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NOAA and partner scientists discover 'portfolio effect' in early juvenile-salmon survival for spring/summer Snake River Chinook

Diversity in first year of life can improve biological outcomes for managed species

Investors know that adding diversity to their investment portfolio can lower the variability of returns and reduce overall risk. NOAA scientists and their colleagues have discovered a similar "portfolio effect" for the threatened Snake River spring/summer Chinook salmon, noting that diversity in the first year of life can protect the entire group's response to large-scale forces such as climate change and the operation of hydroelectric dams.

"Managers understand that diversity is important for maintaining healthy fish populations, but they need to know where to focus their efforts," said Jim Thorson Ph.D., a NOAA fisheries biologist and lead author of the study. "Understanding what life stage conveys that stabilizing 'portfolio effect' is the golden ticket. In this case, it's the parr stage." Parr are juvenile salmon living in freshwater streams during their first year of life.

The findings are reported in a study published online today in the *Journal of Animal Ecology*, a peer-reviewed scientific journal. Up until now, other high-profile studies of the portfolio effect in Pacific salmon have all focused exclusively on adult abundance. There had been no evidence of a similar effect in salmon survival during early freshwater life stages such as eggs and parr.

In addition to refining our understanding of the portfolio effect, this work helps scientists better understand and predict survival in various stages in the life of a salmon.

In the study, scientists from NOAA Fisheries and Idaho Department of Fish and Game used a new set of information on the parr life stage, culled from 25 years of data from 15 different Snake River spring/summer Chinook populations in central Idaho. Combining these new data with novel mathematical models led the researchers to conclude that the likelihood that a young salmon would survive during its first year depended in large part on where it was. Juveniles in some streams, not surprisingly, did better than their cousins in different streams.

And not only did winners and losers vary from place to place, but from year to year. This variability – some salmon survive and some do not – actually helps protect the overall population from large forces like climate change and hydropower operations that affect them all.

"This study represents a sea change for understanding salmon life cycles," Thorson said. "Our analysis is based on more realistic data for populations during the first year of life and a state-of-the-art model. Now, we have vastly improved our ability to see how this group of salmon responds to changes in its environment over time."

Life-cycle models are used extensively by scientists to address a broad range of questions related to Pacific salmon listed under the U.S. Endangered Species Act, such as how harvest policies, habitat restoration and climate change affect population sizes and risks of extinction. Many of these models rely on data from other regions, or even other species, because more specific information simply isn't available. Such information gaps can prevent an accurate assessment of natural and human-caused factors affecting the survival of juvenile salmon.

The study, “Spatial variation buffers temporal fluctuations in early juvenile salmon survival for an endangered Pacific salmon,” was conducted by scientists with NOAA’s Northwest Fisheries Science Center and Idaho Department of Fish and Game, and is available at http://onlinelibrary.wiley.com/doi/10.1111/1365-2656.12117/abstract. The data collection efforts conducted as part of this study were funded by the Bonneville Power Administration.

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