



**NOAA
FISHERIES**

Salmon recovery and southern resident killer whale status



Mike Ford, Northwest Fisheries
Science Center
May, 2018



**NOAA
FISHERIES**

Threats

Lack of sufficient food



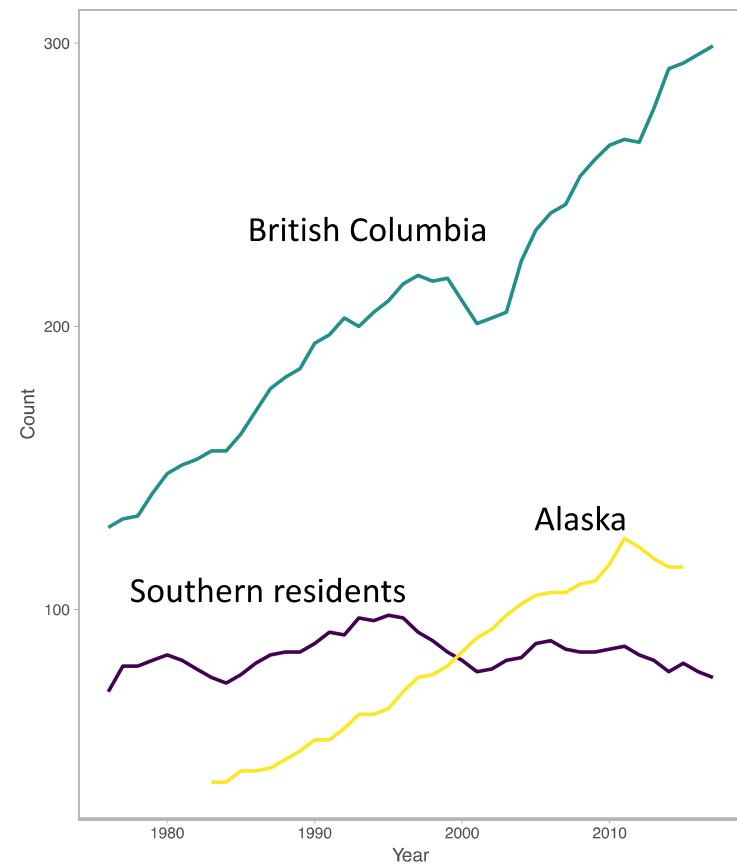
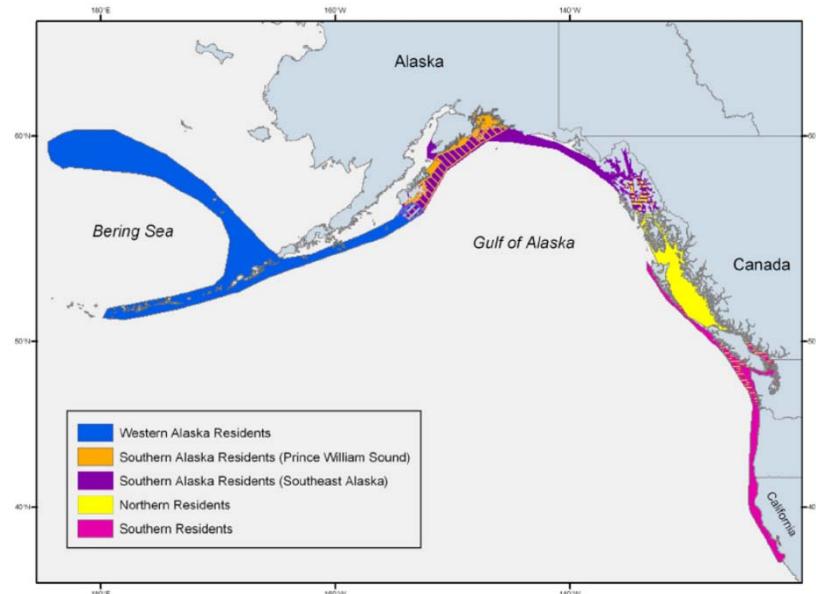
Too much disturbance



High contaminant levels



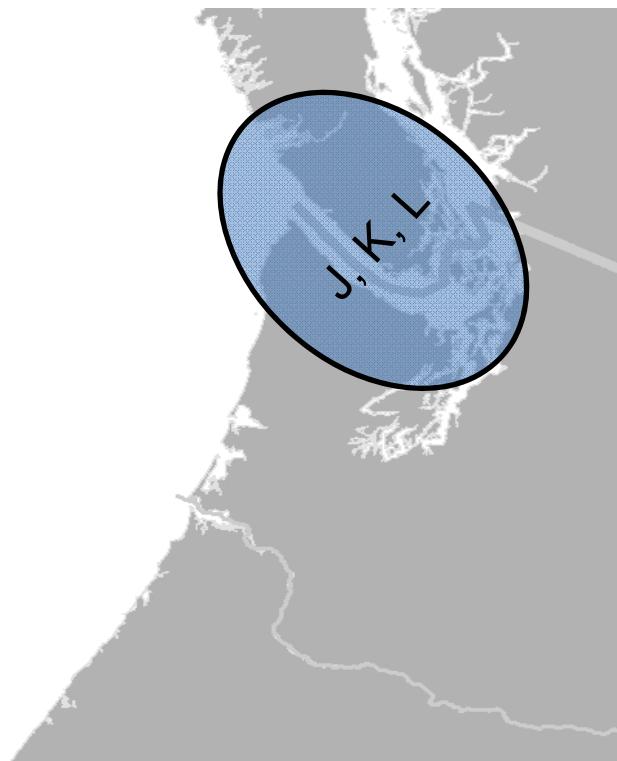
Distribution of salmon-eating populations



