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Murky waters make big eyes, but not big brains

A blue lips cichlid. Photo credit: The Gray lab.

Whether it's used for finding food, mates or shelter, vision is one of the most vital senses for many creatures. This same importance holds true underwater as well. But using vision underwater comes with a few differences; mainly, the water can become cloudy and difficult to see through, obscuring the aquatic environment. One way that aquatic animals like fish can cope with these cloudy waters is by having larger eyes that allow them to see better. But what happens when the water suddenly becomes murky, as happens in some rivers due to farming runoff and deforestation? J. Tiarks and Suzanne Gray of The Ohio State University, USA, along with Lauren Chapman of McGill University, Canada, turned to the blue lips cichlid (*Pseudocrenilabrus multicolor*), a fish that inhabits both clearer swamps and murky rivers throughout Uganda, to answer this question.

Working with fish caught from the swamps and rivers of the Mpanga River basin in 2008, the scientists waited until the fish from both habitats reproduced before raising half of each brood in clear water and the other half in cloudy water. The team then began measuring the diameter of the eye and pupil of some of the young fish. Tiarks and colleagues found that the eyes and pupils of the fish raised in cloudy water were larger than those raised in clear water, regardless of where their parents had come from. 'We think this might be a mechanism that allows these fish to cope with the change in their underwater environment,' says Tiarks. Surprisingly, when examining fish that were a bit older, the researchers found no differences in the eyes of fish raised in clear water or cloudy water. But the older fish whose parents were caught in the swamp had larger eyes than the fish whose parents came from the river. This suggests that the environment in which the fish are raised only plays a role in the size of their eyes when the cichlids are young, potentially allowing them to see better in the murky conditions.

But having bigger eyes doesn't necessarily mean better vision if the brain isn't able to process all the information the eyes receive. So, Tiarks began the difficult task of measuring the tiny brains of young cichlids to see if the larger eyes found in the murky water-raised group also meant larger brains. Surprisingly, the fish had similarly sized brains regardless of where their parents were from or what environment they grew up in. However, this was not the case for the adults. When the researchers measured the brains of the adult cichlids, they found that the fish raised in the turbid waters had larger brains than the fish raised in clear water. But which part of the brain was making up for this difference? Was it the optic lobe, where the information the brain receives from the eyes is processed?

It turns out that the fish from cloudy waters don't have a larger optic lobe, but Tiarks and colleagues noticed something interesting; the fish whose parents were caught in the swamp did have a larger optic lobe. The researchers suggest that this could be due to how visually complex a swamp is. Distinguishing between the submerged roots, plants and rocks is much more complicated than the sparse vegetation and mostly open water of the Mpanga River. While the reasons are unclear, coming from murky waters gives these cichlids larger brains as adults and larger eyes when they're young. As habitat destruction and deforestation continue, and their aquatic homes become cloudier, the need to quickly improve their vision might just give them the advantage they need to survive.

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