Fish use electric signals to find the right mate

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Electric knifefish, close relatives of the electric eel, navigate and communicate by projecting electric fields around their bodies. Research at University of Toronto is clarifying how this sense has evolved, as well as providing groundbreaking new ways to analyse the electric signals of these fascinating fish.

Professor Nathan Lovejoy of U of T Scarborough investigates patterns and processes of biodiversity, with emphasis on marine and freshwater fish from the tropics, particularly in South America.

His lab, associated with the integrative behaviour and neurobiology group at UTSC, is investigating the ability of electric fish to communicate, how that ability has evolved over time and its impact on mating. Lovejoy and his collaborator Will Crampton (a former post-doc, now at the University of Central Florida) spend considerable time researching these fish in South America.

"What we're finding is that if you capture different fish species in the same spot, they have completely non-overlapping electric signal patterns," said Lovejoy. "They've found a way to avoid confusion about species identity. This prevents them from mating with the wrong species and thereby reduces the production of unviable hybrids."

Lovejoy said the finding is a critical one in the search for behavioural mechanisms that trigger mating. The electric fish offer a unique window on the mechanisms of species recognition and speciation. The goal of the ongoing project is to produce a thorough taxonomic revision and phylogeny of the electric fish genus Gymnotus, compile libraries of recorded electric signals and describe up to 30 new species from South and Central America.

"People have been interested for a long time in how species identify one other. In most animals this is very difficult because they use a complex set of cues that could include colour, song and smell. It is hard to deal with these phenomena mathematically. But it turns out that electric signals are much more amenable to those types of analyses."

Lovejoy said capturing the fish isn't that difficult. He hunts for them using small amplifiers (electric guitar amplifiers work well) that turn electric signals into sounds.

"Different species make distinct sounds. Some of these fish produce a wave electric discharge that sounds like a humming power station when translated into sound. Others produce discharges that sound like clicks."

Once Lovejoy's team captures a fish in the field, they digitize and record its signal and then take a sample of its tissue. In the lab, the team sequences the DNA and uses it to reconstruct an evolutionary tree for the species. His studies suggest that a complex interplay of ecological and geographical factors determine patterns of signal and species diversity.

Lovejoy said this research will allow others to see how the biodiversity has evolved in the neotropics. That's important, he said, because the diversity in South America is the highest anywhere in the world.

Source: University of Toronto

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