

**Title:**

The Columbia River estuary and plume: what they are, and why they matter to species recovery in the Columbia Basin

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**Abstract**

Anadromous fishes make critical transitions between freshwater and saltwater phases of their life cycles, and these transitions occur in estuaries and plumes. The Columbia River estuary and plume are highly dynamic, three-dimensional habitats where river and ocean waters meet; conditions here are directly affected by river flow, ocean tides, and wind. Understanding effects the estuary and plume have on fish and wildlife can improve our understanding of mechanisms affecting critical uncertainties in species recovery. For example, there is evidence that early marine survival of juvenile salmon could be affected by fish-eating seabirds in the plume. Seabird aggregation in and preference for plume habitat implies there is increased predation risk for salmon during seaward migration through the plume. Estuary/plume conditions are also thought to affect early marine survival of eulachon during the passive seaward migration of larvae. These 7-9 mm larvae must encounter temperatures and foraging conditions in the estuary and plume that allow for successful feeding after yolk sac absorption. Arriving too early or too late to overlap with adequate food, or absorbing the yolk sac too quickly in warm temperatures, could lead to poor marine survival due to starvation even when freshwater survival is high. In a third example, the impact of pinniped predation on interior spring Chinook salmon is thought to be modulated by the effect of estuary and plume conditions on variation in run timing of eulachon. Exploratory work shows strong, positive relationships between annual and weekly eulachon abundance and sea lion abundance, and sea lion abundance is in turn negatively correlated with salmon survival. Because estuary and plume conditions are likely to affect growth and survival during critical periods in the life cycles of anadromous fishes, it behooves biologists, managers, and policy-makers to consider the role of the estuary and plume in species recovery.