

Effects of Landscape Pattern on the Distribution of Coastal Cutthroat Trout in Headwater Catchments in Western Oregon

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Extended abstract.—To evaluate landscape influences on the distribution and relative abundance of coastal cutthroat trout, we conducted spatially continuous surveys of stream habitat and trout abundance in forty randomly selected watersheds (500-1000 ha) in the Cascades, Coast Range, and Klamath Mountains ecoregions of western Oregon. Our investigation of coastal cutthroat trout populations across a broad range of headwater environments revealed that landscape patterns, including topography, geology, stream network structure, annual precipitation, and forest cover type, were associated with the distribution and scale of variation of trout abundance within watersheds. Understanding influences of landscape pattern on the distribution of coastal cutthroat trout is critical in the Pacific Northwest where resource managers must consider potential effects of forest management on aquatic ecosystems.

Headwater catchments were randomly selected from a known population of coastal cutthroat trout streams in western Oregon. Because a database with locations of isolated, potamodromous populations of coastal cutthroat trout did not exist, a sampling frame of isolated watersheds meeting this criterion had to be developed (Gresswell et al. 2004). After the sampling frame of watersheds was established, isolated watersheds with coastal cutthroat trout were stratified by ecoregion and erosion potential based on dominant bedrock lithology (i.e., sedimentary and igneous). A stratified random sample of 40 watersheds was selected with proportional allocation in each stratum (Figure 1).

The extent of fish-bearing stream in each watershed was sampled for aquatic habitat and coastal cutthroat trout distribution (Gresswell et al. 2006). The surveys were

conducted during the summer months over a three-year period (1999-2001). Physical variables that describe habitat unit size (e.g., length, depth, and width), substrate size class, channel type, valley segment type, and woody debris were estimated or measured for all sampled habitat units. The relative abundance of coastal cutthroat trout in all pools and cascades was assessed by single-pass removal using

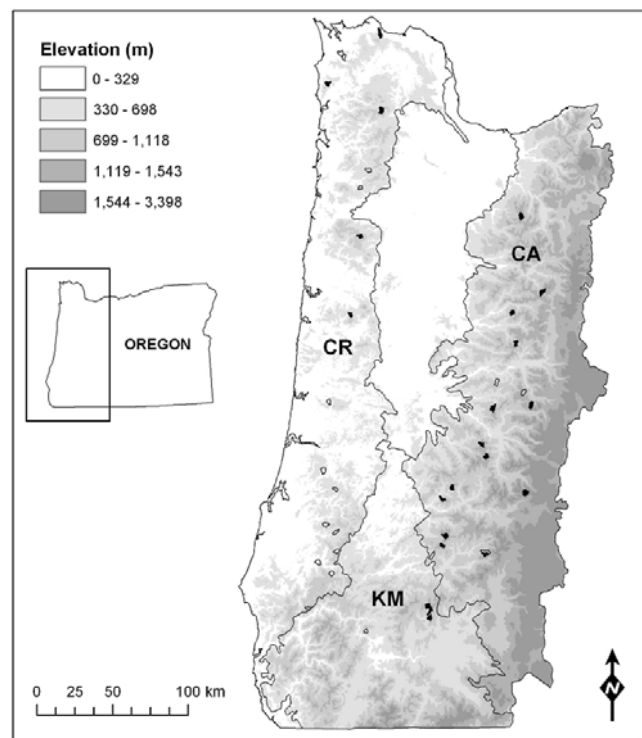


FIGURE 1.—Locations of 40 randomly selected catchments with isolated coastal cutthroat populations in the Coast Range (CR), Klamath Mountains (KM), and Cascades (CA) ecoregions of western Oregon (Gresswell et al. 2004).

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electrofishing to collect fish (Bateman et al. 2005).

Semivariograms were used to determine the spatial scale at which landscape characteristics were associated with fish distribution within watersheds (Ganio et al. 2005). Patterns of spatial variability in coastal cutthroat trout abundance were evaluated by comparing variograms among watersheds. Characteristics of the variogram, including the shape and the distance over which fish abundance was autocorrelated, were compared among watersheds with respect to landscape characteristics such as erosion potential, geology, ecoregion, and watershed characteristics (elevation, slope, and drainage density).

The spatial extent of fish distribution in each study basin was calculated in kilometers and normalized by watershed area (km^2). This variable, representing the length of stream occupied by coastal cutthroat trout, was compared among watersheds to identify broad-scale physiographic and climatic patterns that influence coastal cutthroat trout distribution. Multiple linear regression was used to identify a set of models that predicted fish distribution based on landscape explanatory variables derived from spatial data layers (climate, topography, and land use).

Spatial scaling of coastal cutthroat trout distribution was correlated with landscape characteristics. Multiple regression analysis indicated that patch size (determined from semivariograms) of coastal cutthroat trout distribution was positively associated ($r^2 = 0.78$, $P < 0.05$) with erosion susceptibility, the average distance between tributary junctions, and the maximum distance separating any two channel units within the surveyed portion of the stream network. We are currently investigating how this model can be used to predict the spatial scale of variation in coastal cutthroat trout distribution that is necessary for sampling and monitoring populations in headwater streams.

Regression models were used to investigate the spatial extent of coastal cutthroat trout distribution. Results suggest pronounced differences among watersheds and ecoregions (Figure 2), and channel slope, annual precipitation, and forest vegetation type were the primary landscape variables associated with observed differences. The biological responses of coastal cutthroat trout to changes in channel morphology, forest vegetation, prey availability, and physical constraints to movement are highly context dependent both spatially and temporally (Latterell et al. 2003). Therefore, caution should be exercised in drawing conclusions about causal relationships between coastal cutthroat trout distribution and management practices.

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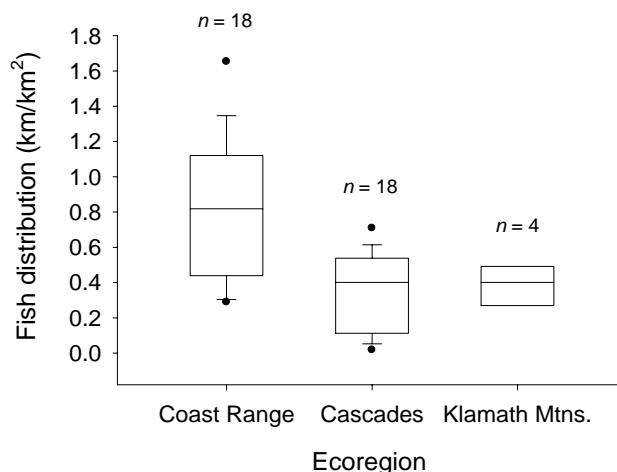


FIGURE 2.—Variability in the spatial extent of coastal cutthroat trout distribution among watersheds in ecoregions of western Oregon. Upper and lower boundaries of the box indicate 25th and 75th percentiles, whiskers indicate 10th and 90th percentiles, the midline marks the median, and the solid circles are outliers. The number of sampled watersheds per ecoregion is indicated above each box.

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