Exploring the upper distribution limits of fish in streams

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Streams with fish receive more protections than streams without fish making the boundary of the upper limit of fish in forested streams important. For example, policies may impose costs in the form of forest harvest restrictions on lands adjacent to fish-bearing reaches owing to greater protections and wider riparian buffers than portions of streams without fish. Consequently, identifying the upper distribution of fish is ecologically, economically, and regulatorily relevant. We offer two novel methods to identify the position of the upper extent of fish, including modeling and eDNA and uncover how this boundary marks a distinct ecological change in freshwater biodiversity assemblages. The model, UPRLIMET, predicted more fish on private lands than on land managed by the state, U.S. Forest Service, or U.S. Bureau of Land Management, highlighting the importance of using transparent, spatially explicit maps across a region and working across ownerships when developing management plans for fish and forests. In over half of the streams sampled with eDNA in Washington and Oregon, eDNA extended the upstream limit of fish by at least 50–250 m. eDNA analysis of residual DNA in water provides insights into presence, diversity, and management effects on freshwater biodiversity above and below the upper extent of fish. This boundary marks a shift in species assemblages elevating its importance. Both modeling and eDNA offer a non-invasive management tool to determine the upper extent of fish in streams offering science-based, data-driven information to make more inclusive conservation decision around identifying this boundary. Accurate determination of the upper extent of fish helps managers make more accurate forest management prescriptions, while providing optimal protection for freshwater species of concern.