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Spatial Patterns in Consumption Demand and Growth Potential of Juvenile Pink Salmon (*Oncorhynchus gorbuscha*) in the Gulf of Alaska

Jamal H. Moss[1], **David A. Beauchamp**[2], **Alison D. Cross**[2], **Edward V. Farley, Jr.**[1], **John H. Helle**[1], and **Katherine W. Myers**[3]

[1]*Department of Commerce, NOAA, NMFS, Alaska Fisheries Science Center, Auke Bay Laboratory 11305 Glacier Highway, Juneau, AK 99801, USA*

[2]*U.S. Geological Survey, Washington Cooperative Fish and Wildlife Research Unit, School of Aquatic and Fisheries Sciences, University of Washington, Box 355020, Seattle, WA 98195-5020, USA*

[3]*High Seas Salmon Research Program, School of Aquatic and Fisheries Sciences, University of Washington, Box 355020, Seattle, WA 98195-5020, USA*

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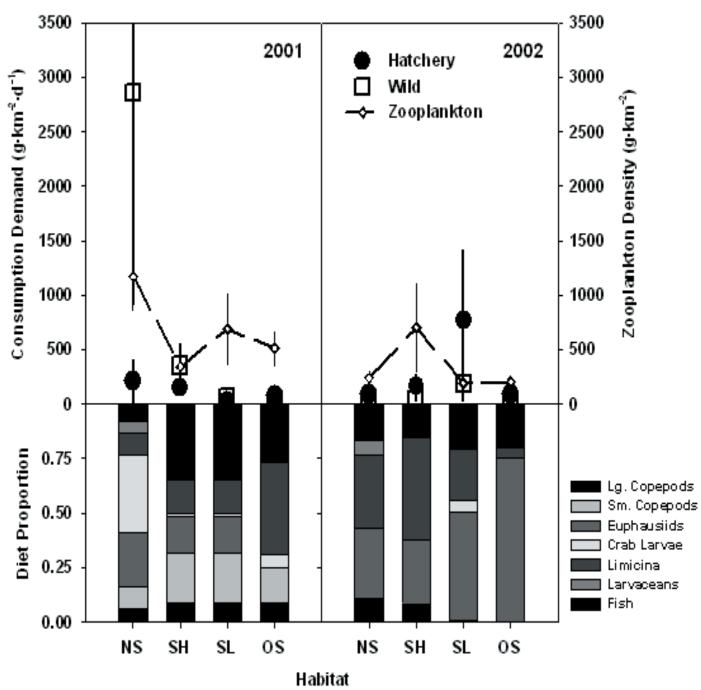
Salmon experience high mortality during early marine life, however, size-dependent mortality might be concentrated during specific life stages (Beamish and Mahnken 2001), and vary among regions (Mueter et al. 2002, 2005; Pyper et al. 2005). Survival of pink salmon during their marine residence appears to be determined in two stages, with the first stage characterized by high initial size-selective predation on juveniles as they enter the coastal regions (Parker 1965, 1968, Willette et al. 1999), and the second by significant size-selective mortality after the first summer growing season (Moss et al. 2005). Different stocks of fish will experience different conditions, as they inhabit different areas during different portions of their life cycle. However, each stock should respond to the same underlying mechanisms, and may express this two-stage mortality process differently. For pink and chum salmon, similar marine survival was reported for populations originating within regions (within 100–200 km) but differed among regions, suggesting that localized environmental processes operated similarly on early life stages in nearshore and coastal marine waters (Mueter et al. 2002, 2005; Pyper et al. 2005). Therefore, localized conditions affecting growth during the first summer in coastal shelf regions could determine the severity of over winter survival.

Average localized daily consumption estimates for wild juvenile pink salmon (706 g • km^{-2} • d^{-1}, ± 371 standard error (SE)) were greater than for hatchery pink salmon (127 g • km^{-2} • d^{-1}, ± 75 SE) during 2001, whereas, hatchery pink salmon were estimated to have consumed more prey (203 g • km^{-2} • d^{-1}, ± 88 SE) than wild pink salmon (60 g • km^{-2} • d^{-1}, ± 20 SE) during 2002, primarily because of differences in relative density. Daily prey consumption demand by wild juvenile pink salmon was greater than that estimated for hatchery stocks in nearshore and shelf habitats, but similar in magnitude with slope and offshore habitats during 2001 (Fig. 1). During 2002, daily prey consumption demand by hatchery and wild stocks were similar in nearshore, shelf, and offshore habitats, but estimates of prey consumption by hatchery stocks was greater in slope habitat than for wild stocks (Fig. 1).