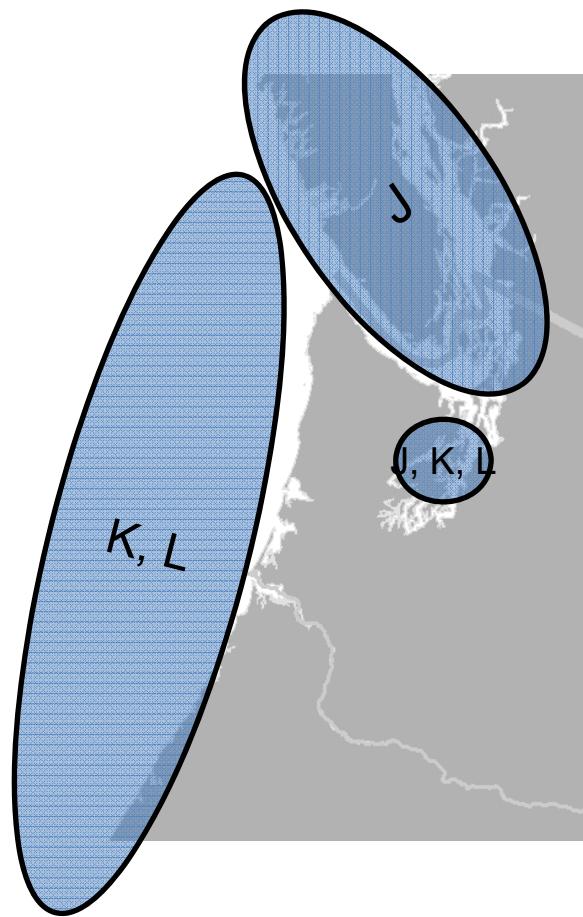
NMML

SRKW temporal and spatial distribution

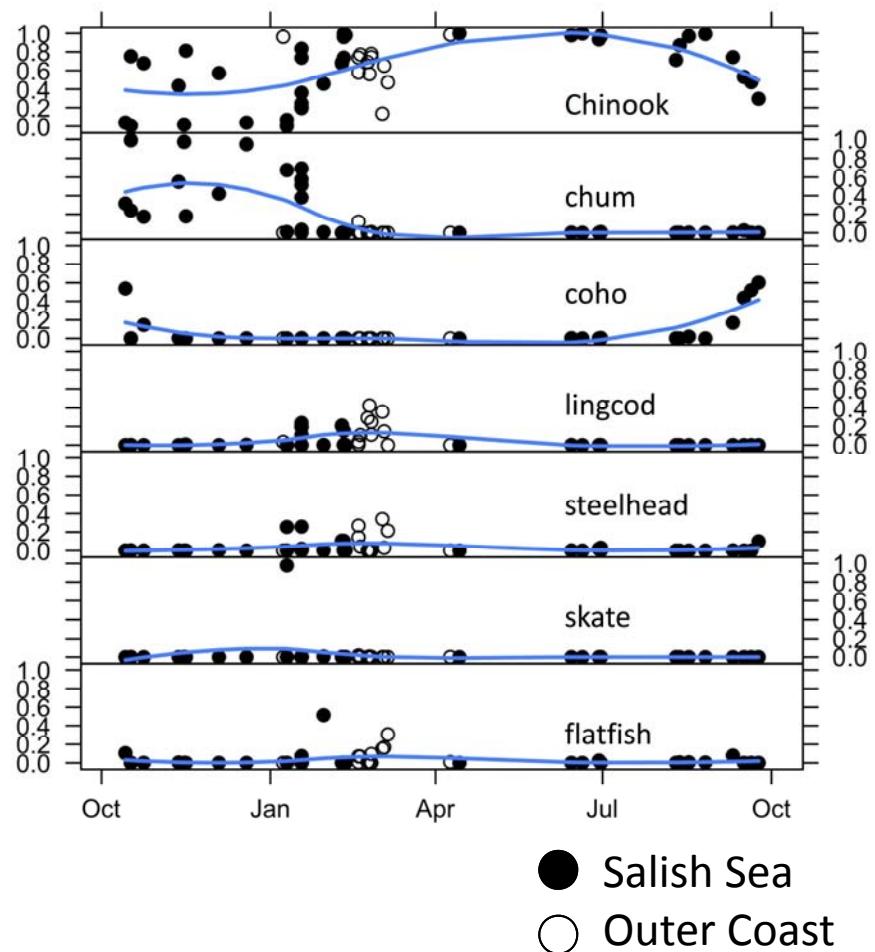
Summer



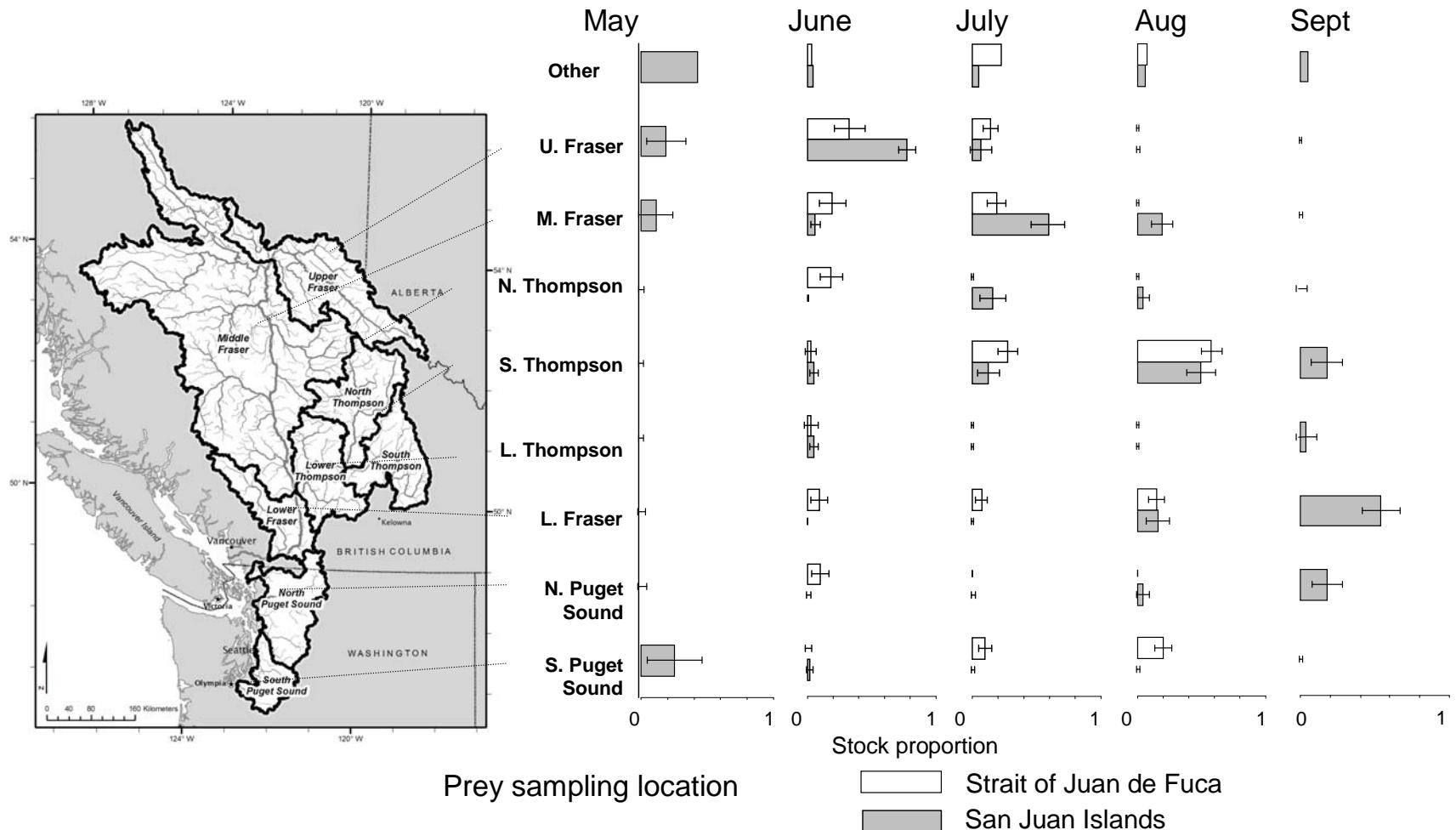
Fall, winter, spring



Resident killer whale diet



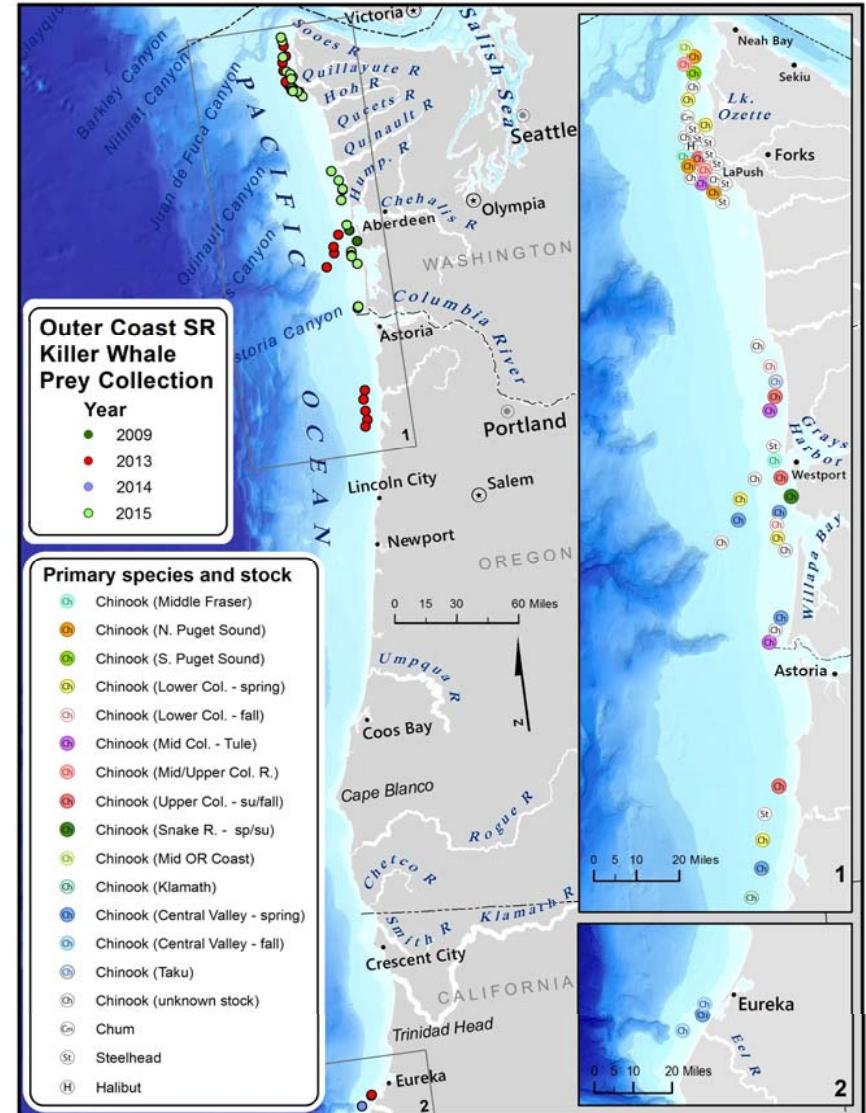
Fraser River Chinook is majority of diet in Salish Sea in summer time



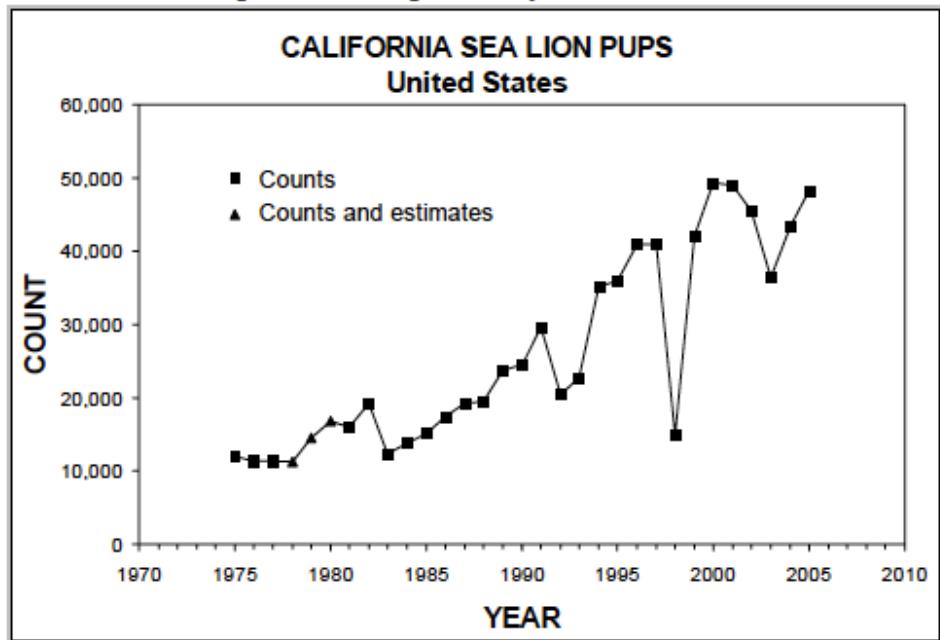
*Upper, Middle, and Lower Fraser, and
South Thompson are seasonally important*

Whale eat a variety of Chinook stocks in the winter

- ~65% Puget Sound while in Puget Sound
- ~50% Columbia River while on coast
- Wide variety of other stocks



Trends in other marine mammals



2007 SAR



Photo: ODFW

- Killer whales
 - AK residents increasing
 - Northern residents 120 in 1975, ~280 currently
- CA sea lions ~6X increase since 1975
- Harbor seals 8-10X increase since 1970s
- Steller sea lions increase ~4X since 1975

