Vol. 719: 1–40, 2023
https://doi.org/10.3354/meps14402

MARINE ECOLOGY PROGRESS SERIES
Mar Ecol Prog Ser

Published September 21

From diatoms to killer whales: impacts of pink salmon on North Pacific ecosystems

Gregory T. Ruggerone[1,*], Alan M. Springer[2], Gus B. van Vliet[3], Brendan Connors[4], James R. Irvine[5], Leon D. Shaul[6], Matthew R. Sloat[7], William I. Atlas[7]

[1]Natural Resources Consultants, Seattle, WA 98199, USA
[2]College of Fisheries and Ocean Sciences, University of Alaska Fairbanks, Fairbanks, AK 99775, USA
[3]PO Box 210442, Auke Bay, AK 99821, USA
[4]Fisheries and Oceans Canada, Institute of Ocean Sciences, Sidney, BC V8L 5T5, Canada
[5]Fisheries and Oceans Canada, Pacific Biological Station, Nanaimo, BC V9T 6N7, Canada
[6]1316 3rd St., Douglas, AK 99824, USA
[7]Wild Salmon Center, Portland, OR 97209, USA

ABSTRACT: In response to a climate regime shift in 1977 and general heating of the North Pacific Ocean, pink salmon Oncorhynchus gorbuscha abundance reached record highs during 2005–2021, comprising 70% of all Pacific salmon. Pink salmon are approxi- mately 25 times more numerous in odd- than even- numbered calendar years in some major North Pacific ecosystems, a unique demographic pattern analogous to repeating whole ecosystem treatment–control ex- periments. We found compelling examples indicating that in odd years, preda- tion by pink salmon can initiate pelagic trophic cascades by reducing herbivorous zoo- plankton 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 in- dicated by numerous biennial patterns in the diet, growth, survival, abundance, age-at-maturation, dis- tribution, and/or phenology of ecologically, culturally, and economically important forage fishes, squid, Pa- cific salmon and steelhead trout Oncorhynchus spp., seabirds, humpback whales Megaptera novaeangliae, and endangered southern resident killer whales Orci- nus orca. In aggregate, the evidence 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 and by ocean heating, and that large-scale hatchery production (~40 % of the total adult and immature salmon biomass) likely has unintended consequences for wild salmon, includ- ing Chinook salmon O. tshawytscha, and many other marine species. Further investigation of the effects of pink salmon on other species will increase our knowl- edge of ecosystem function and the important role top- down forcing plays in the open ocean

Ruggerone, G.T., Springer, A.M., van Vliet, G.B., Connors, B., Irvine, J.R., Shaul, L.D. et al. (in press) (2023) From diatoms to killer whales: impacts of pink salmon on North Pacific ecosystems. Marine Ecology Progress Series. Vol. 719: 1-40,