From:	Penaluna, Brooke - FS, OR
To:	Amy Stark
Subject:	two coastal cutthroat trout posters
Date:	Wednesday, April 3, 2024 12:52:04 PM
Attachments:	image001.png image002.png image003.png image004.png

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Hi Amy,
I have two posters about Coastal Cutthroat that I could bring if you are interested for the CCT symposium.

Poster 1. UPRLIMET: UPstream Regional LiDAR Model for Extent of Trout in stream networks

Brooke Penaluna, Jonathan Burnett, Kelly Christiansen, Ivan Arismendi, Sherri Johnson, Kitty Griswold, Brett Holycross, and Sonja Kolstoe

Predicting the edges of species distributions is fundamental for species conservation, ecosystem services, and management decisions. In North America, the location of the upstream limit of fish in forested streams receives special attention, because fish-bearing portions of streams have more protections during forest management activities than fishless portions. We present a novel model development and evaluation framework, wherein we compare 26 models to predict upper distribution limits of trout in streams. The models used machine learning, logistic regression, and a sophisticated nested spatial cross-validation routine to evaluate predictive performance while accounting for spatial autocorrelation. The model resulting in the best predictive performance, termed UPstream Regional LiDAR Model for Extent of Trout (UPRLIMET), is a two-stage model that uses a logistic regression algorithm calibrated to observations of Coastal Cutthroat Trout (*Oncorhynchus clarkii clarkii*) occurrence and variables representing hydro-topographic characteristics of the landscape. We predict trout presence along reaches throughout a stream network, and include a stopping rule to identify a discrete upper limit point above which all stream reaches are classified as fishless. Although there is no simple explanation for the upper distribution limit identified in UPRLIMET, four factors, including upstream channel length above the point of uppermost fish, drainage area, slope, and elevation, had highest importance. Across our study region of western Oregon, we found that more of the fish-bearing network is on private lands than on state, US Bureau of Land Mangement (BLM), or USDA Forest Service (USFS) lands, highlighting the importance of using spatially consistent maps across a region and working across land ownerships. Our research underscores the value of using occurrence data to develop simple, but powerful, prediction tools to capture complex ecological processes that contribute to distribution limits of species.

Poster 2. Better boundaries: identifying the upper extent of fish distributions in forested streams using eDNA and electrofishing

Brooke Penaluna, Jenn Allen, Ivan Arismendi, Taal Levi, Tiffany Garcia, and Jason Walter

The management of species that occur in low densities is a conservation concern worldwide across taxa with consequences for managers and policymakers. The distribution boundary at the upper extent of fish in North America receives extra attention because stream reaches with fish are managed differently and often have more protections than fishless reaches. Here, we examine the relative reliability of water environmental DNA (eDNA), polymerase chain reaction (PCR)-amplified for Coastal Cutthroat Trout (*Oncorhynchus clarkii clarkii*) to detect the upper extent of fish across streams as a potential management tool compared to standard electrofishing methods. We provide estimates of fish detection probabilities from eDNA analyses, and probabilities of detection for both eDNA field samples and quantitative PCR (qPCR) given covariates of habitat characteristics and fish densities from electrofishing. We present a primer and probe based on the cytochrome oxidase I gene using qPCR to detect trout DNA across water samples from 60 forested streams in the Pacific Northwest, USA using high-resolution spatial sampling. In 28% of streams, the upper extent of fish matches between methods. In over half of the streams, Coastal Cutthroat Trout eDNA was detected above the electrofishing last-fish boundary. Although some detections could be attributed to false-positive errors, eDNA results extend the upstream, leading edge of fish by 50–250 m from the electrofishing boundary. In 20% of the streams, detections of last-fish occurred higher in the stream network with electrofishing rather than eDNA, but generally by only 50 m. Modeled results revealed that the occurrence of trout eDNA was higher in wider-stream locations and that eDNA detections occurred at lower electrofishing densities (<5 trout per 50 linear m). We also showed that three replicate eDNA samples were sufficient to capture trout eDNA when eDNA was present. Although eDNA constitutes an effective addition to approaches to delimit the upper extent of fish, its effectiveness depends on previous knowledge of the last-fish boundary to apprise where to start sampling and targeting fish species anticipated to be last-fish. We present evidence that eDNA is a valuable tool in investigating fish distributions taking its place alongside traditional high-effort catch–release tools.

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