SCIENTIFIC REPORTS

OPEN

Competing tradeoffs between

increasing marine mammal
predation and fisheries harvest of

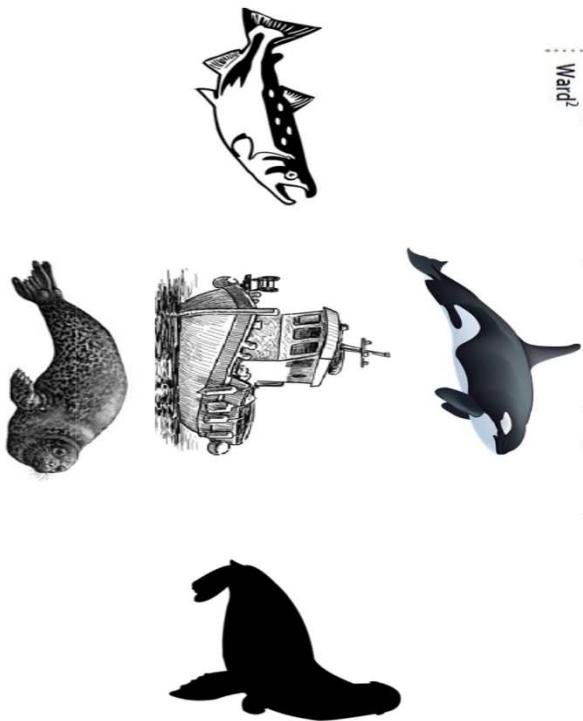
Chinook salmon

Received: 26 July 2017

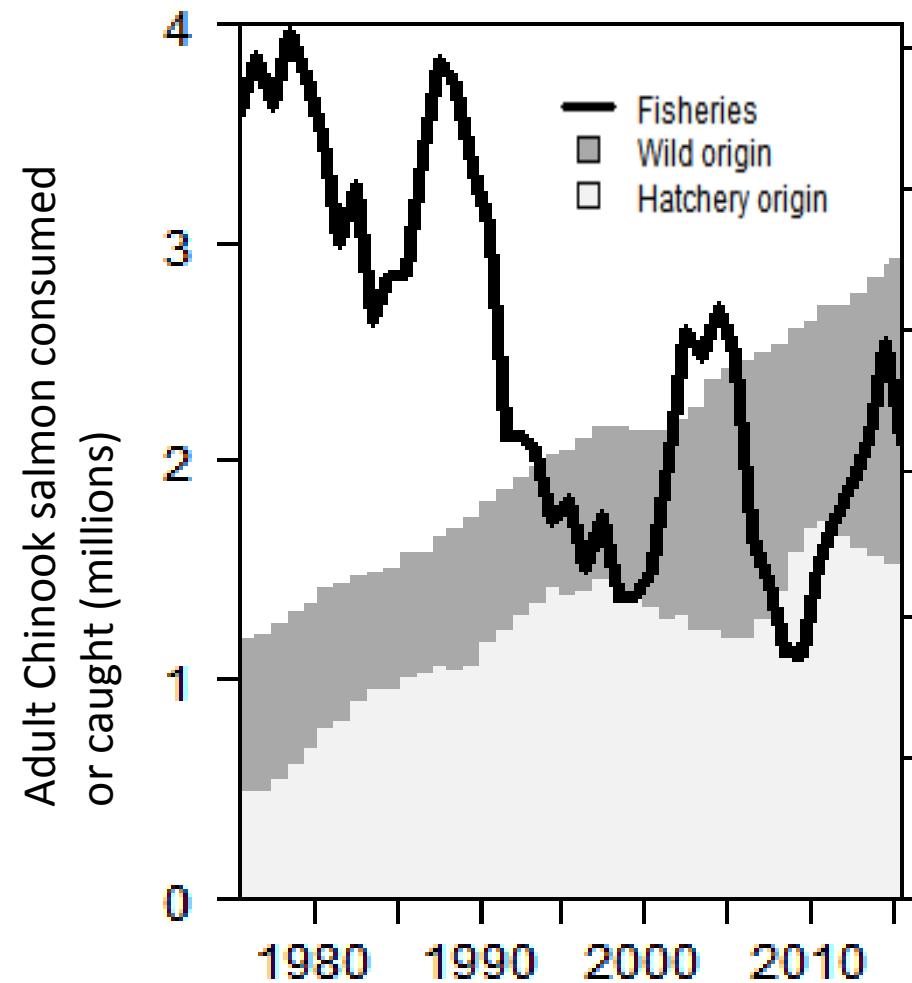
Accepted: 16 October 2017

Published online: 20 November 2017

Brandon E. Chasco^{1,9}, Isaac C. Kaplan², Austen C. Thomas³, Alejandro Acevedo-Gutiérrez⁴, Dawn P. Norén², Michael J. Ford², M. Bradley Hanson², Jonathan J. Scordino⁵, Steven J. Jeffries⁶, Kristin N. Marshall¹⁰, Andrew O. Shelton⁷, Craig Matkin¹⁰, Brian J. Burke⁸ & Eric J. Ward²

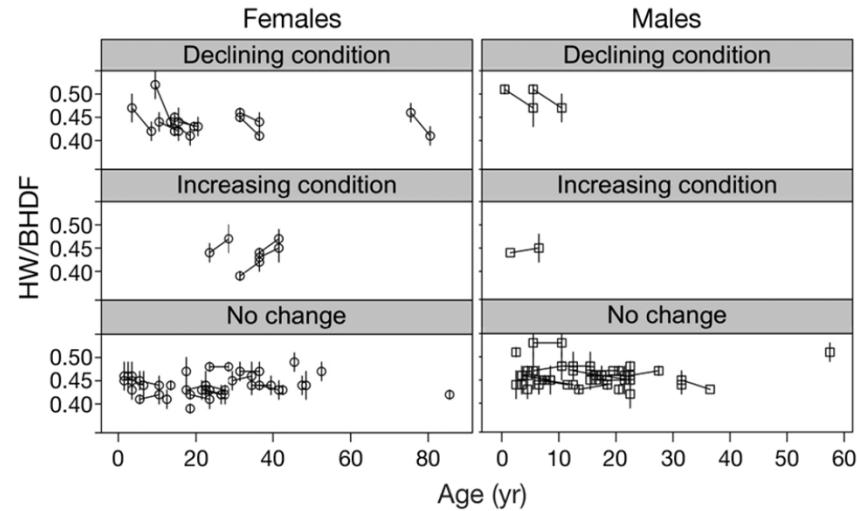


Mammal consumption of salmon



Evidence for nutritional stress?

- Changes in body shape – Fearnbach et al. 2018 and unpublished
- High fetal loss rate – Wasser et al. 2017

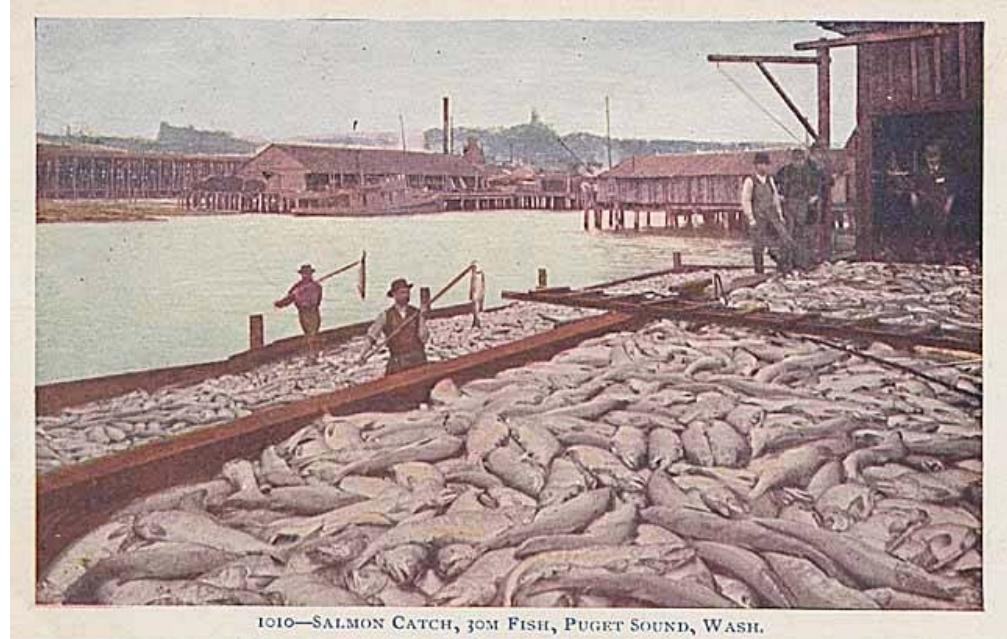


Summary - whales

- SRKW population is not growing
- Other RKW populations (with overlapping diet) are growing
- Diet is heavily dependent on salmon, esp. Chinook
- The whales eat lots of different Chinook stocks, from CA – BC, including large hatchery stocks
- Correlation between whale survival/birth and salmon (but weakening)
- Some evidence of nutritional stress
- Prey availability = abundance + access

Overview of salmon status

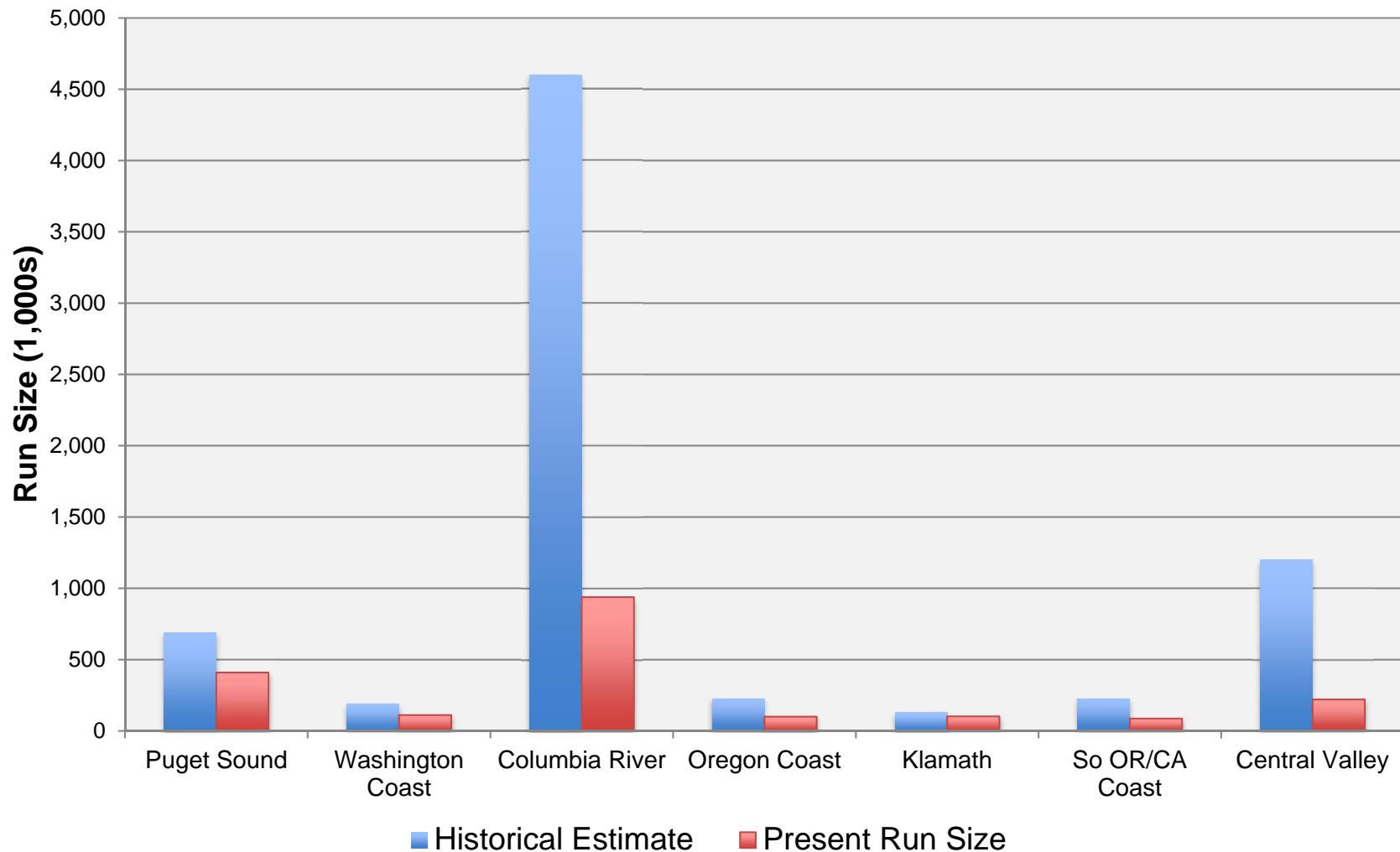
- Historical abundance
- Long and short-term trends
- Focus on Chinook salmon



1010—SALMON CATCH, 30M FISH, PUGET SOUND, WASH.

