The relative influence of ecological processes in predicting steelhead redd abundance along a complex riverscape in the John Day River basin, Oregon.

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Habitat models to predict the distribution and abundance of stream fishes often focus on ecological processes that operate at local spatial scales. However, broad-scale processes such as habitat complementation, supplementation, and neighborhood effects may also play an important role in how fish perceive and respond to their environment. Because anadromous stream fishes carry out their life histories across broad spatial and temporal scales, understanding the influence of the environment on these organisms should benefit from an approach that explicitly incorporates a spatially-continuous and multi-scale “riverscape” perspective. We applied this perspective to investigate the relative influences of spatial ecological processes on the abundance of steelhead (*Oncorhynchus mykiss*) redds across a large riverscape in eastern Oregon, USA. We generated spatially-continuous measures of key processes hypothesized to affect several life stages, including influences on 1) the survival of adults, 2) survival of juvenile steelhead, 3) quality of the environment for egg and larval incubation, 4) the accessibility of spawning habitats, and 5) the potential for interactions between natural-origin and hatchery fish. We calculated metrics based on these processes for ~15,000 km of stream in the John Day River basin, and used hurdle regression to model steelhead redd occurrence and abundance as a function of covariates at three spatial scales: local spawning survey reaches, ecological neighborhoods, and the riverscape. We then used a multi-model information theoretic approach to identify ecological processes that best explained redd abundance in the John Day basin. Top-ranked models included covariates measured at both local and ecological neighborhood scales. Together, these factors integrate important processes that affect steelhead across life stages. Owing to model uncertainty, we model-averaged parameter estimates from top models and used the composite model to predict the distribution and abundance of steelhead redds in the John Day River basin. We anticipate that our results will have utility for conservation and management of ESA listed steelhead populations in the John Day River basin, and will help to optimize survey designs and prioritize areas for habitat restoration.