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Juvenile salmon habitat use drives variation in growth and highlights vulnerability to river fragmentation

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Funding information

Alaska Sustainable Salmon Fund, Grant/Award Number: 44708; US Fish and Wildlife Service

Handling Editor: Andrew L. Rypel

Abstract

Widespread stream network fragmentation from dams and culverts has altered habitat connectivity in river ecosystems and presents an acute threat to migratory fish. To support watershed management for an iconic migratory fish group, we assessed juvenile salmon growth outcomes across habitat use strategies and characterized how these life histories may be impacted by stream connectivity loss. Juvenile coho salmon (*Oncorhynchus kisutch*) in the Big Lake drainage, Alaska, USA, were individually tracked over 2012–2013 and categorized into habitat use behaviors, with fish either remaining in streams throughout freshwater residency or migrating seasonally to overwinter in lake habitats. Size, growth rate, and body condition of smolts ($n = 1113$) were compared across habitat use strategies. Juvenile coho salmon that moved seasonally to lake overwintering habitats, the most frequently observed strategy, grew faster and were significantly larger as smolts compared to their counterparts who remained in streams exclusively (spring Age 1 fish: 18% larger by weight, 9% faster growth rate; spring Age 2+ fish: 26% heavier, 11% faster growth). Environmental data from a subset of overwinter lakes indicate that greater foraging opportunity and lower energy costs may be implicated in growth advantages conferred by lentic overwintering strategies. Habitat use strategies requiring seasonal migrations, however, increased exposure to stream connectivity loss, and fish blocked from accessing a potential overwinter headwater lake by a culvert and dam had lowest body condition among study groups. Stream network fragmentation restricts access to preferred overwinter habitats, and our findings suggest this may constrain freshwater rearing strategies associated with strong juvenile coho salmon growth. As size at smolt has been implicated as a driver of salmon survival through ocean residency, reduced freshwater habitat connectivity during juvenile stages may have deleterious impacts on later marine life stages. Consequently, conservation of

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