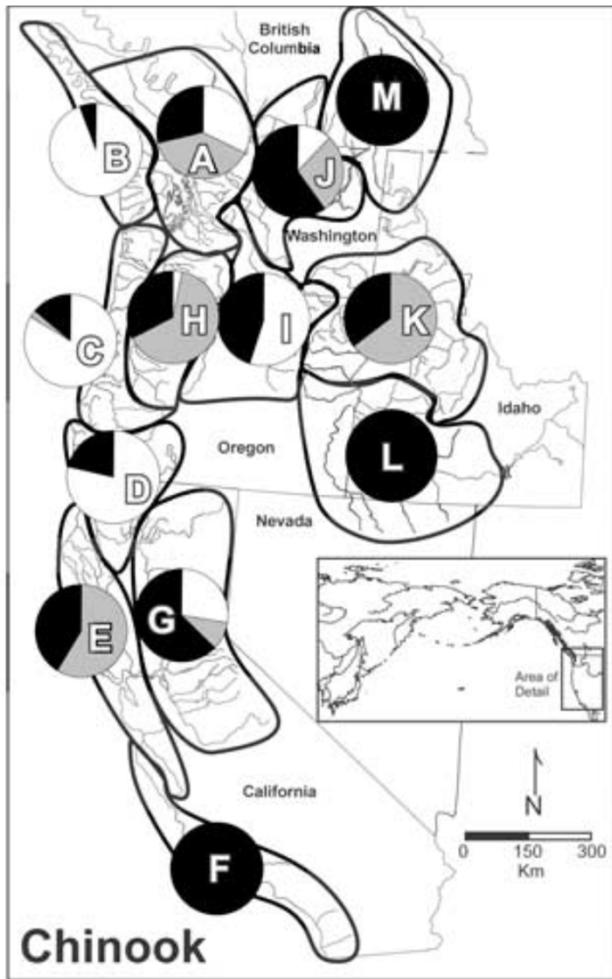
Property of Museum of History & Industry, Seattle

Historical Chinook salmon abundance

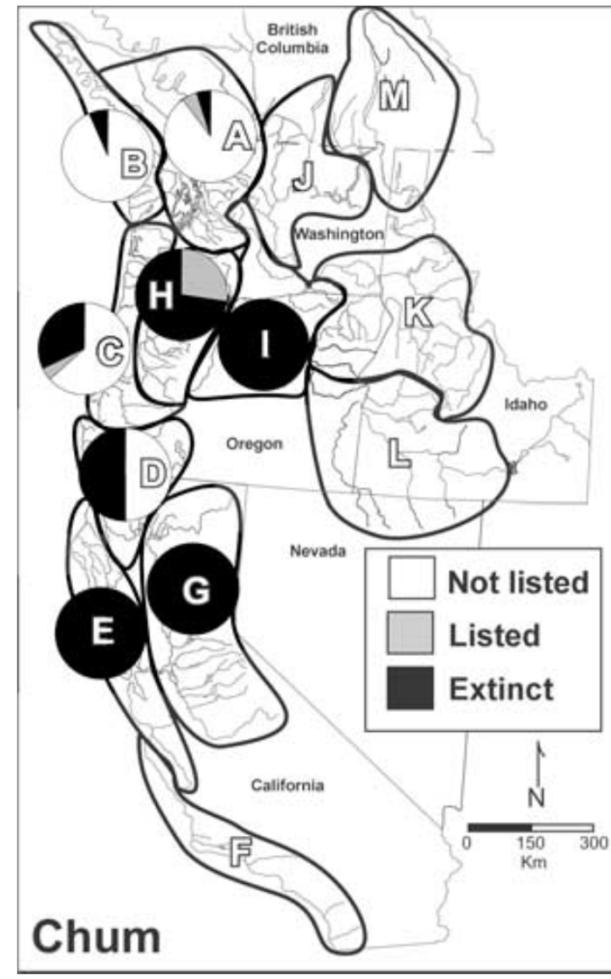


Source: Various, compiled by Jim Myers NWFSC

Many losses are due to extirpations



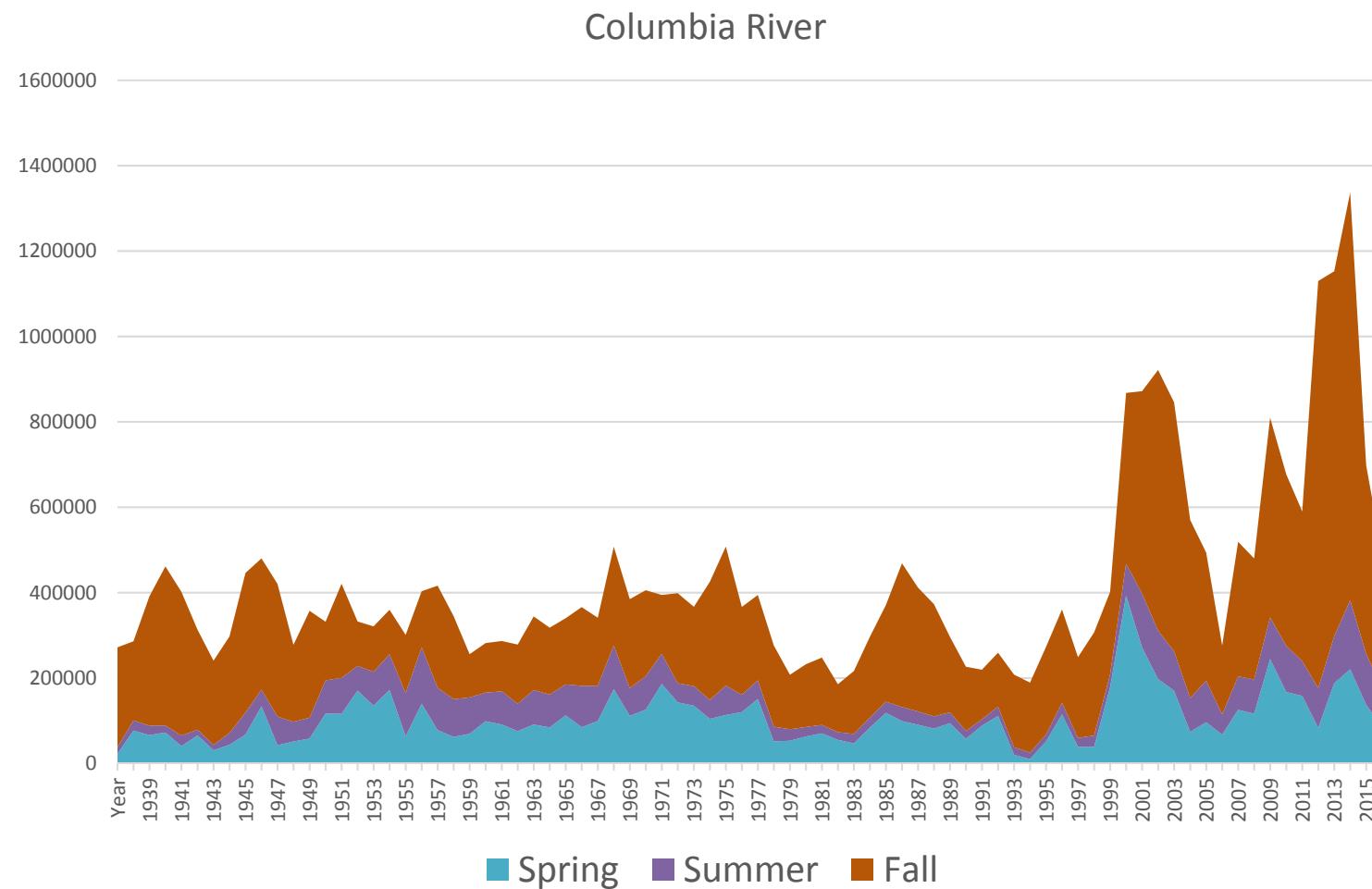
159/396 population extirpated



23/112 population extirpated

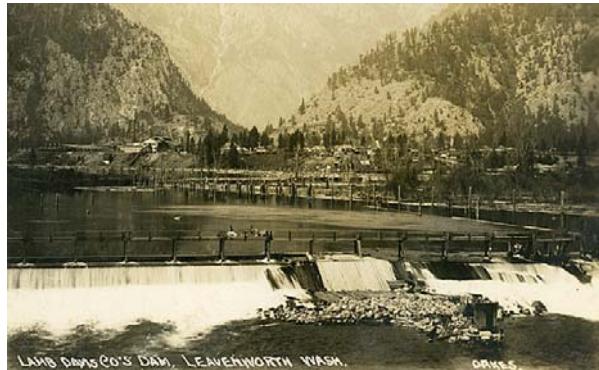
Source: Gustafson et al. 2007

Abundance trends over the past 40-70 years



Bonneville Dam Chinook salmon counts – 1938 - 2017

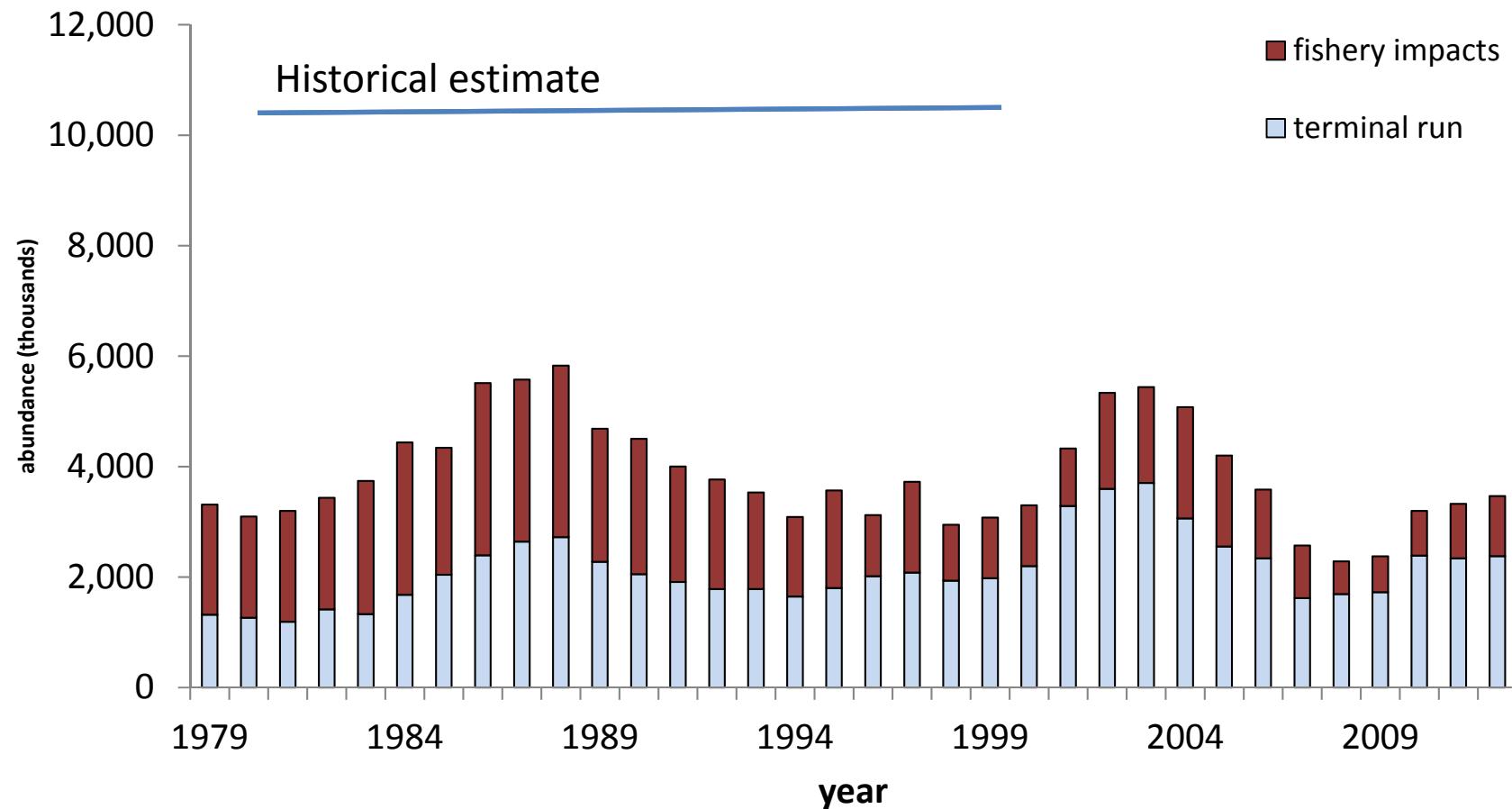
In some areas, things may be better now than they used to be



