

You are invited to participate in

A range-wide, eDNA-based survey of the U.S. distribution of juvenile bull trout

A joint project of the U.S. Forest Service's Rocky Mountain Research Station and National Genomics Center for Wildlife and Fish Conservation

The bull trout is an ESA-listed species with a historical range that encompasses many waters across the northwestern U.S. Though once abundant, bull trout have declined in many locations from an array of factors—habitat degradation, population isolation, and nonnative species invasions (USFWS 2014)—and there is recent evidence of range contraction in response to climate change (Eby et al. 2014). Federal listing mandates that agencies have reliable and precise information about the distribution of bull trout in thousands of streams, but bull trout surveys are expensive because the fish are often rare and difficult to collect (USFWS 2008). Consequently, many potentially or historically occupied habitats have been sampled infrequently or not at all. The uncertainty about bull trout distributions comes at a cost; agencies may not be able to efficiently target their limited conservation resources, may forego or delay land management critical for other objectives, and may even avoid monitoring populations because of the added burden of obtaining sampling permits.

To overcome some of that uncertainty, Rocky Mountain Research Station scientists recently developed the Climate Shield habitat occupancy model, which predicts the probability of juvenile bull trout presence in all 5,332 of their potential natal cold-water habitats across the northwestern U.S. (Figure 1; Isaak et al. 2015). The fish and temperature data used to develop the model were crowd-sourced, provided by hundreds of biologists working for dozens of resource agencies and collected from thousands of sites. The Climate Shield model accurately predicts those cold-water habitats likely to support bull trout (78% classification accuracy). This model can act as a guide to make population surveys more efficient, but applying traditional sampling methods like electrofishing or snorkeling to the thousands of potential bull trout habitats is logistically impossible. What biologists need is a method that provides precise, robust information about the presence of bull trout that can be collected quickly and at low cost across the entire range of this species.

This goal is now attainable because of advances in environmental DNA (eDNA) sampling in streams i.e., the collection of DNA released by a target species into the water. Researchers at the U.S. Forest Service's National Genomics Center for Wildlife and Fish Conservation have pioneered developments in this field—including the first

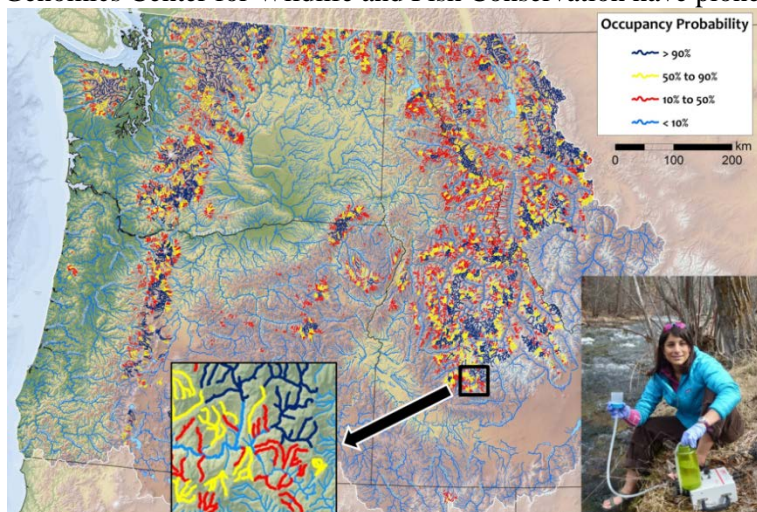


Figure 1. The 5,332 locations that potentially provide spawning and rearing habitat for bull trout in the northwestern U.S. (Isaak et al. 2015). The status of bull trout (present/absent) in 1,000–2,000 of those habitats is unknown because sites have rarely or never been sampled. We will use inexpensive, highly sensitive eDNA surveys to census these habitats. Photo shows typical eDNA sampling equipment that a single person carries to a site. Field samples are being collected by a suite of partner agencies and Forest Service personnel. Samples are processed at the [National Genomics Center for Wildlife and Fish Conservation](#).

reliable eDNA assay for salmonid fish species, and the first that distinguishes bull trout from other species of char (Wilcox et al. 2013, 2014). They have also developed a field-proven eDNA sampling protocol that requires only 15 minutes of effort by a single person to collect a sample (Carim et al. 2014). Species detection with eDNA is remarkably sensitive—in earlier research, 100% detection efficiency of target species was achieved despite order-of-magnitude changes in stream discharge (Jane et al. 2014). Subsequent field experiments indicate that detection probability of a single trout in 100 m of stream exceeds 85%, an efficiency several-fold better than one-pass electrofishing (Wilcox et al. in review). Collected samples are easily stored while in the field, can be processed in the lab in under 48 hours, and cost as little as \$65 to analyze. This protocol has been adopted by biologists from partner agencies in most western states, on projects ranging from population

inventories to gauging the effectiveness of chemical treatments or electrofishing to remove nonnative species. Often, an entire 6th-code subwatershed (~20–40 km of stream) can be sampled by a single person in one day.

Bull trout have been a focus of these eDNA surveys. The initial studies have been directed at precisely delineating the distribution of bull trout within select watersheds, as well as confirming their absence from potential habitats and discovering previously unknown populations (McKelvey et al. in press). In 2015, we built on previous work by pairing predictions of bull trout habitat occupancy from the Climate Shield model with an optimized eDNA protocol to survey all juvenile bull trout habitats throughout two 4th-code river basins in Montana and Idaho, and to begin these surveys in 10 additional 4th-code basins. In 2016–2018, we hope to extend this sampling to the entire range of bull trout in the U.S. Locations to be sampled will include those predicted to be suitable by the Climate Shield model, those designated as critical spawning and rearing habitat by the U.S. Fish and Wildlife Service, and those with historical observations of juvenile or spawning bull trout for which there are no recent surveys.

To be successful, we need your help. We can afford to analyze many eDNA samples in the inland Columbia River basin, but need volunteers willing to collect the samples from potential bull trout habitats. We will provide all the sampling gear and a list of locations to visit. We also seek partners willing to cost-share the analysis of samples in eastern Washington and Oregon, and collaborators interested in extending the project to west of the Cascade Mountains in Washington and Oregon. For more information or if you would like to participate, please contact **Michael Young** (406-542-3254; mkyoung@fs.fed.us), **Kevin McKelvey** (406-542-4163; kmckelvey@fs.fed.us), **Michael Schwartz** (406-542-4161; mkschwartz@fs.fed.us), or **Dan Isaak** (208-373-4385; disaak@fs.fed.us).

Webpages

On eDNA: <http://www.fs.fed.us/research/genomics-center/edna/>.

The Rangewide Bull Trout eDNA Project: http://www.fs.fed.us/rm/boise/AWAE/projects/BullTrout_eDNA.html

On the Climate Shield suite of outputs: <http://www.fs.fed.us/rm/boise/AWAE/projects/ClimateShield.html>.

Key references

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