Deep enough to swim? Stream water depths that support endangered coho salmon outmigration

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December 29, 2022

Abstract

Streamflow depletion is occurring globally, due to land use change, climate change, and increasing human water demand. Ecological effects of low flows are particularly significant for diadromous fish, which require connected stream networks to migrate between fresh and marine waters. In coastal California, USA, drying streams are known to limit rearing habitat for juvenile salmon, but effects on their seaward migration remain poorly understood. In this study, we evaluated the outmigration of endangered, juvenile coho salmon (*Oncorhynchus kisutch*) during the late spring flow recession in four streams over 10 years. We monitored the outmigration of fish tagged with passive integrated transponders via detections at stationary antennas, and we measured stream water depths when movement was detected. We assessed depths at multiple riffle crest thalwegs (RCTs), the shallowest geomorphic feature that fish must navigate. Finally, we calculated population-level outmigration depth preferences by evaluating depths during fish movement, relative to depths available during the potential outmigration window. Juvenile fish moved over a wide range of depths (interquartile range 6.1–18.0 cm), which varied by year and stream. Fish ceased to move at shallow water depths, which limited late-season outmigration as stream drying occurred. Our findings suggest that management actions to increase streamflow during the spring would benefit salmon outmigration and could contribute to population recovery. Streamflow-RCT depth relationships, used to assess coho depth preferences during movement, is a relatively simple and effective method for assessing environmental flow needs, a priority for aquatic conservation in California and globally.

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