- “Unfortunately, most of the original salmon populations of these streams have been so seriously depleted by unscreened diversions, dams with improper ladders, and other bad conditions that it is very difficult to secure any first hand information regarding their time of appearance in these tributary streams”
- “Unfortunately the salmon runs of the Entiat River have been practically exterminated for many years because of dams built on the stream...” – Craig and Suomela 1941

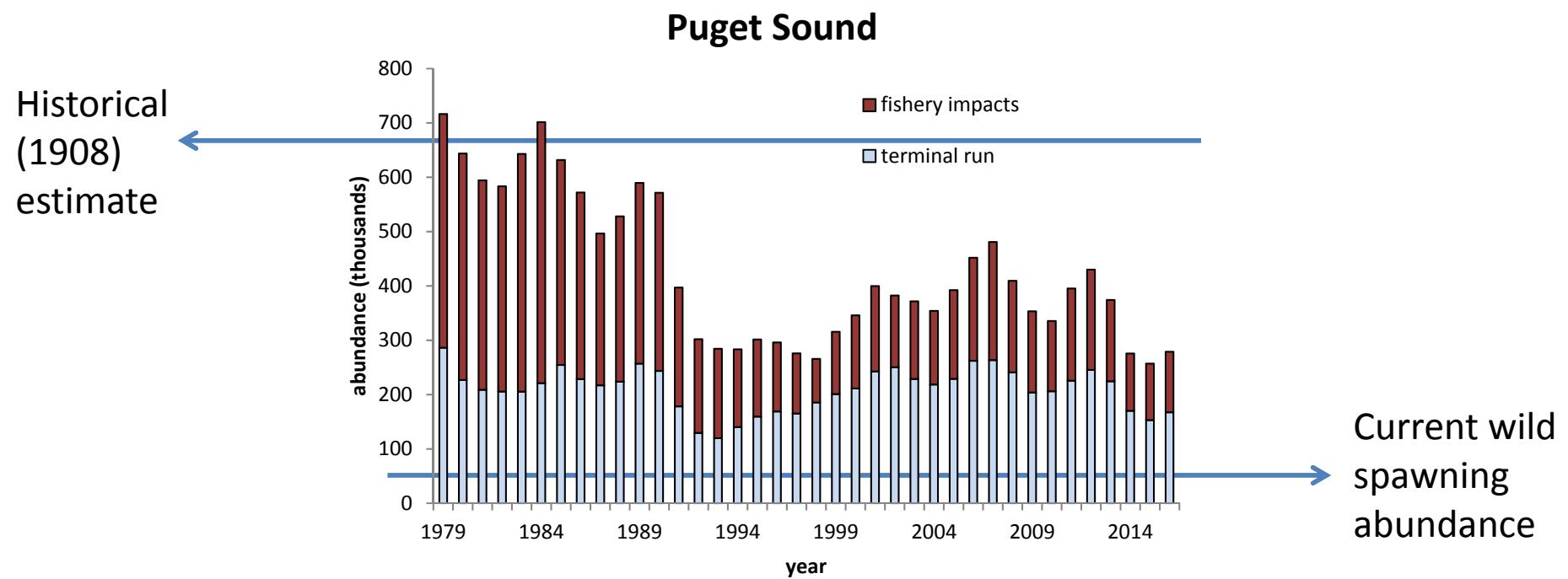
Images from WA
Historical Society

Coast wide trend, BC to California



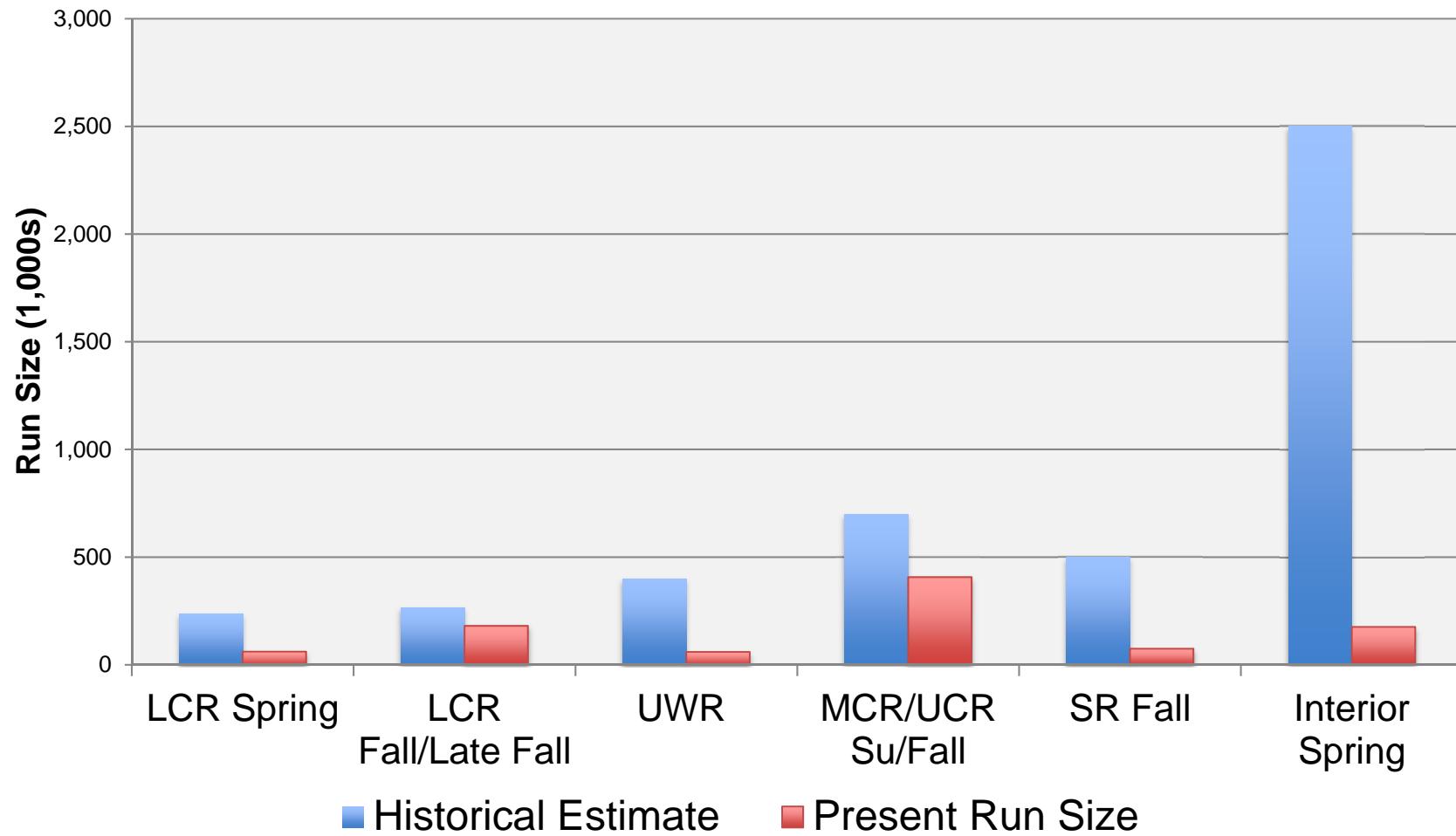
Source: Robert Kope / CTC

