



AYK SUSTAINABLE SALMON INITIATIVE

Project Synopsis

AYK REGION-WIDE



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(Christian E. Zimmerman)

PROJECT 425

PRINCIPAL INVESTIGATOR

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*United States Fish and
Wildlife Service*

RESEARCH PERIOD

May 2004 -
July 2005

BUDGET

\$47,109.00

GENETIC HEALTH CHECK

Maintaining genetic diversity is necessary for maintaining healthy, viable populations. To determine genetic health, we used effective population size rather than actual population size. The effective population size is the number of breeding adults in an “idealized population” that would lose genetic diversity at the rate observed in the actual population. Because real populations rarely exist under ideal conditions, the effective population is typically much smaller than the actual population—on average, by a factor of ten times. This underscores the danger in relying solely on census population size to evaluate short- and long-term population health. Conservation guidelines suggest that isolated populations with effective population size below 500 or 50 are at risk of significant loss of genetic diversity in either the long-term or, in the case of the latter figure, the short-term. Our study provides the first effective population size estimates for Chinook salmon in the AYK region.

OUR OBJECTIVES

Use genetic analysis to estimate the effective population sizes of Chinook salmon in Yukon and Kuskokwim river tributaries.

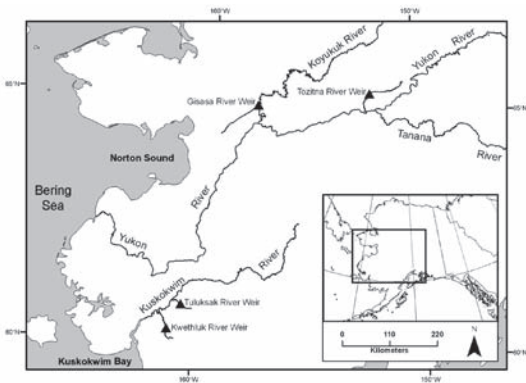
Derive two estimates for each of these populations: one that assumes the populations are isolated and one that assumes that there is migration.

**RESEARCH
FRAMEWORK:**
SYNTHESIS &
PREDICTION –
PRIORITY #10

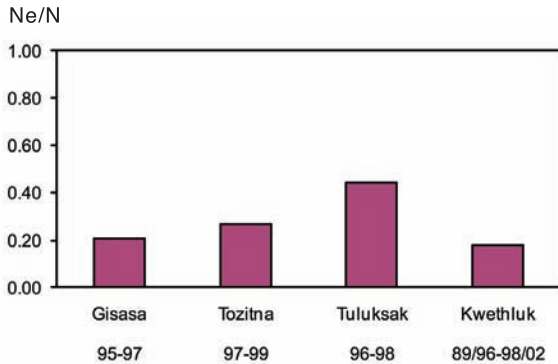
SNAPSHOT

This project focused on the genetic health of Chinook salmon populations in two Yukon and two Kuskokwim river tributaries.

After estimating effective population sizes—a more accurate indication of genetic health than actual population sizes—and comparing them to demographic factors, researchers learned that, over the short term (less than 10 years), sex ratios and reproductive success affect genetic health more than changing population size.



Map of western Alaska showing the Kwethluk, Tuluksak, Gisasa, and Tozitna rivers. (Olsen, USFWS)



The ratio of effective population size (N_e) to total census size (escapement, N) for the Gisasa, Tozitna, Tuluksak, and Kwethluk rivers. (Olsen, USFWS)

AYK SSI Mission: To collaboratively develop and implement a comprehensive research plan to understand the causes of the declines and recoveries of AYK salmon.

ARCTIC-YUKON-KUSKOKWIM SUSTAINABLE SALMON INITIATIVE

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Assess the relative influence of demographic factors (population sizes, sex ratios, and reproductive success) on genetic health.

HOW WE DID IT

We estimated effective population sizes for Chinook salmon in the Gisasa and Tozitna rivers in the Yukon River watershed, and in the Kuskokwim River tributaries: the Kwethluk and Tuluksak rivers. We used archived tissue samples for DNA sources. Tissue from adult salmon was collected in each of the four rivers between 2001 and 2003, and from juveniles on the Kwethluk River only during 1990 and 2003. We used sex-specific population data from escapement surveys conducted during two or more years between 1991 and 2003.

WHAT WE DISCOVERED

Our effective population size estimates, assuming isolation, range from 2,307 to 7,674. Estimates that assume migration range from 448 to 576. The average ratio of effective to actual population size was 0.28. Our findings suggest that the two Yukon River populations are less influenced by gene flow and more vulnerable to loss of genetic diversity and extinction than the lower Kuskokwim River populations. We also found that the effective population sizes of all of the stocks examined are influenced most by unequal sex ratios and variance in reproductive success, and least by fluctuating population size over the short time period studied.

PRODUCTS AND OUTREACH

This report was published in a collection of symposium proceedings.

WHAT'S NEXT?

We recommend that managers strive to maintain connectivity among populations and continue to monitor sex ratios. Our ratio of effective population size to actual population size can be used to estimate the genetic health of other Yukon and Kuskokwim river Chinook salmon populations. A larger study is needed to evaluate gene flow patterns among populations from different regions in each watershed.