Smithsonian Tropical Research Institute News

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Frog-Hunting Bats Overcome Noisy Environments by Switching Sensory Channels

In one of nature's crueler fatal-attraction scenarios, a male túngara frog's mating call also attracts frog-eating bats. Any hopes a frog has of disguising his call against background noise were dashed by Smithsonian scientists in the Sept. 16 issue of *Science* magazine. Bats are efficient hunters even when it is too loud to hear their prey.

When background noise masks the frogs' dead-giveaway calls, fringe-lipped bats crank up their use of echolocation, the sensory system they use to navigate in the dark. Echolocation acts as a motion detector, focusing the bats' attention on the túngara frog's vocal sac, which expands like a quickly inflating balloon when the frog calls.

As scientists begin to better understand the detrimental effects of human-made noise on ecosystems, this research shows how animals adapt to survive on an increasingly noisy planet.

"Our study ties together behavior, sensory ecology and conservation," said Dylan Gomes, the lead author who conducted the research during an internship at the Smithsonian Tropical Research Institute (STRI) in Panama. "As sources of anthropogenic noise continue to expand, animals will, ultimately, have to overcome noise in one way or another."

The effects of human-generated noise on animal behavior has primarily focused on birds and whales, said Gomes, who is now a Fulbright scholar at the Max Plank Institute for Ornithology. The impact of noise on bats, however, is a relatively new field of study.

The team used two robotic frogs that precisely mimic the calls and vocal sac expansion of the túngara frog, *Physalaemus pustulosus*. They placed the robofrogs inside a flight cage with the fringe-lipped bat, *Trachops cirrhosus*. The static robofrog played the frog's distinct mating call without any inflation of the vocal sac, while the dynamic robofrog played the call, coupled the inflation and deflation of the vocal sac. When researchers played a masking noise over the call, the hunting bat's

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echolocation activity increased, and it preferentially attacked the frog with the dynamically moving vocal sac. Without the masking sound, it attacked both frog models.

"We show how animals can adapt to increased noise levels by making using of their other senses, and our findings have important implications for other species that try to locate prey, avoid predators or attract mates in human-impacted environments," said Wouter Halfwerk, an assistant professor at VU University Amsterdam and former STRI fellow.

Halfwerk helped design the experiment and was Gomes' co-adviser. Smithsonian Tupper Fellow Inga Geipel, who specializes in echolocation and studies how bats navigate and hunt in the rain, contributed technical expertise to the research. The study was carried out under the guidance of staff scientist Rachel Page, and STRI research associates Mike Ryan, a professor at the University of Texas at Austin, and Ryan Taylor, a professor at Salisbury University.

"This is an excellent example of the type of study that can emerge from long-term research opportunities at the Smithsonian in Panama," said Page, whose research has become increasingly focused on the perception of multimodal sensory signals. "The lead author is an undergraduate who interned in my lab over the course of a year."

"Dylan's experiments reveal how flexible these predators are. In the face of masking noise, bats can shift their sensory focus from one modality to another, upping the use of echolocation when eavesdropping on frog mating calls alone becomes less efficient," Page said. "This is especially relevant given the need to process multiple streams of information, for example in the cacophony of calling frogs in a rainforest pond at night or in the face of increased human disturbance."

The research was funded by a Smithsonian fellowship, a National Science Foundation grant and STRI. STRI, headquartered in Panama City, Panama, is a part of the Smithsonian Institution furthers the understanding of tropical nature and its importance to human welfare, trains students to conduct research in the tropics and promotes conservation by increasing public awareness of the beauty and importance of tropical ecosystems. Website. Promo video.

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D.G.E. Gomes, R.A. Page, I. Geipel, R.C. Taylor, M.
J. Ryan, W. Halfwerk. 2016. Bats perceptually weight prey cues across sensory systems when hunting in noise. *Science.*