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RESEARCH REVIEW

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Changing estuaries and impacts on juvenile salmon: A systematic review

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Abstract

Estuaries are productive ecosystems providing important habitat for a diversity of species, yet they also experience intense levels of anthropogenic development. To inform decision-making, it is essential to understand the pathways of impacts of particular human activities, especially those that affect species such as salmon, which have high ecological, social-cultural and economic values. Salmon systems provide an opportunity to build from the substantial body of research on responses to estuary developments and take stock of what is known. We conducted a systematic English-language literature review on the responses of juvenile salmon to anthropogenic activities in estuaries and nearshore areas asking: what has been studied, where are the major knowledge gaps and how do stressors affect salmon? We found a substantial body of research (n = 167 studies; 1,369 comparative tests) to help understand responses of juvenile salmon to 24 activities and their 14 stressors. Across studies, 82% of the research was conducted in the eastern Pacific (Oregon and Washington, USA and British Columbia, Canada) showing a limited geographical scope. Using a semiquantitative approach to summarize the literature, including a weight-of-evidence metric, we found a range of results from low to moderate–high confidence in the consequences of the stressors. For example, we found moderate–high confidence in the negative impacts of pollutants and sea lice and moderate confidence in negative impacts from connectivity loss and changes in flow. Our results suggest that overall, multiple anthropogenic activities cause negative impacts across ecological scales. However, our results also reveal knowledge gaps resulting from minimal research on particular species (e.g. sockeye salmon), regions (e.g. Atlantic) or stressors (e.g. entrainment) that would be expedient areas for future research. With estuaries acting as a nexus of biological and societal importance and hotspots of ongoing development, the insights gained here can contribute to informed decision-making.

KEYWORDS

environmental impact assessment, estuary impacts, salmon, smolt, stressors