Century-old salmon scales show historical decline in population abundance and diversity

Price, M.H.H., Moore, J.W., Connors, B.M., Wilson, K.L., and Reynolds, J.D. 2021. Portfolio simplification arising from a century of change in salmon population diversity and artificial production. Journal of Applied Ecology 58: 1477-1486

Population and life-history diversity can buffer species from environmental variability and contribute to long-term stability through differing responses to varying conditions akin to the stabilizing effect of asset diversity on financial portfolios.

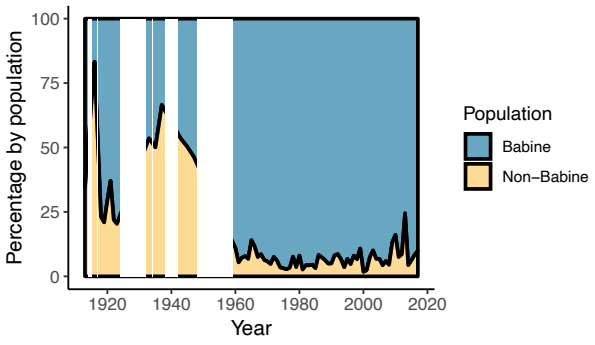
Skeena sockeye scale collection

We applied modern genetic tools to century-old salmon scales to reconstruct historical abundance and diversity for the 1913-1947 period. Fisheries scientists began collecting scales from sockeye caught in commercial fisheries on the Skeena River in 1912.

Commercial fleet towed to fishing grounds

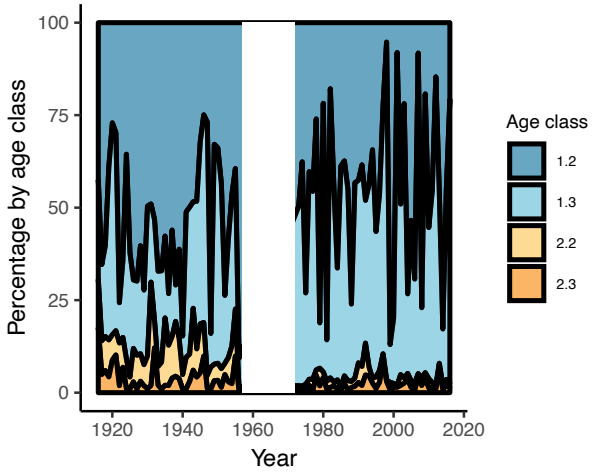
Our goal was to quantify changes in population and life-history diversity, explore the role of artificial enhancement on population dynamics, and assess the risk to fisheries and ecosystems as a result of the observed changes in diversity and enhancement over the last century.

Our results show that the total number of wild adult sockeye returning to the Skeena River in recent years is ~70% lower than during 1913-1947. Wild population composition has shifted greatly over the last century; the Babine population now accounts for 90% of all sockeye returning to the Skeena.



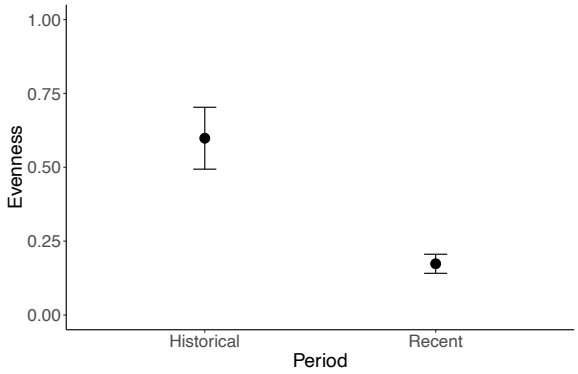
Change in population proportions

While the average age of populations has not changed, life-history diversity has shifted: populations are migrating from freshwater at an earlier age, and spending more time in the ocean. While the reduced duration of freshwater residency may be influenced by increasing lake temperatures associated with climate change, artificial production of fish in Babine Lake has been a strong driver.



Change in life history proportions

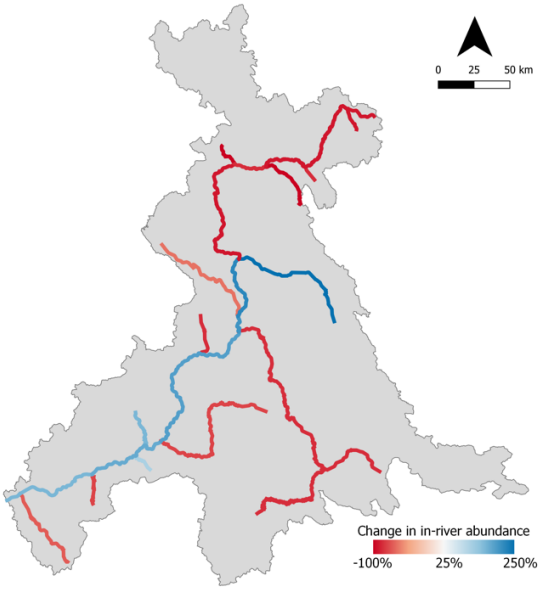
Individual contributions of wild populations to overall abundances have greatly diminished, such that population diversity (measured as Evenness among populations) has declined by 70% over the last century.



Change in population diversity (measured as Evenness) between time periods

Such decline in population diversity has resulted in a highly simplified population portfolio. Whereas one century ago, the Skeena watershed hosted a diverse portfolio consisting of many populations that fluctuated in abundance from year-to-year, the Skeena now is dominated by a single population – Babine, that is primarily supported by artificial production.

Wild sockeye abundance has declined in all tributaries and headwater regions since the historical era, which has compromised food security for Indigenous Peoples that rely upon these areas for subsistence fisheries. These tributaries also are important corridors that provision salmon resources to local ecosystems.



Change in wild salmon abundance to rivers throughout the Skeena watershed

Why is this information important?
Such loss in wild sockeye abundance throughout the Skeena constrain foraging opportunities for humans and wildlife dependent on salmon, lessens the overall delivery of salmon nutrients to ecosystems, and leaves commercial fisheries dependent on a single population that is largely composed of enhanced fish, which in turn are dependent upon annual human and financial resources to exist.

Conserving a diversity of abundant populations and their varied habitats would help ensure that watershed complexes like the Skeena are robust to global change.