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Decline and Recovery of Snake River Salmon

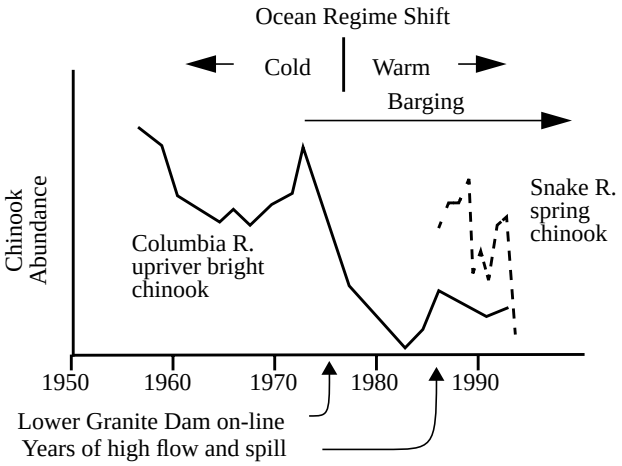
Columbia River stock declines resulted from long term loss of habitat, commercial harvest, changes in the ocean, and development of the hydrosystem.

The completion of Snake River dams in 1976 changed the river ecology. To mitigate these changes fish are now barged from Snake River dams to below Bonneville dam. Coincident with hydrosystem completion and barging, the ocean went through a fundamental change which decreased survival of fish entering the ocean.

Declines in the Columbia and Snake River salmon populations began well before the construction of the hydroelectric projects. Significant events for Columbia River chinook populations include:

- Fishery expansion between 1865 and 1885
- Stable fishery between 1885 and 1920
- Fishery decline after 1920
- Population declined to record lows after 1977
- First dam on-line in 1932, last dam on-line in 1982
- Snake River populations declared Endangered in 1992

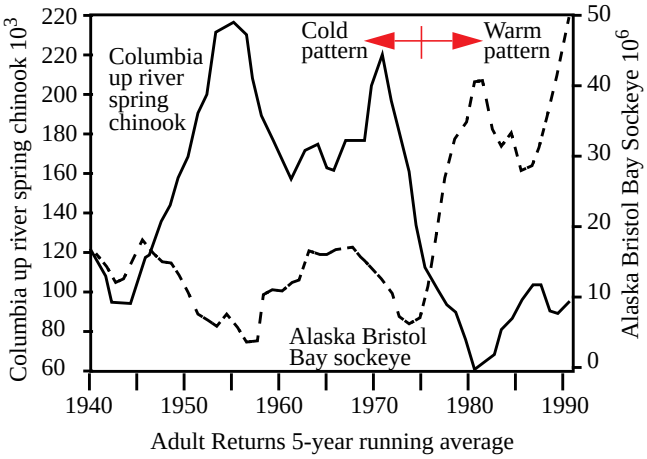
Our research suggests that, although many factors have caused salmon decline, barging and improved dam passage have mitigated many of the effects of the dams. Poor ocean survival resulting from a shift in the ocean regime is an important, if not the most important, factor in the recent decline of the stocks.



Higher survival in the mid 80's, associated with high flows and spills in smolt migration, were likely a result of better ocean conditions because coastal stocks also exhibited higher survival over the period.

The ocean regime shift involves a switch between two basic patterns of temperature and currents in the North Pacific. In the shift, the subarctic boundary moves north in warm years and south in cold years. The shift occurs every few decades. The last major shift occurred in 1977 when the ocean switched from the cold year pattern to the warm year pattern. We are currently in a warm pattern.

The ocean regime shift is correlated with stock abundances. The current warmer pattern favors Alaskan stocks. The cold pattern prior to 1977 favored West Coast salmon.

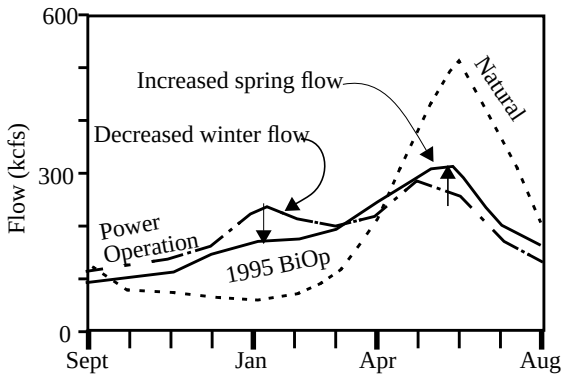


High flows may be ineffective

Flow and spill actions, like those proposed in the National Marine Fisheries Service draft salmon recovery plan, are ineffective recovery actions. Contrary to the claims of some analyses, the flow augmentation will have little impact on fish survival.