Fig. 1. Consumption demand by juvenile pink salmon at near shore stations (NS), over the continental shelf (SH), over the continental slope (SL), and offshore of the continental slope (OS) during July–August 2001 and 2002 Gulf of Alaska research cruises.



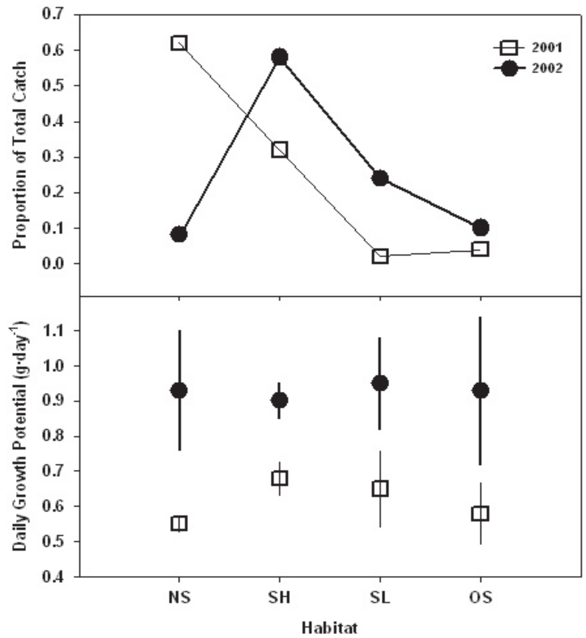
Estimates of daily growth potential were greater during 2002 for each habitat across the Coastal Gulf of Alaska (CGOA) relative to 2001 (Fig. 2). Shelf and slope habitats were estimated to have the highest rates of potential growth during 2001, whereas the nearshore region ranked the lowest (Fig. 2). Averages of daily growth potential for a given habitat type during 2002 were relatively constant, but had a high degree of variability around the mean (Fig. 2). Densities of juvenile pink salmon

All correspondence should be addressed to J. Moss.
e-mail: jamal.moss@noaa.gov

were greatest in nearshore regions and to a lesser degree shelf stations during 2001, whereas during 2002 densities were highest at shelf stations and to a lesser degree slope stations (Fig. 2).

Consumption demand on prey resources varied spatially. Growth potential was relatively low during 2001 and varied among habitats, where growth potential was relatively high and constant during 2002. Spatial differences in zooplankton abundance revealed that food limitation exists in some years and locations. Higher and more uniform estimates of daily potential growth across habitats during 2002 suggested that fish encountered less favorable growing conditions during 2001. During 2001 growing conditions were less favorable across the CGOA, with the largest abundances of juvenile pink salmon inhabiting the nearshore regions, which had the least favorable conditions for supporting growth. Daily growth potential for juvenile pink salmon inhabiting the CGOA increased from 2001 to 2002, as did marine survival for juvenile Prince Willian Sound (PWS) hatchery stocks. Total returns to PWS (hatchery and wild stocks combined) were greater in 2002 relative to 2001 by a factor of 2.21. This suggests that the daily growth potential metric has the ability to describe variation in marine survival. A large proportion of juvenile pink salmon were concentrated in nearshore habitats, which ranked the lowest in daily growth potential relative to other habitats during 2001, and average juvenile pink salmon body size and estimated consumption rates were lower in 2001 than 2002, thus, density dependent forces may have contributed to lower survival.

Fig. 2. Top panel displays the proportional contribution of juvenile pink salmon catch by habitat, which is classified as either nearshore (NS), continental shelf (SH), continental slope (SL), or offshore of the continental slope (OS) during July–August 2001 and 2002 Gulf of Alaska research cruises. The bottom panel displays corresponding daily juvenile pink salmon growth potential estimates.



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