We know you're in there

Geneticists use new eDNA science to quickly and accurately identify fish species in streams and lakes and trace the origins of individual fish. **By Ladd Knotek**

One of the toughest challenges of fisheries management is monitoring fish populations. While mostly effective, traditional techniques like gill netting and electrofishing are labor intensive, time consuming, and often don't pick up species low in abundance. Biologists have long hoped for a new and better way to find fish to complement our usual tactics.

Now we've found it in environmental DNA analysis.

Environmental DNA (eDNA) is the fragments of genetic material naturally shed by plants and animals into their environment. In the case of fish, eDNA is found in the cells of body mucous, scales, and skin that end up in streams, rivers, and lakes. The eDNA is unique for each species and can be detected in very small amounts by genetic scientists.

Using eDNA analysis, Montana Fish, Wildlife & Parks fisheries biologists are able to quickly confirm if a certain species is present in a stream. All we need to do is take a water sample to a lab, where geneticists look for that species' unique DNA. Let's say we want to learn which tributaries of a river contain native westslope cutthroat trout. We collect water at various points along a tributary, send the samples to a genetics lab, and soon learn which streams hold cutthroat. Then we follow up with electroshocking to learn more about the cutthroat trout populations, such as sizes and ages of fish. We save time and money because we don't have to survey every tributary.

Sometimes biologists need to remove aggressive non-native brook trout from a stream so they can restock it with genetically pure westslope cutthroat. It's an expensive and difficult operation. Before eDNA analysis, we could never be sure we removed all the non-natives. We would sometimes stock cutthroat only to find, a few years later, that some brook trout had survived and were again outcompeting the native species. Environmental DNA analysis gives us greater confidence in how well our eradication efforts are working.

FWP is also using eDNA sampling to monitor for invasive species such as Eurasian watermilfoil and zebra mussels and to identify illegal fish introductions. Controlling unwanted plant and fish infestations is much easier if caught early, before the species can gain a foothold in a lake or river. In lake-rich northwestern Montana, FWP crews and volunteers use eDNA analysis to regularly test lake outlets for unwanted plants and aquatic organisms.

Tracking sauger

In central Montana, FWP fisheries biologist Mike Ruggles hopes that eDNA analysis will help him track the progress of sauger now returning to historic reaches of the Musselshell River. FWP is trying to restore the native species after several fish-blocking diversion dams were blown out by a 2011 flood and a fish passageway was recently installed on a newly rebuilt dam. Kellie Carim, eDNA coordinator at the National Genomics Center for Wildlife and Fish Conservation in Missoula, developed a genetic "marker" that identifies sauger. In the future, when Ruggles sends Musselshell River water samples to the lab, Carim and her colleagues will use their marker to see if sauger are making their way upstream.

Using eDNA analysis has its limitations. It can't tell you how many fish are in a stream or their size or age. To gather that and other information essential for fisheries management, FWP fisheries biologists continue to use electrofishing, netting, and other traditional fish sampling techniques. And eDNA can't tell scientists about genetic diversity and purity within a fish population. For that, we still need to obtain and examine the DNA in tissue from multiple individuals in a fish population. But when we want to quickly and inexpensively learn if a certain species is in a stream, we now have an accurate tool.

Ladd Knotek is an FWP Missoula-area fisheries biologist.

Population "fingerprint"

In northwestern Montana, biologists are using a different DNA technique called "genetic assignment" to trace an individual fish to its tributary of origin or source population. Geneticists compare genetic markers from an individual fish with the presence and frequency of these markers in the tributary populations where the fish may have originated. In one recent application, FWP biologists wanted to learn from which specific tributaries individual bull trout in lakes of the Clearwater Basin (Seeley-Swan area) originated. The information will help us identify the relative importance of the various spawning tributaries in a watershed so we can decide where to focus conservation projects.

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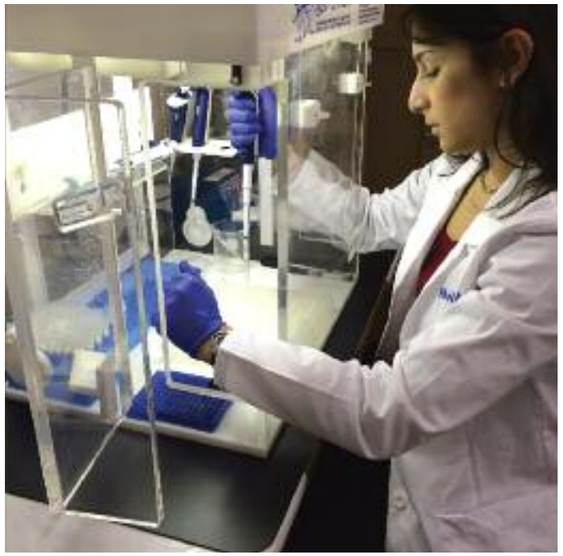
FWP fisheries crews collected genetic samples from juvenile bull trout in all five Clearwater Basin bull trout spawning tributaries. Geneticists then identified a distinctive genetic "baseline"—or unique genetic "fingerprint"—for each tributary population.

Next, we collected tissue samples from bull trout captured by ice fishing in lakes throughout the system and then released. By comparing the genetic make-up of each fish with the distinctive genetic characteristics of baseline populations in the tributaries, we learned which tributary each trout came from. With that cumulative information, we can steer future conservation work toward the most productive and important tributaries.

By taking a fin clip, we can also learn how far an individual fish travels. For instance, we now know bull trout from the Blackfoot River system move up into the Clearwater system. That information helps us make a strong case for projects on the Clearwater to improve fish connectivity because the work will also benefit Blackfoot River fish.

Advances in genetics science are allowing FWP to conserve and manage Montana's native species more rapidly, accurately, and effectively than ever before. We still use old-fashioned nets, electric currents, and even hook-and-line angling to learn about fish in lakes, streams, and rivers. But, increasingly, some of our most valuable information on native fish populations and individual fish comes from a genetics laboratory.



LEFT TO RIGHT: MIKE SCHWARTZ; KATIE ZARN; MONTANA FWP

WHERE THEY CAME FROM Facing page: Kellie Carim of the National Genomics Center for Wildlife and Fish Conservation, takes water samples on a northwestern Montana stream. Top: Back at her lab in Missoula, the geneticist analyzes the water for environmental DNA from bull trout. FWP used the analysis to determine the origins of bull trout caught and released in Seeley Lake, like this one (right) from Morrell Creek.