

Rocky Mountain Research Station Science You Can Use *(in 5 minutes)*

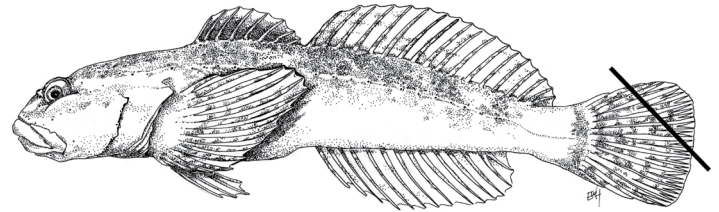
MARCH 2023



Doubling Down: A New Molecular Taxonomy More Than Doubles the Number of Sculpin Species

While sampling freshwater fish across Montana and northern Idaho about 15 years ago, Michael Young, a research fish biologist at the USDA Forest Service Rocky Mountain Research Station, became interested in the taxonomy for sculpins. “Biologists across the West, including us, were resorting to labeling our field-collected specimens as ‘*Cottus sp.*,’ which is shorthand for ‘we don’t know what we’re looking at,’” Young recalled. “We got fed up not knowing the identity of these fish and decided to do something about it.”

Commonly known as sculpins, fishes of the genus *Cottus* are found in freshwater and coastal ecosystems throughout North America. Despite their prevalence, a comprehensive taxonomy—an understanding of the identity, range, and evolutionary relations among species of sculpins—has eluded scientists for nearly two centuries. The problem is that the species are almost indistinguishable from one another and



*Drawing of a sculpin with a slash where a small fin clipping might occur. FIGURE 4. Illustration of the holotype of *Cottus schitsuumsh*. 2014 Magnolia Press*

that the appearance of a “good” species is variable, depending on what part of the range is sampled.

Young had recently begun using newly available molecular tools—like genetic sequencing—to address ecological questions and thought the strategy might help characterize the taxonomy of sculpins. He decided to use different ways of analyzing DNA sequences to the problem, such as how those sequences clustered or how different they were from one another.

A New Taxonomy for Sculpins

Young and his team asked biologists, land managers, students, and citizen scientists to collect tissue samples from sculpins and record the location of the collection point. Stakeholders located across western North America, and eventually eastern North America and even Sweden, responded by sending 8,000 samples from over 1,000 locations to Young and his team. These data were combined with samples from existing public databases.

Young’s analysis produced a new molecular taxonomy, which proposes the existence of 37 species of *Cottus*, in the West, up from the 19 species in the currently accepted taxonomy. The work even suggested that what was thought to be a single species in eastern North



*Fishes of the genus *Cottus*, or sculpins, are morphologically similar, which has impeded identification of species. Composite image of sculpins from SculpinQwest.*

America may instead represent four distinct but look-alike species. “In this day and age, you don’t find very many new species—especially vertebrates, and especially in the U.S.—so we were really excited by these results,” Young said.

This new molecular taxonomy for sculpins aligns with the geological and climate record, such as how the arrival and departure of glaciers, and giant glacial floods, redistributed sculpins in new river basins across the West. It also explains how sculpins in widely separated areas—the Great Basin in Nevada, the Colorado River in Colorado, Utah, and Wyoming, the Snake River in Idaho, and

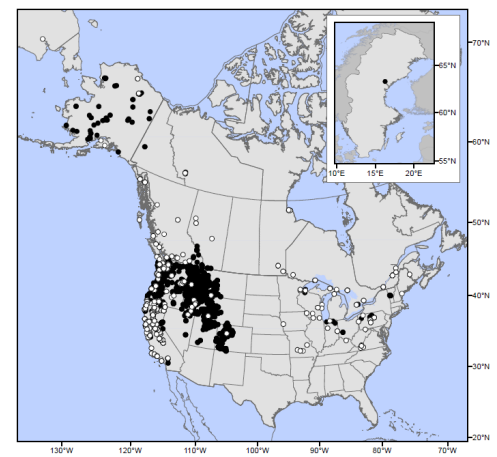
the Columbia River in Oregon and Washington—are closely related. Most importantly, though, it provides missing information to scientists studying biodiversity in aquatic ecosystems. “Fish biologists in the West are charged with maintaining the diversity of native species, understanding fish habitat requirements, or how some species interact with fish that people deeply care about, like trout and salmon. But that’s so hard when you don’t even know what fish species you’re holding in your hand. For sculpins, our study changes that,” Young noted.

The taxonomy may also be of interest to climate scientists monitoring stream health. “One group of sculpin thrives in the same cold-water conditions as bull trout, a species traditionally seen as the canary in the mine for warming water temperatures,” said Young. “This sculpin group may be another that is going to respond very sensitively to changes in climate.”

Looking Forward

Future research will focus on refining and validating the newly

FIGURE 1 FROM YOUNG ET AL 2022



Young and his team analyzed sculpin tissue samples collected by stakeholders across North America (filled circles) and available in public databases (open circles).

proposed molecular taxonomy of sculpins. For Young, this process will include collecting samples from locations underrepresented in the current study and sequencing tissue samples with higher resolution. He also anticipates valuable contributions from fish biologists who specialize in morphology.

Lead Scientists

Michael K. Young is a research fisheries biologist at the Rocky Mountain Research Station in Missoula, MT. His research focuses on the ecology and biology of aquatic species in western North America.

Key Management Considerations

- Sculpins are morphologically similar, which has hindered the identification of species until now.
- A new study used genetic sequencing to build a molecular taxonomy for sculpins, which increases the number of proposed species from 19 to 37 in the West. Knowing the location—the river basin, or even the specific stream—tells a lot about which sculpin could be present.
- This taxonomy will support the work of fish biologists seeking to maintain the native diversity of species and climate scientists monitoring stream health.
- A link to data archives data, a copy of this paper, and the datasets that were used are available on this [website](#).

Further Reading

Lemoine, Michael; Young, Michael K.; McKelvey, Kevin S.; Eby, Lisa; Pilgrim, Kristine L.; Schwartz, Michael K. 2014. *Cottus schitsuumsh, a new species of sculpin (Scorpaeniformes: Cottidae) in the Columbia River basin, Idaho-Montana, USA*. Zootaxa. 3755(3): 241–258.

Young, Michael K.; McKelvey, Kevin S.; Pilgrim, Kristine L.; Schwartz, Michael K. 2013. *DNA barcoding at riverscape scales: Assessing biodiversity among fishes of the genus Cottus (Teleostei) in northern Rocky Mountain streams*. Molecular Ecology. doi: 10.1111/1755-0998.12091.

The Rocky Mountain Research Station is one of seven units within USDA Forest Service Research & Development. RMRS maintains 14 field laboratories throughout a 12-state geography encompassing parts of the Great Basin, Southwest, Rocky Mountains, and the Great Plains. While anchored in the geography of the West, our research is global in scale. RMRS also administers and conducts research on 14 experimental forests, ranges and watersheds and maintains long-term research databases for these areas. Our science improves lives and landscapes. More information about Forest Service research in the Rocky Mountain Region can be found here: <https://www.fs.usda.gov/rmrs/>.

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