Century-old salmon scales show historical decline in wild salmon populations

Price, M.H.H., Connors, B.M., Candy, J.R., McIntosh, B., Beacham, T.D., Moore, J.W., and Reynolds, J.D. 2019. Genetics of century-old fish scales reveal population patterns of decline. Conservation Letters 12: e12669

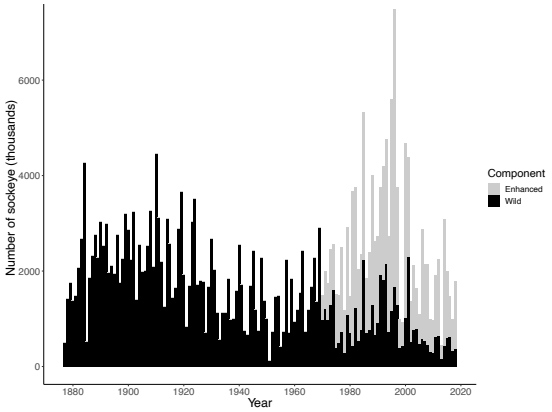
Scientists rarely have the information required to understand changes in abundance over more than a few decades, even for important species like Pacific salmon.

Skeena sockeye commercial fishery (1915)

We applied modern genetic tools to a unique collection of 100 year-old salmon scales to characterize changes in abundance of sockeye populations over a century spanning the onset of industrial fishing to the present. Fisheries scientists began collecting scales from sockeye caught in commercial fisheries on the Skeena River in 1912, and the annual collection program continued until 1948.

Skeena sockeye scale collection

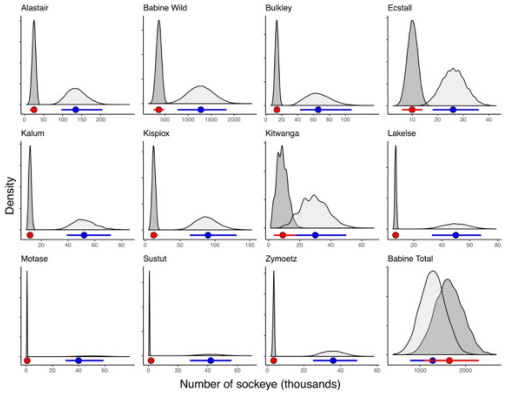
Our results demonstrate that the total number of wild adult sockeye returning to the Skeena River in recent years is 75% lower than during historical times; production of sockeye from Babine Lake spawning channels has largely offset the long-term decline in wild fish.



Sockeye abundance 1877-2018

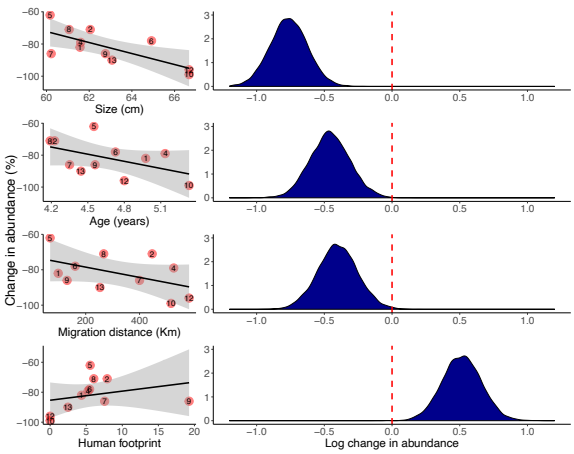
Across wild sockeye populations, our analyses reveal century-long declines of 56% to 99%. These declines are far greater than those based on modern era abundance data, which suggested that only 7 of 13 populations declined over the last five decades.

Some headwater populations that averaged ~40,000 sockeye annually during 1913-1923, now average less than 1,000 fish spawning each year.



Comparisons of historical (1913-1923; blue) & recent (2007-2014; red) abundance

We also tested four leading hypotheses to explain changes in population abundance observed. Specifically, we hypothesized that larger declines in abundance have occurred for populations that: (1) had larger body sizes because gill-nets catch larger-sized fish, (2) are from more degraded habitat because of lost carrying capacity, (3) had older ages because late-maturing populations tend to have lower productivity, and (4) had longer migrations because long-distance migrants face more in-river fisheries and changing hydrologic patterns.



Change in abundance in relation to each hypothesis (left) & model results (right).

We found that fisheries selectivity of larger-bodied populations was the most probable driver of differences in rates of decline among populations over the last century, though age-at-maturity and migration distance also were associated with declines.

Why is this information important?
Historical perspectives for exploited species like sockeye salmon are critical to understand the extent of decline in depressed populations; naturally, the better we understand the past, the more informed our decisions towards recovery will be.

In the absence of this historical information, many Skeena River sockeye populations appear to be relatively healthy. However, commercial fishing and human impacts had occurred for more than 80 years before current baseline data had been acquired; most populations had already undergone large declines in abundance.

Our historical perspective will help inform status evaluations and rebuilding plan discussions for depleted populations by expanding our understanding of their production potential.