Hatchery production

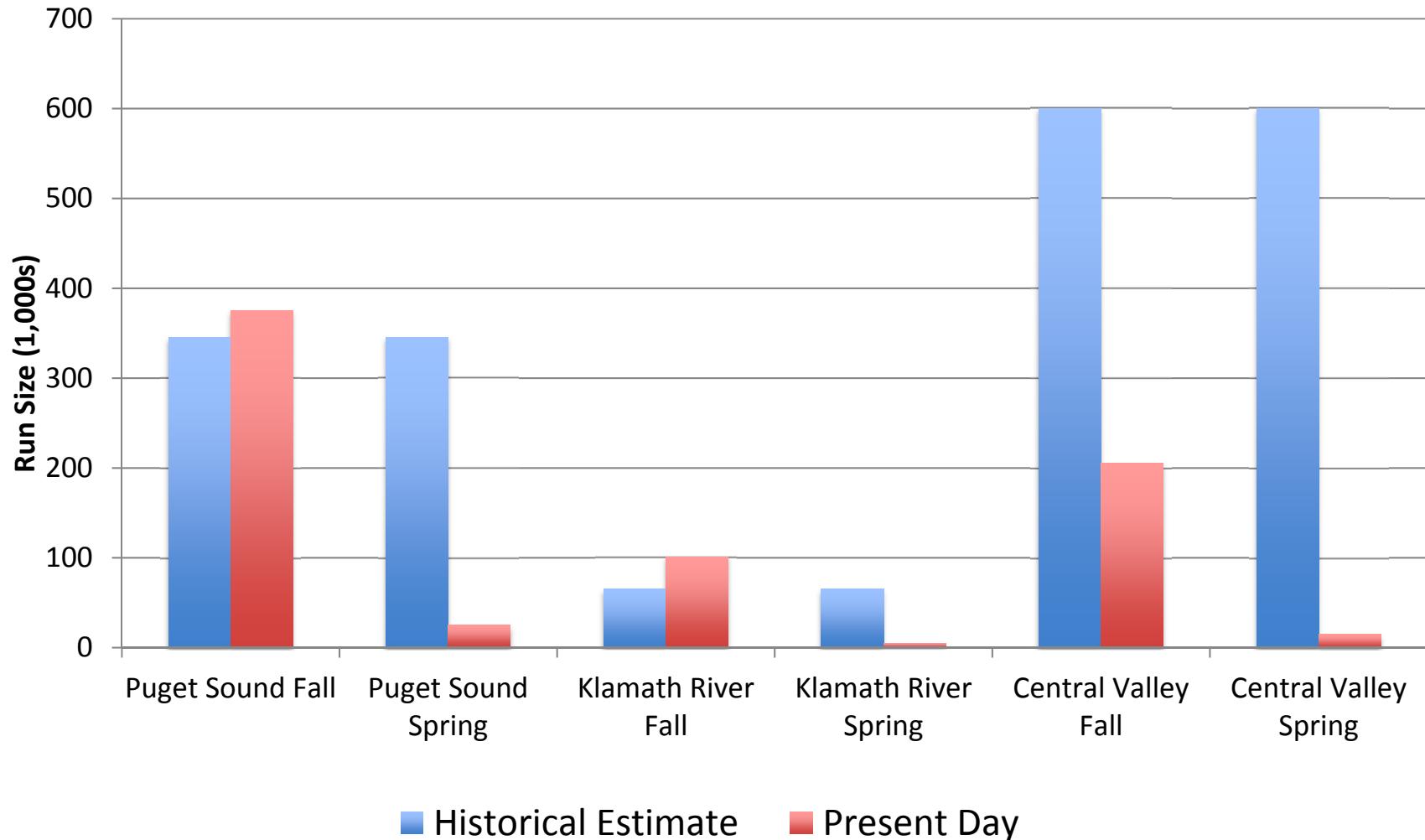


Source: Robert Kope, PFMC, PSC

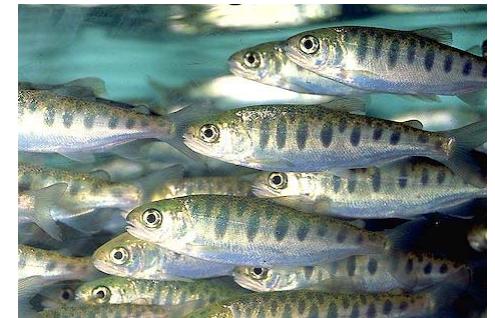
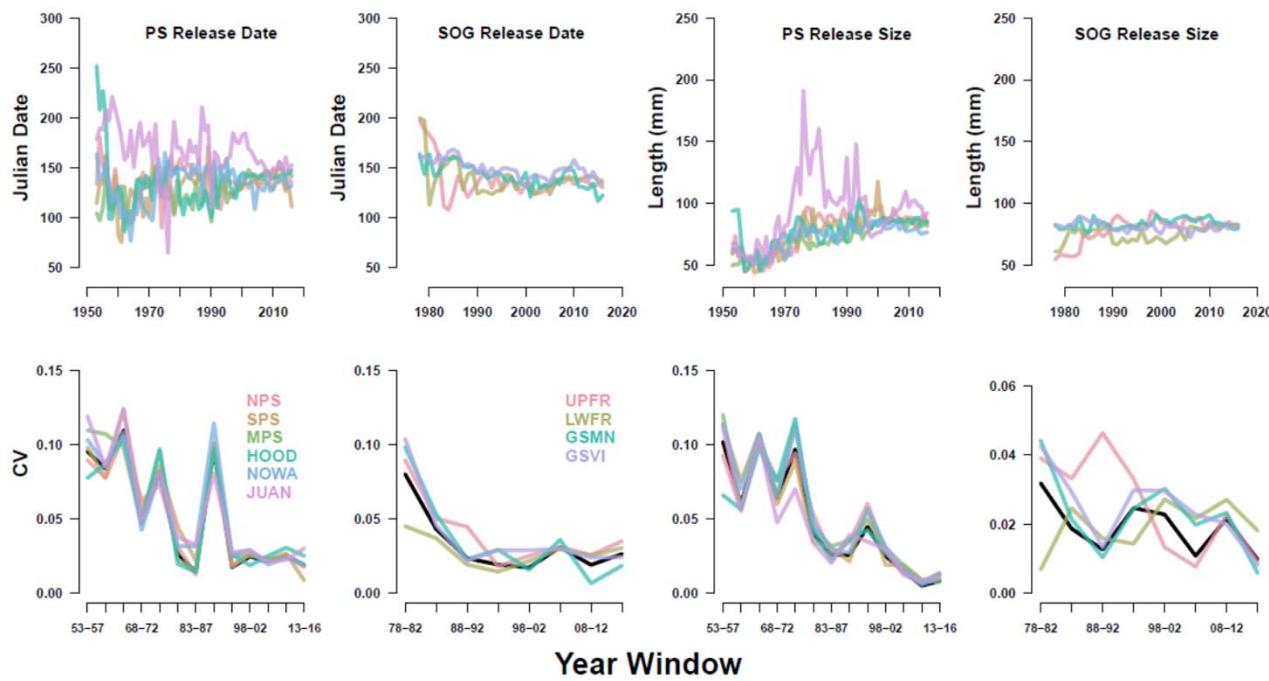
Run timing changes – Columbia River



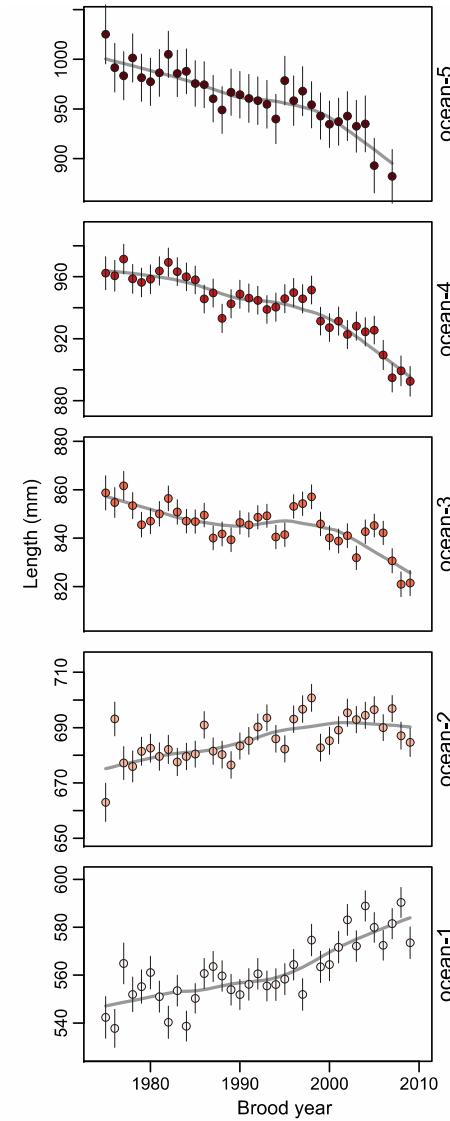
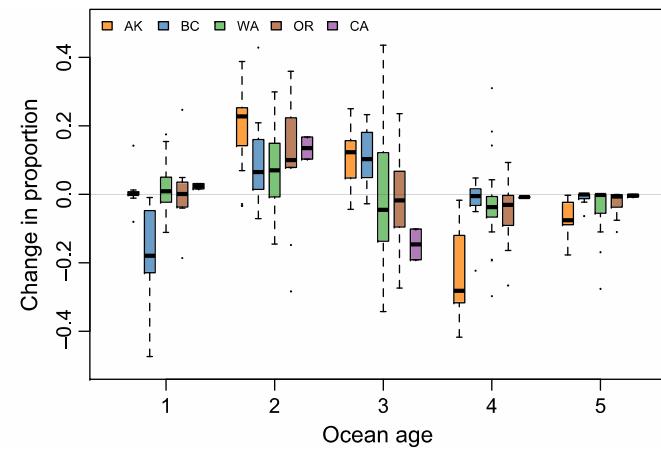
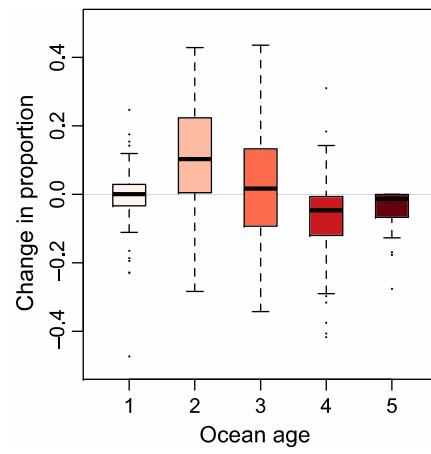
Run Timing Changes – other major rivers



Changes in hatchery diversity



Changes in salmon size and age

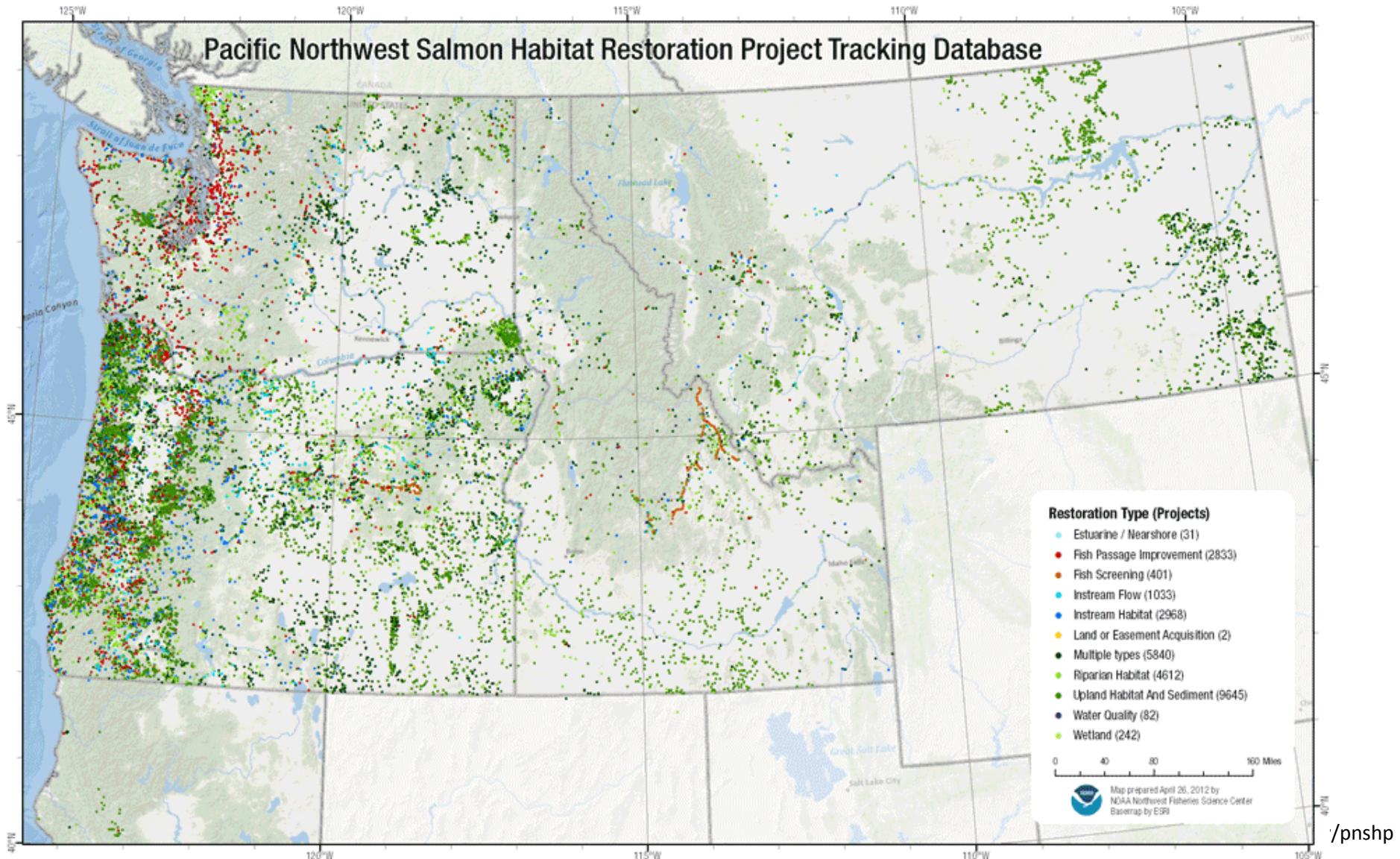


Ohlberger et al. 2017 Fish and Fisheries

Salmon recovery efforts

- Habitat
- Harvest changes
- Hatchery changes
- Dam removal and passage improvement
- Reintroductions

