Using Population Projection Matrices to Evaluate Recovery Strategies for Snake River Spring and Summer Chinook Salmon

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Abstract:
*I explored the efficacy of alternative actions to recover threatened Snake River chinook salmon (*Onchorhyncus tshawytscha*). I compared the potential to increase population growth rates from two different actions: (1) habitat restoration efforts, aimed at increasing egg-to-smolt survival rate, and (2) dam breaching, intended to improve smolt-to-spawner survival. Eight dams obstruct the migration corridor these populations traverse as juveniles (downstream) and as adults (upstream), and a large portion of the juvenile migrants are collected and transported past most of the dams on barges or trucks. I applied sensitivity, elasticity, and direct perturbation analyses to an age-structured projection matrix to predict potential effects from simultaneous, nonproportional changes in multiple survival rates. Throughout the analyses, I explicitly incorporated alternative assumptions about the effectiveness of transportation, which is known to be influential. Results of the numerical experiments suggest that dam breaching has more potential to increase population growth rates than habitat restoration, except for the most optimistic assumption about the efficacy of transportation. I then fit the matrix to historical data to identify life stages in which actual decreases in survival rates have caused the observed declines in abundance. There was no reduction in egg-to-smolt survival, indicating that neither habitat deterioration nor hatchery impacts (in that life stage) caused the stocks to decline. The large decrease in smolt-to-adult survival rate from the historical period, when there were fewer dams, is consistent with the hypothesis that increased stress from transportation and passage through additional dams on the Snake River has elevated delayed mortality levels.*