Using Landscape Principles to Guide Largescale Estuary Restoration

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Abstract

Over the last two decades, habitat restoration actions have been proposed and implemented along the 146-mile lower Columbia River Estuary (Figure 1) specifically to aid salmon and steelhead listed under the Endangered Species Act. As the largest river in western North America, the estuary is the gateway to the 258,000 square mile Columbia River Basin and is the corridor through which threatened and endangered Columbia Basin salmon and steelhead must pass. The lower Columbia River is also an industrial river, hence the US Army Corps of Engineers maintains a 600-ft wide, 43-ft deep navigation channel from the Pacific Ocean to Vancouver, Washington to support transport of almost 50 million tons of cargo valued at $16 billion. This fluvial-tidal estuarine gradient is punctuated by large tributary rivers (e.g. Willamette, Cowlitz), cities (e.g. Longview, Vancouver), and industrial land uses, and has lost approximately two-thirds of its historical floodplains and wetlands to development and agriculture (Hood et al. 2021). While constraints on restoration actions are significant, there have also been substantial achievements.

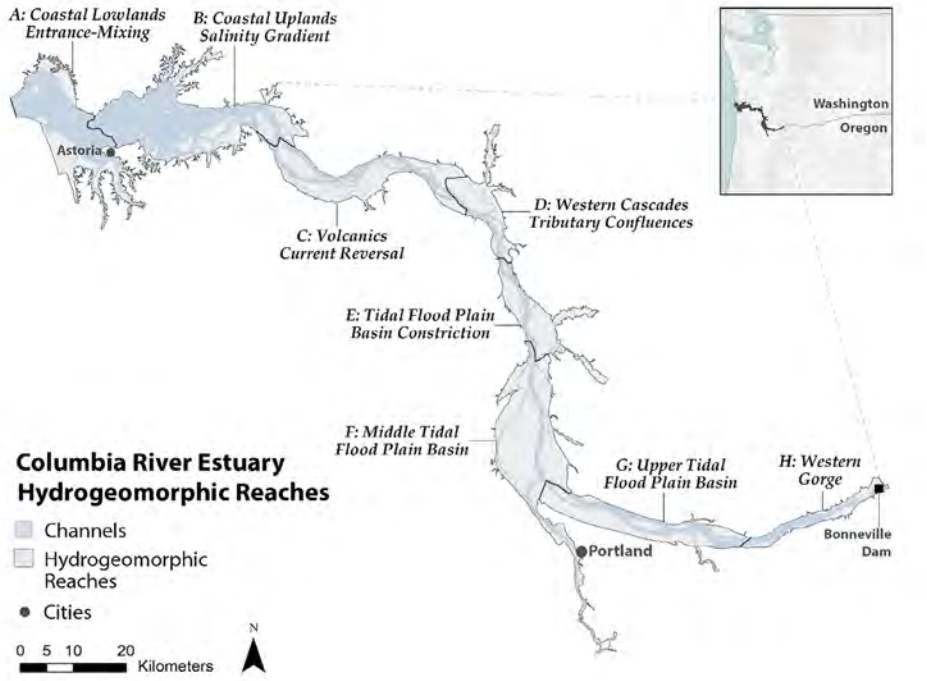

Figure 1. From Hood et al. 2021. The eight hydrogeomorphic reaches of the lower Columbia River Estuary.

Since 2010, proposed restoration projects in the Columbia River Estuary have been evaluated by an Expert Regional Technical Group (ERTG) that considers the potential benefits to juvenile salmon of each project based on its contributions to salmon rearing opportunity and capacity. These criteria generally favor large restoration projects located near the estuary mainstem but provide little guidance for the distribution of projects along the mainstem or the utility of alternative actions in areas where these priorities cannot be met. In response, the ERTG developed a landscape framework for restoration to assess and reduce habitat discontinuity, and thereby improve habitat functions to increase juvenile salmon survival. Our framework applies the concept of restoring and conserving habitat "stepping stones" of appropriate size and location to benefit juvenile salmon growth and survival throughout their estuary residency and migration (Figure 2). Our approach operationalizes landscape ecology-based decisions within the Columbia River Estuary for migratory salmon and is applicable to other large estuary systems with migratory aquatic species.

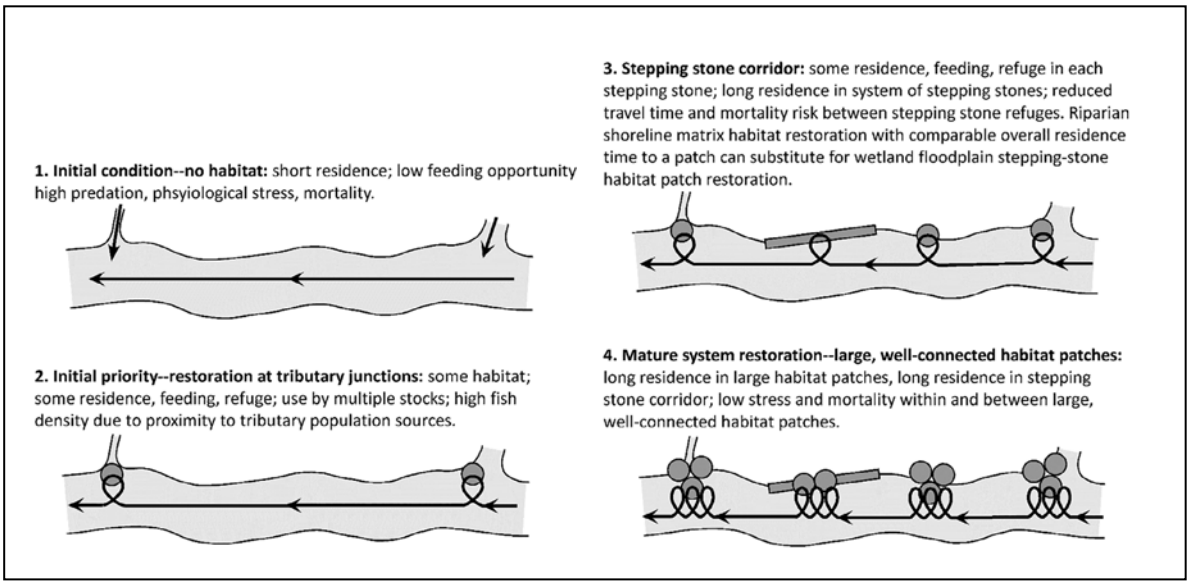

Figure 2. From Hood et al. 2021. Conceptual model of stepping-stone migratory corridor restoration for juvenile salmon. Dark gray circles are floodplain wetland habitat patches. Narrow gray rectangles are restored riparian shoreline habitat, which supplements or substitutes for patch restoration (when it is not feasible). Arrows represent the direction of river flow and migration. Loops indicate temporary fish residency.

References

Hood, W.G., Blauvelt, K., Bottom, D.L., Castro, J.M., Johnson, G.E., Jones, K.K., Krueger, K.L., Thom, R.M., and Wilson, A. 2021. "Using Landscape Ecology Principles to Prioritize Habitat Restoration Projects Across the Columbia River Estuary", Restoration Ecology, Volume 30, Issue 3.