Extensive effort on habitat restoration

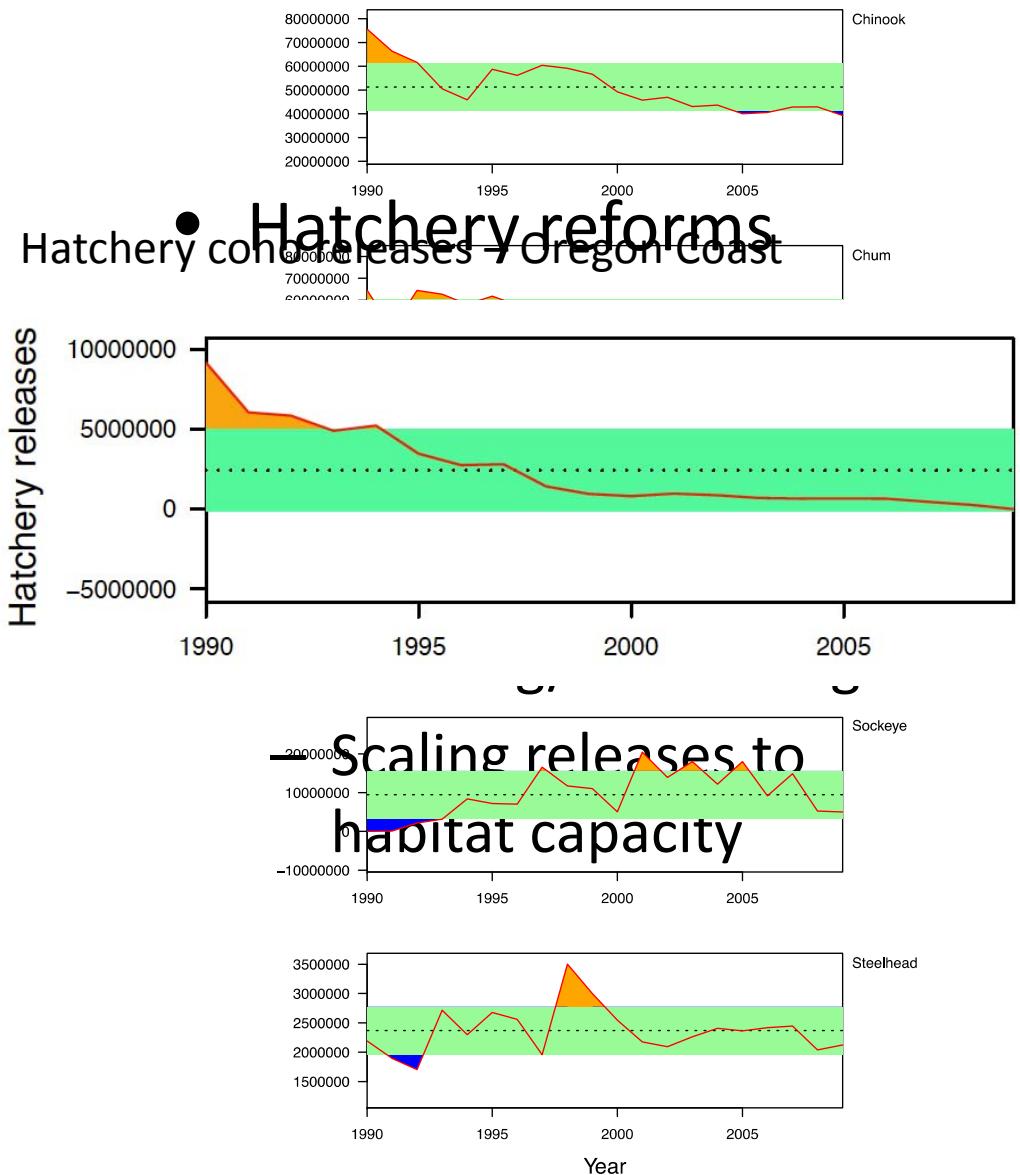


- 31,000 projects completed at over 51,000 locations throughout the Pacific Northwest. Over \$1 billion spent on restoration to date.

Hatcheries

- Types of changes
 - Reduced releases
 - Control of straying
 - Hatchery Genetic Monitoring Plans
 - Local broodstock
 - Marking

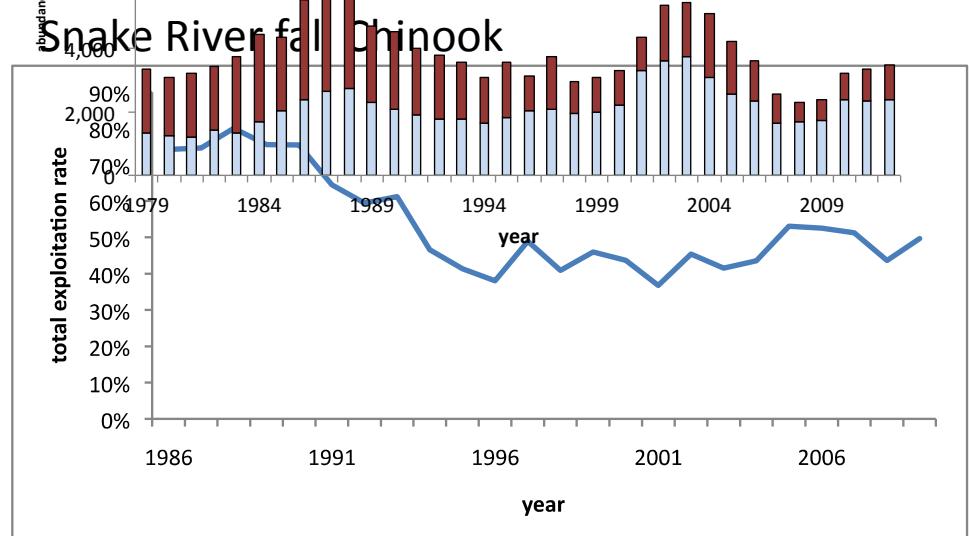
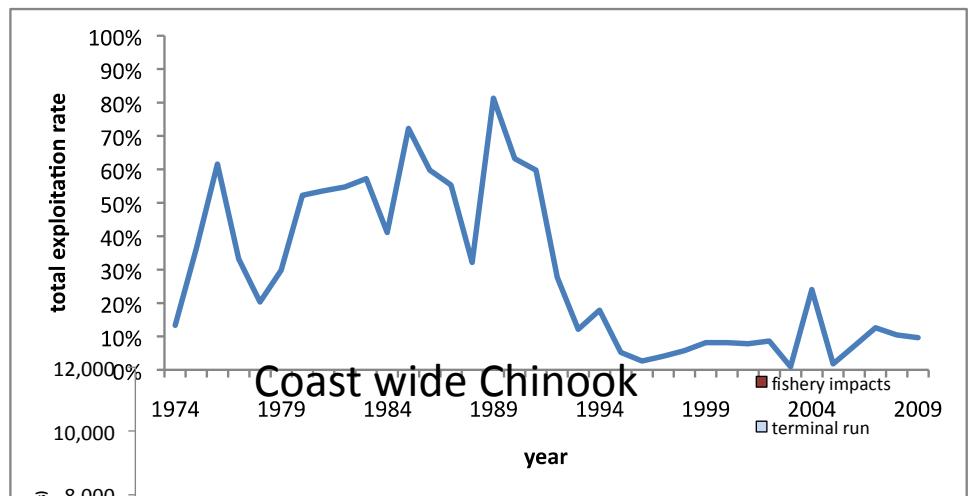
Puget Sound Chinook Salmon ESU



Harvest

- Types of changes
 - Reduced exploitation rates
 - Risk assessments
 - Focus on hatchery fish

Hood Canal Summer chum

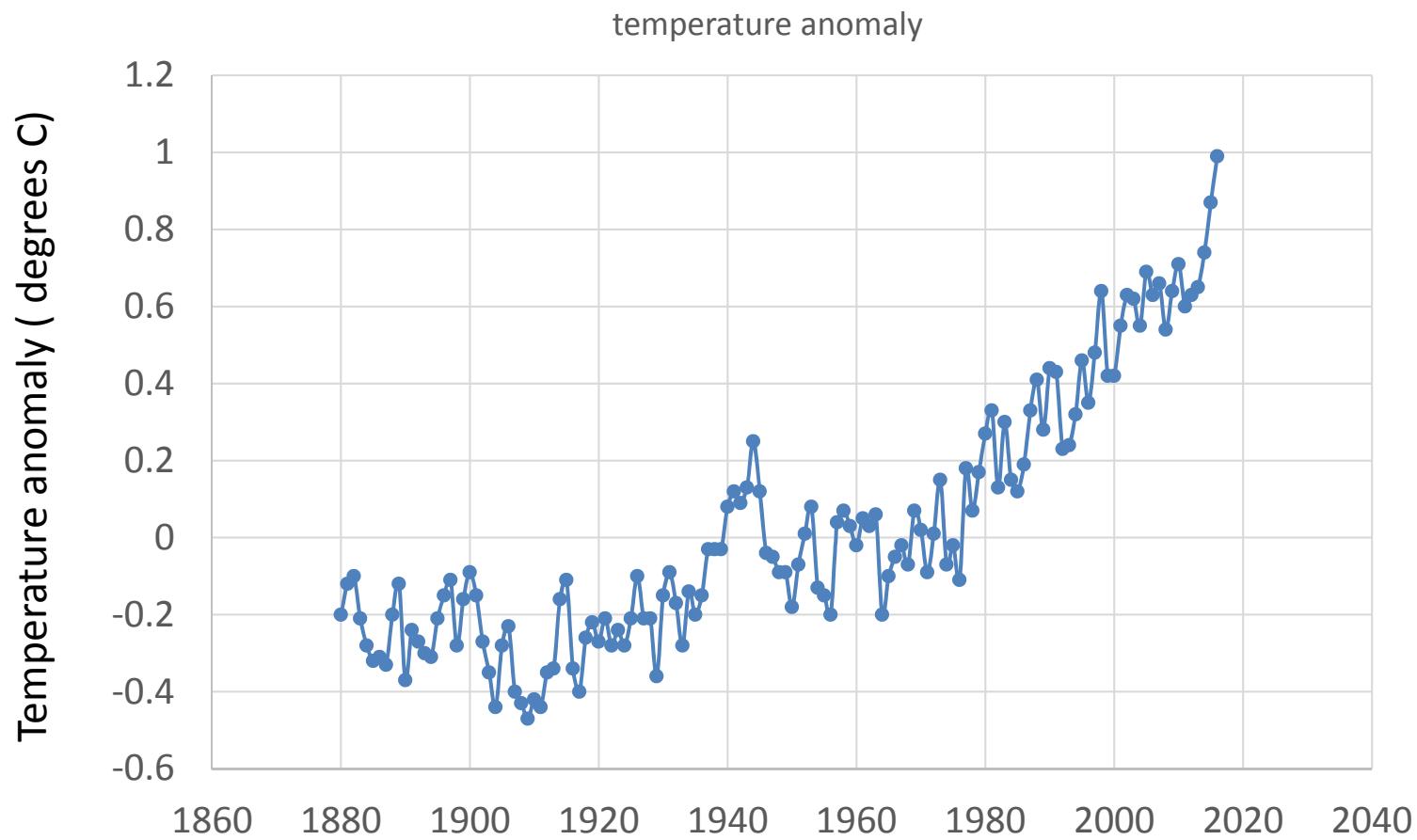


Hydro/large dams

- Types of changes
 - Improved fish passage
 - Predator control
 - Spill
 - Barging
 - Dam removal
 - Elwha
 - Condit
 - Rogue
 - Sandy
 - Hood River

