Researchers discover the African cichlid's noisy courtship ritual

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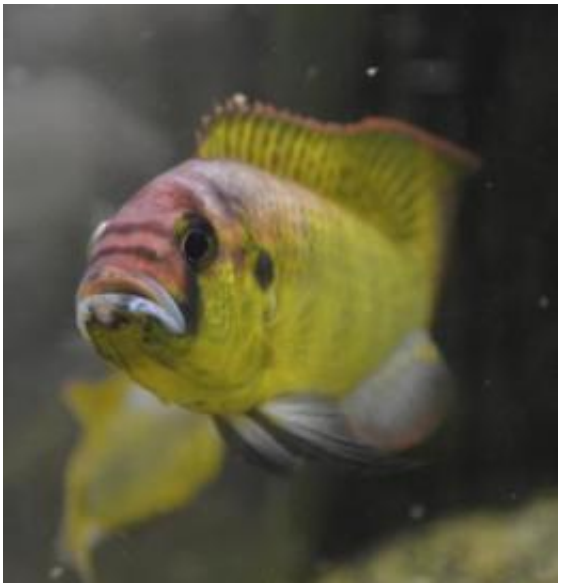

Stanford researchers say the sounds the dominant male cichlid makes may help explain how similar-looking cichlid species avoid interbreeding. Credit: Fernald Lab

African cichlids enjoy an alien, exotic courtship routine. A dominant male attracts choice females to his territory by dancing seductively. If the female is sufficiently impressed, she lays her eggs and immediately collects them in her mouth, where the male fertilizes them. And, in some species, every once in a while, a lower-ranking male will dart into the scene and try to fertilize a few eggs before the dominant male knows what's happened.

At least that's what we thought was going on. But one day, while watching this nostalgic display in the lab, Stanford postdoctoral biology researcher Karen Maruska noticed something unusual. A dominant male was courting a female in one corner of the tank, at the entrance to a terra cotta pot he had claimed as his territory.

"Then, at the last minute, a subordinate male made a beeline for them from the corner of the tank behind the pot, so he could spawn at just the right time," Maruska said. "And I thought: there's no way the subordinate saw" that opportunity. In fact, he didn't see it. He heard it.

Astatotilapia burtoni's predilection for waggling its tail and quivering its body before mating is well documented. But what Maruska, undergraduate researcher Uyhun Ung and Stanford biology Professor Russ Fernald would later write in a paper published last week in *PloS ONE* was that males also vocalize during courtship. Not only are females responsive to these calls, but their ability to hear them improves with their sexual receptiveness. This additional courtship component may provide crucial signals used for mate choice decisions and help explain how similar-looking cichlid species avoid accidental interbreeding.

Listening fish

Using underwater microphones called hydrophones, the researchers found that males would make low-frequency sounds when confronted with receptive females. And females preferred males associated with playbacks of these courtship sounds over males that were associated with no sound, or a neutral noise.

But not all hearing thresholds were created equal. Females that were sexually receptive – and had high circulating levels of sex hormones – were dramatically more sensitive to the low frequencies contained in the courtship sounds than females that had already spawned and were in the

mouth-brooding parental care phase of their cycle. This kind of hormone-dependent hearing has been observed in other animals, and is a reliable indicator of the importance of sounds in courtship displays.

Subordinate males were also subtly more sensitive to certain frequencies than dominant males. Although the reasons for this change are less clear, Maruska suggests the subordinate males may "use the frequency of the sound to determine which males to fight with and attempt to take over their territory." Because the frequency of the courtship sound is related to body size, subordinate males may listen to these courtship sounds to identify the smallest – and most vulnerable – males in their area.

A small pond

The cichlids studied by the Fernald lab are native to Lake Tanganyika in East Africa "where they co-exist with a lot of other cichlid species," said Maruska. "Each species needs to find its niche in the system."

The high level of diversity within the cichlid family is unusual, and difficult to maintain when all the relatives are in the same body of water. Researchers had previously assumed that cichlids, which tend to be brightly colored fish, only used visual cues to distinguish potential mates from out-of-species mistakes. But biologists now believe that visual cues alone can't account for the phenomenon.

Recent field studies by other scientists have shown that cichlid species that live in overlapping areas in the wild produce distinct sounds. The Stanford researchers' discovery that these sounds are an integral component of courtship rituals lends credence to the theory that the vast array of cichlid species may be a consequence of courtship displays that make use of more than one sensory system.

Still, "not a lot is known about fish sounds," said Maruska. There

remains a host of unsolved mysteries in the field. "We don't even know the mechanism of sound production in this species yet."

Provided by Stanford University

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