

Relationships between juvenile size, instream flow, emigration timing, downstream travel time, and age-at-return for a Columbia River Basin spring Chinook Salmon hatchery population

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Abstract

Pacific Salmon abundance is now heavily reliant on hatchery production. Hatchery culture, management practices, and environmental factors greatly influence release size and juvenile migration timing. These factors in turn influence important demographic characteristics in returning adults. While relationships between juvenile characteristics and subsequent survival to adulthood for Pacific Salmon have been studied, additional clarification of these relationships can result in new approaches to hatchery practices that might better achieve production goals. We analyzed a data set of more than 450,000 PIT-tagged spring Chinook Salmon juveniles detected exiting Cle Elum Supplementation and Research Facility (Yakima River, Washington, USA) acclimation sites over twelve brood years (2003-2014; juvenile migration years 2005-2016; adult return years 2006-2019) and evaluated juvenile size and migration timing relative to other factors. Except in very low flow years (drought conditions), flows did not appear to affect the date that juveniles volitionally exited acclimation sites. We observed a relationship between fork length at PIT-tagging and volitional exit timing of fish from acclimation sites, with larger fish tending to migrate earlier than smaller fish. Fish that left acclimation sites earlier had longer travel times to downstream detection sites than fish that migrated later. However, migrating juveniles had similar detection rates and generally arrived during the month of May at Bonneville Dam (500-530 km downstream of acclimation sites). In general, for fish surviving to adult return, those that returned at younger ages were earlier juvenile migrants and larger at release, whereas fish that were older at return were later juvenile migrants and were smaller at release. Our results support the need for additional research into artificial production factors such as growth and thermal regimes that affect the tradeoff between survival to adult return and size- and age-at-return.