

## **The Cold-Water Climate Shield: Delineating Refugia for Preserving Native Trout Through the 21st Century**

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The distribution and future fate of ectothermic organisms in a warming world will be dictated by thermalscapes across landscapes. Marquis salmonine fishes like trout, salmon, and char have undergone broad declines over the last two centuries and depend on particularly cold environments at high elevations and latitudes. The extreme nature of those environments also precludes invasions by most nonnative species so identifying habitats capable of absorbing future climate change while still supporting native populations would resolve refugia critical for conservation planning. Using crowd-sourced biological datasets and high-resolution stream temperature scenarios, we delineate climate refugia across >250,000 stream kilometers in the Northern Rocky Mountains for two native trouts—Bull Trout and Cutthroat Trout. Even under an extreme late-century climate scenario and pessimistic assumptions about species invasions, refuge habitats with high probabilities of species occupancy occur for both species. Most refugia occur on federal lands (80% - 90%) where only a small portion has protected status (10% - 20%). Precise information about refuge locations should enable better protections but refuges could also provide a foundation for climate-smart conservation networks designed to maintain broader species distributions. Using cold water as a “climate shield” is generalizable to other cold-water species and geographic areas because it mines information from existing datasets and is built on nationally available geospatial data. Importantly, it creates a framework that can be updated with new data and the process of developing information from contributions by many individuals and resource agencies strengthens the social networks that will be needed to preserve cold-water salmonids through the 21st Century.