

Impacts of Pink Salmon on other Pacific Salmon and Marine Species

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For the past 25 years we have used the unique and extreme biennial pattern of pink salmon abundance in marine and freshwater habitats to test for their interactions with other species of Pacific salmon and marine species. This approach is robust because oceanographic conditions and other potential drivers are not known to vary biennially. Additionally, numbers of adult pink salmon returning from the North Pacific Ocean in odd years have quadrupled since the early 1970s in response to ocean heating, leading to record-high annual abundances in 2021 and 2023 (~800 million pink salmon each year). Evidence indicates that predation by maturing pink salmon in odd years can initiate a trophic cascade in the North Pacific by reducing herbivorous zooplankton abundance sufficiently that phytoplankton densities increase, with opposite patterns in even years. Widespread interspecific competition for common-pool prey resources can be dominated by pink salmon, as indicated by numerous and typically consistent biennial patterns in the diet, growth, survival, abundance, age-at-maturation, distribution, and/or phenology of forage fishes (4 species), squid, Pacific salmon (5 species) and steelhead trout, seabirds (11 species), and the critically-endangered Southern Resident Killer Whale. In aggregate, the evidence from approximately 100 peer-reviewed publications indicates that open-ocean marine carrying capacity in the northern North Pacific Ocean and Bering Sea can be mediated by top-down forcing by pink salmon. Evidence also indicates pink salmon in freshwater and nearshore marine habitats may benefit other species (e.g., marine derived nutrients; prey as fry), but new evidence shows that abundant adult pink salmon on Puget Sound spawning grounds can disrupt redds and the spawning distribution of Chinook salmon, leading to reduced reproductive success and a 34% decline in odd- compared with even-year abundances of Chinook salmon returning to Puget Sound watersheds since 1997. This interaction appears to have had a cascading effect on Southern Resident Killer Whales (SRKW), which also show significant biennial patterns in body condition, mortality, and births since 1997. If SRKW numbers had not declined in relation to reduced foraging in odd-years, then the SRKW population would have likely increased rather than decreased.

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