

## **Examining the effects of juvenile migration timing on adult age of Columbia River salmon.**

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Dynamic changes in the ocean environment have important implications for salmon production. Both intra- and inter-annual differences in water temperature and food web structure can lead to large differences in growth and survival within and among year classes. In recent years, large numbers of juvenile yearling Chinook salmon and steelhead from the Columbia River have been tagged with Passive Integrated Transponder (PIT) tags prior to migration to the Pacific Ocean. We used information from these tagged fish to estimate how adult age, as measured by year-of-return proportions (YORs), varied as a function of juvenile seasonal migration timing, year, migration route (i.e., bypass and transportation history), and ocean conditions (e.g., average January-March PDO, seasonal temperature at a fixed location, and an overall ranking of a suite of indicators). We considered an important dataset: Wild spring/summer Chinook salmon tagged at or above Lower Granite Dam on the Snake River. Using ordinal logistic regression, we found clear patterns in YORs versus time of arrival below Bonneville Dam. We found a general pattern indicating that fish migrating later returned as older adults. Also, there was definite inter-annual variation in YOR proportions, somewhat explained by ocean conditions. These analyses highlight how seasonal and annual changes in the estuarine and nearshore environment can translate into important differences in salmon survival and how PIT tags can be used to examine these phenomena.