Scientist describes first known use of colored rocks in fish nest decoration

November 9 2018

Credit: Brian Hickey

Cutlip minnows, a species of small fish that inhabit streams, could be described as the master interior decorators of the fish world.

Working with collaborators in eastern Ontario, Canada, Andy Bramburger, a research associate at the University of Minnesota Duluth's Natural Resources Research Institute, found that male cutlip minnows carefully select pebbles that are darker and more color-saturated than the streambed background to construct their conspicuous mound-shaped nests. The researchers noticed the nests while conducting regular surveys of the stream and wondered if the fish responsible for building them were indeed choosing nesting materials based on color.

Their findings were published in the *Journal of Fish Biology*.

Along with several students, Bramburger and Brian Hickey from the St. Lawrence River Institute of Environmental Sciences located recently-constructed cutlip minnow nests during the nesting season in April. Once the eggs had hatched and male cutlip minnows—who build and defend the nests—and juveniles had left the stream, the researchers collected pebbles from nest sites as well as from background areas of the streambed. They used a digital camera system and image analysis software to measure the wavelength, color saturation, and brightness of similarly-sized nest and background pebbles.

The researchers found that:

- male cutlip minnows choose rocks that are darker and more color-saturated than other rocks in the stream, leading to nests that contrast sharply with the relatively drab background;
- nest rocks are remarkable similar in wavelength—with a range of less than 4 nanometers—meaning there is a severe pressure for male cutlip minnows to build their nests using rocks of a specific color, specifically an orange hue in this case.

"Cutlip minnows have a specialized, three-lobed lower jaw that they use to pick up and carry pebbles to the nest," said Bramburger. "That means

that nests are composed of uniformly sized pebbles. We needed to be sure that the differences in color characteristics that we were seeing were not a function of all the pebbles of similar size being the same color. That's not the case here. These fish are remarkably picky about the color of their nesting materials."

Bramburger adds that it is likely that all cutlip minnows, both male and female, evolved an ability to see really well in this part of the color spectrum, likely in order to find food items (e.g., crustaceans) with orange pigmentation. In other species of minnows, males have evolved orange or red body coloration that they display during mating season to take advantage of this sensitivity and make themselves more attractive to females. Cutlip minnows do not display special mating colors; but, over time, male cutlip minnows who built nests that incorporated this coloration were more successful at mating and passing their genes to future generations.

"It is especially impressive that the wavelengths of multiple nests are so similar," said Bramburger. "It would be like trying to match the color of your living room wall by making a mosaic from pebbles you found in your yard."

So far, the research team has not been able to evaluate whether specific nest colorations are more attractive to females or if males who build nests of a specific coloration father more offspring, but those are future projects that are being considered.

Before this study, the use of colored materials in nest building had not been described in fishes. Among birds, however, there are many examples. Most notably, Satin Bower Bird males typically decorate their nests with bright blue items, capitalizing on a heightened sensitivity to blue pigments in the female's visual spectrum.

In fish who use color cues in mating, such as body coloration or nest decoration, it is an important consideration for the female in selecting a mate. Males who display the best color or build the most attractive nest are generally the healthiest, a sign of favorable genes to pass on to offspring.

As stream habitats are increasingly threatened by runoff and sedimentation, the lack of clear water could impair the ability of the female to choose the best mate and threaten genetic health of fish populations.

Bramburger says studies such as this are important in order to provide guidance for the management and conservation of habitats of species that use color in mating.

More information: Andrew J. Bramburger et al. Preferential incorporation of dark, coloured materials into nests by a mound-nesting stream cyprinid, *Journal of Fish Biology* (2018). DOI: 10.1111/jfb.13741

Provided by University of Minnesota