Exploring evolution via electric fish hybrid zone

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Jason Gallant, MSU integrative biologist, shows that a single evolutionary road may lead to Rome. Credit: G.L. Kohuth

Michigan State University is using a $700,000 National Science Foundation grant to study how electric fish signals evolve, research that

could offer insights into the evolution of new species.

Mormyrids are African freshwater fish that can produce and sense electric fields. Along Gabon's Louetsi River, two populations of one species of fish (*Paramormyrops kingsleyae*) live above and below Bongolo Falls. The population below the falls produces a more complex electric signal than the group that lives above the falls. While these populations are normally separated by this waterfall, annual flooding may create an intermittent, temporary "bridge" allowing the fish to pass the waterfall. When these two populations have the opportunity to mate, it can lead to fish with hybrid electric signals.

The discovery of this natural hybrid zone could be used to identify the genes underlying the evolution of complex and simple electric signals, proved possible by Gallant's research on butterflies.

"We think that a single gene is responsible for differences in signal complexity," said Jason Gallant, MSU integrative biologist, and leader of the grant. "The beauty of hybrid zones is that they remove all other confounding sources of genetic variation. It's a natural experiment that's been conducted for us. We can scan the fishes' genome to see the differences in the genes that correlate with the differences in signals."

Mormyrid electric fish use electric signals for communication, much in the way male birds sing to female birds. Because finding a mate for so many animals involves communication, some evolutionary biologists think that evolution of new electric signals may be important in the speciation process.

"There are so many complex parts in communication systems like birdsong; with electric fish fish, we're able to take away many of these complexities and look for a single underlying factor."

"This research is important because electric discharges are a critical component in the speciation of mormyrid electric fish," Gallant said. "Identifying the genes responsible for behavioral differences within species will ultimately help us understand how changes in behavior can facilitate, or perhaps cause, one species to become multiple species."

The project will draw on next-generation genomic sequencing technologies and the development of new transgenic techniques, like CRISPR, in electric fish. The team will first look for the different regions that control the signal. Once the regions are identified, the genes will be manipulated to see if the signal is changed.

Provided by Michigan State University