisfied by sponging off its partner.

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**Exercising Dolphin’s Fins Feel the Heat!**