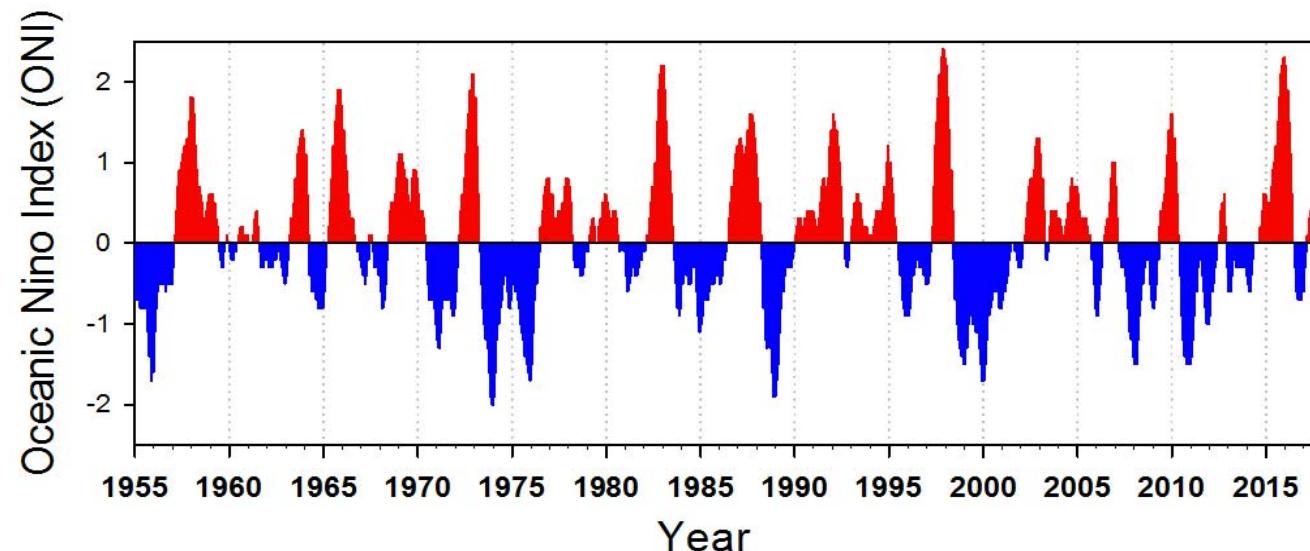
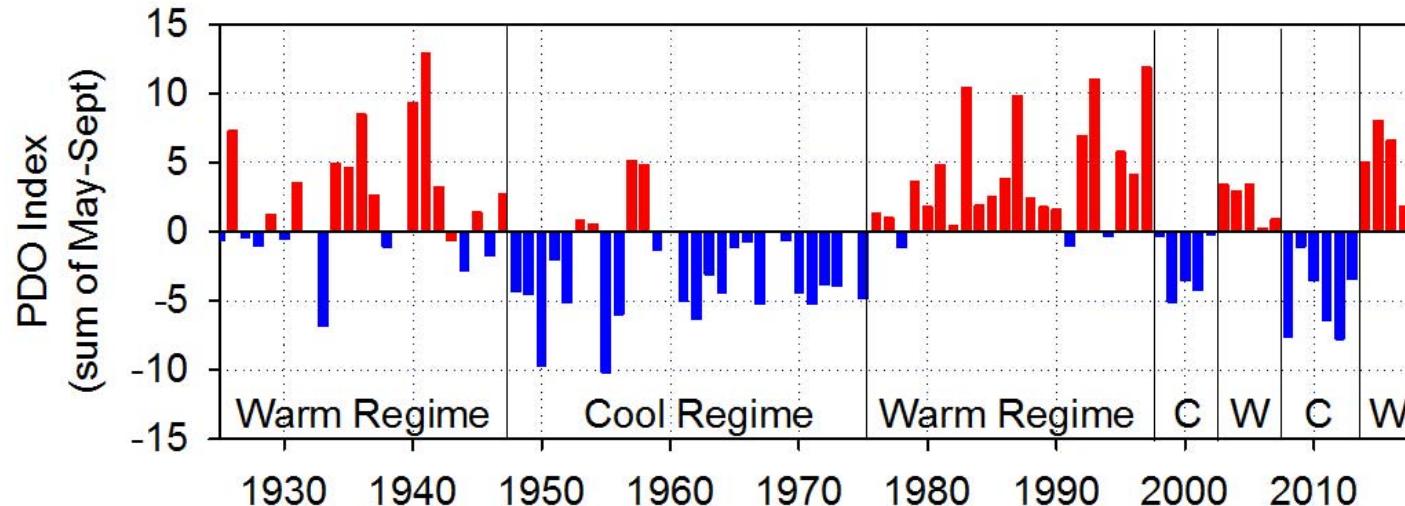


Climate change



Data source: NASA

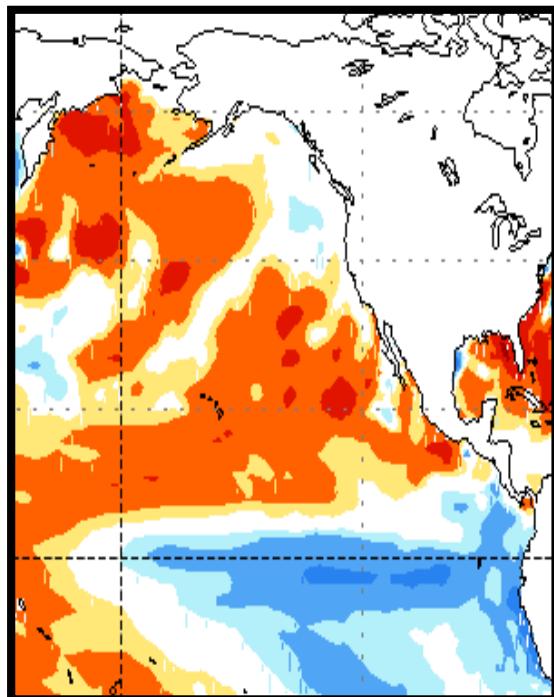
External drivers



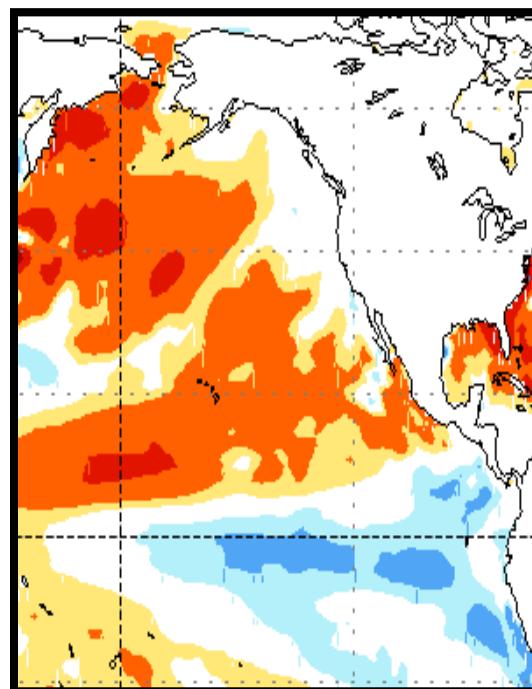
Forecast SST anomalies

NOAA Climate prediction Center coupled forecast model 2

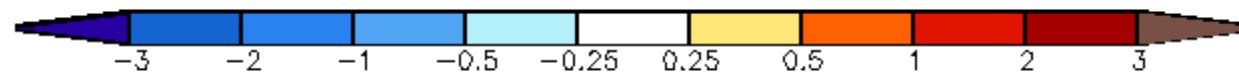
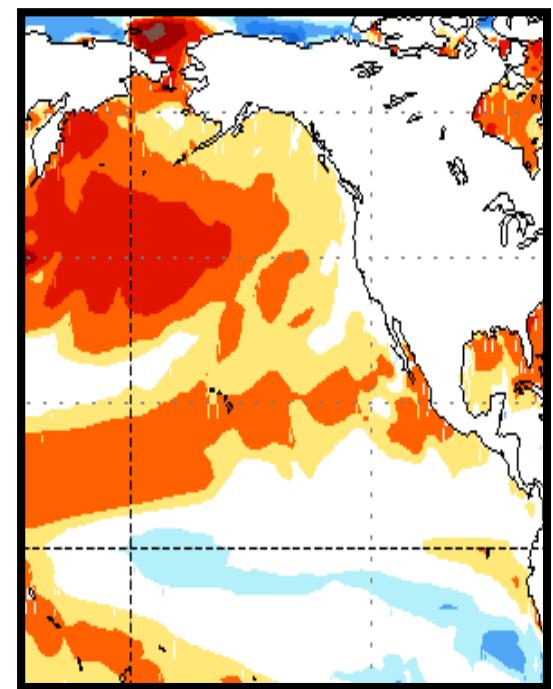
Feb-Mar-Jun 2018



Apr-May-Jun 2018



Jun-Jul-Aug 2018



<http://www.cpc.ncep.noaa.gov/products/CFSv2/CFSv2seasonal.shtml>

Summary and conclusions

- Salmon have not been continuously declining – some very large returns have occurred in the last decade
- Big declines occurred early in the 20th Century – full recovery of wild salmon to historical levels is very challenging
 - Not just an ESA issue
 - Will require reintroduction of extirpated stocks
- Hatchery abundance is a major factor when thinking about whale food and salmon in the ecosystem
 - Hatchery Chinook are majority of return in Sacramento, Columbia, and Puget Sound
 - Some salmon recovery actions reduce hatchery abundance
- Restoring diversity is important – it's not all about total numbers
 - Greater loss of spring run Chinook populations
 - Whales utilize a wide variety of stocks – no silver bullet
- Marine mammals consume a lot of salmon