The graph below demonstrates three river flow patterns: natural river flow, flow maximized for power operations, and river operations under the 1995 Biological Opinion/recovery plan intended to mimic the "natural" river with flows increasing in the spring and summer.

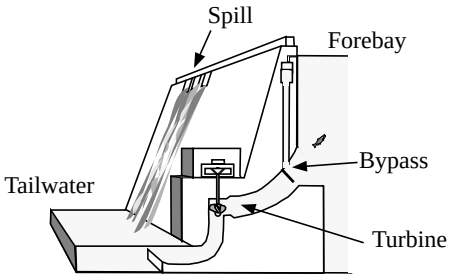
The discrepancy between natural flow and the BioOp flow augmentation amounts to about 200,000 cubic feet per second, however, pointing out the ineffectiveness of using flow augmentation to mimic a natural system. Today Snake and Columbia rivers cannot be returned to a pre-dam configuration-there is no natural system to return to.



Spills can decrease survival

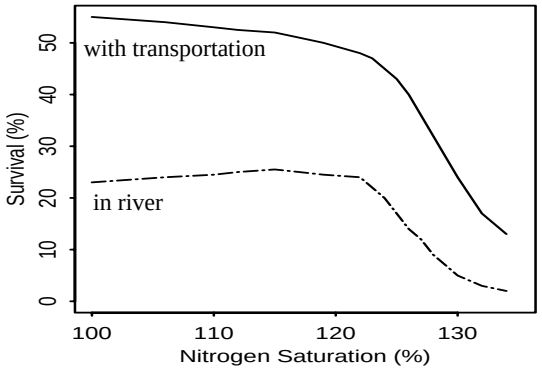
Spills of water over the Columbia and Snake River hydroelectric projects have come under close scrutiny this year after spills produced such high dissolved gas levels in the river that chinook salmon in net pens below Ice Harbor Dam died.

Spill forces water over the dam spillway instead of through turbines. The falling water forces dissolved gases into the water, which can cause fatal gas bubble trauma in fish. Although spill proponents believe fish can detect this nitrogen-loaded water and swim away from it, more recent information indicates fish do not sound to avoid dissolved gas.



Those who advocate the spill program say the fish survival under a spill regime is higher than if the fish travel through turbines. This is true only if no gas supersaturation occurs. Gas bubble trauma can negate benefits of spill passage. Spill can actually decrease survival because of the resulting gas bubble trauma. The Columbia River Salmon Passage computer model (CRiSP) indicates that the 1995 spill program likely decreased fish survival. The model indicates that without the spill about 8% of the fish would have died on their journey from Ice Harbor Dam to McNary Dam. But the spill program increased the mortality through the river reach by 12 to 25% depending on the fish depth.

Spilling at dams that collect fish for transportation also decreases total system survival by forcing more fish to pass through the river instead of being barged.



Transportation increases survival

In nearly all barging studies the survival of returning adults barged as juveniles was 50 to 300% greater than the survival of adults that were not barged as juveniles.

Using the best available information, analysis indicates that only a fish transportation option has a chance of recovering endangered chinook salmon. We have developed a consistent and rigorous picture of the juvenile salmon transportation action and have determined it to be the best chance to improve smolt survival. This finding is in accord with NMFS researchers.

The recent data on fish survival support our conclusions that mitigation efforts in the Columbia River, including transportation, bypass systems, and improved dam operations, have worked. Based on this information, recovery plan actions should focus in three areas:

- Increasing and improving fish barging
- Flow augmentation to improve fish survival to dams where collection and transportation occur
- Improving collection for barging, using collectors that capture fish near the surface before they reach the turbine entrance.

Dr. James J. Anderson is an Associate Professor in the School of Fisheries and Center for Quantitative Science at the University of Washington. His work on salmon issues has been funded by Bonneville Power Administration and the Army Corps of Engineers. Further information is available through the World Wide Web at http://www.cqs.washington.edu.