Trends in Adult Returns of Idaho Salmon and Steelhead Relative to Pink Salmon Abundance the Year of Ocean Entry

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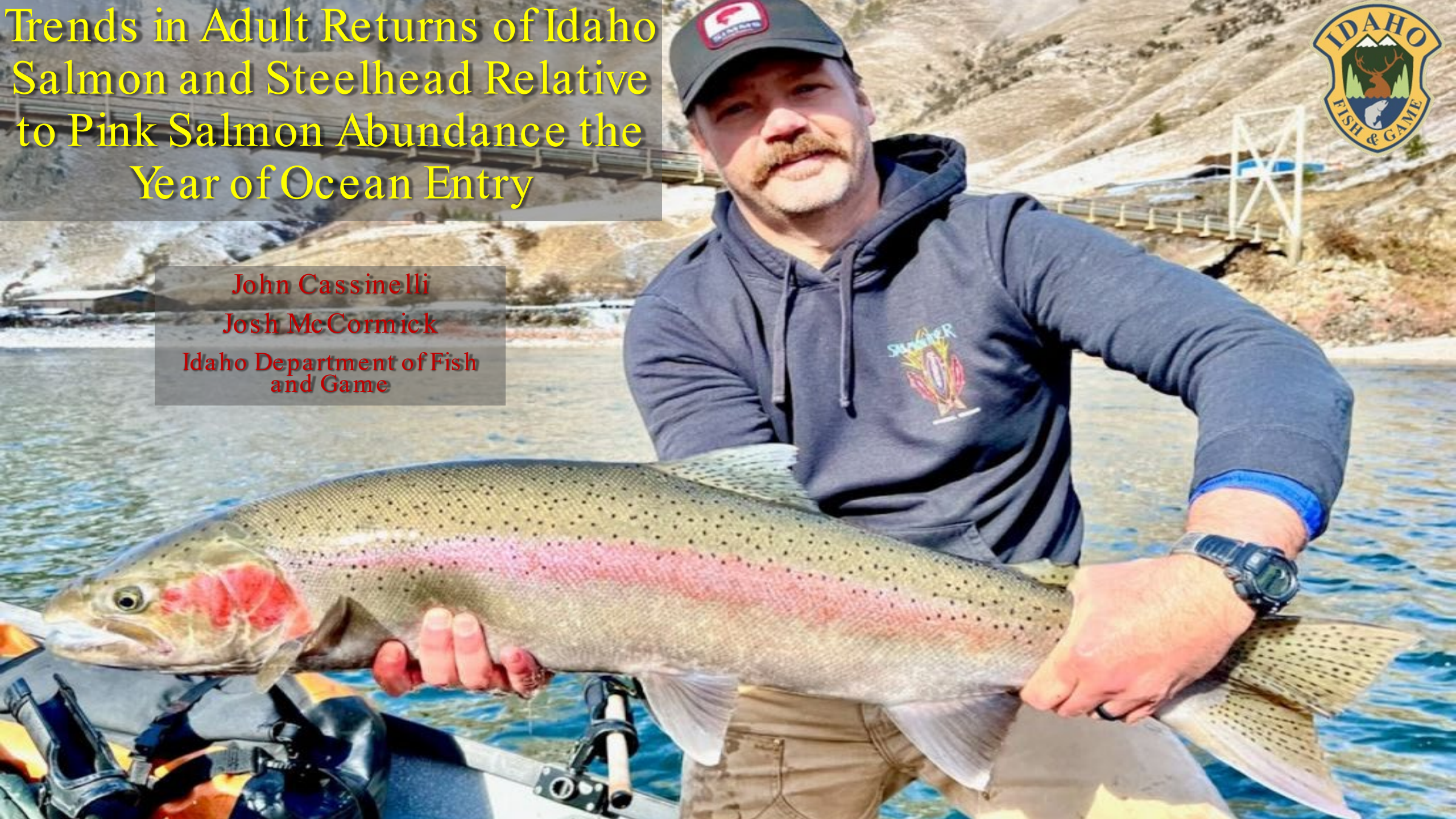
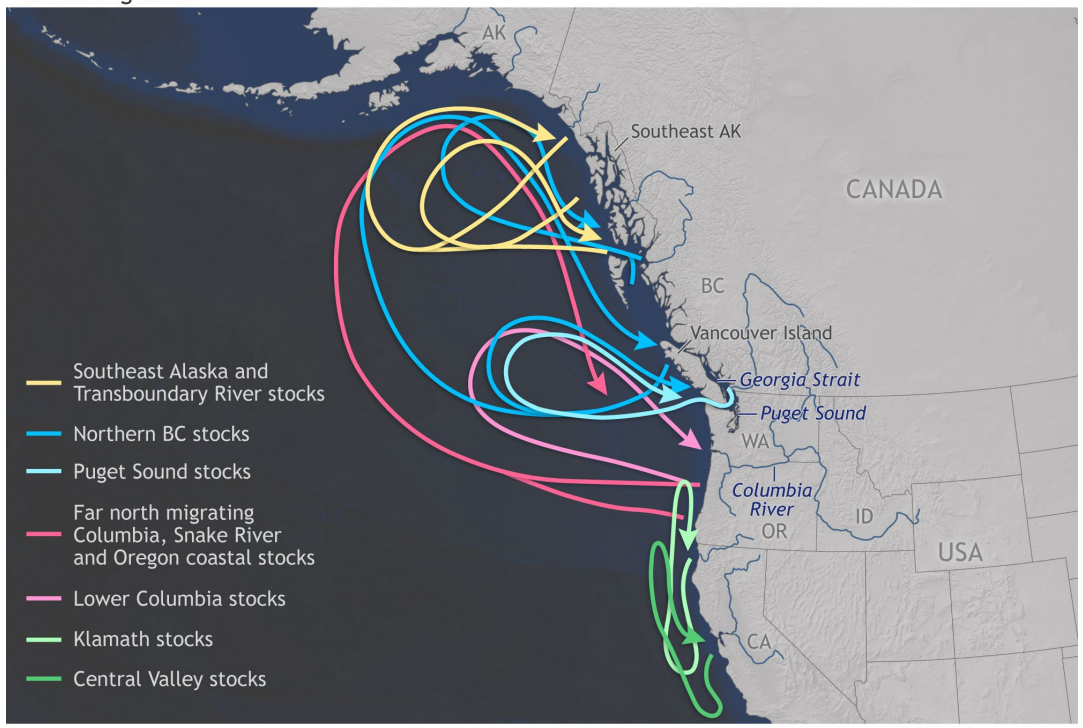
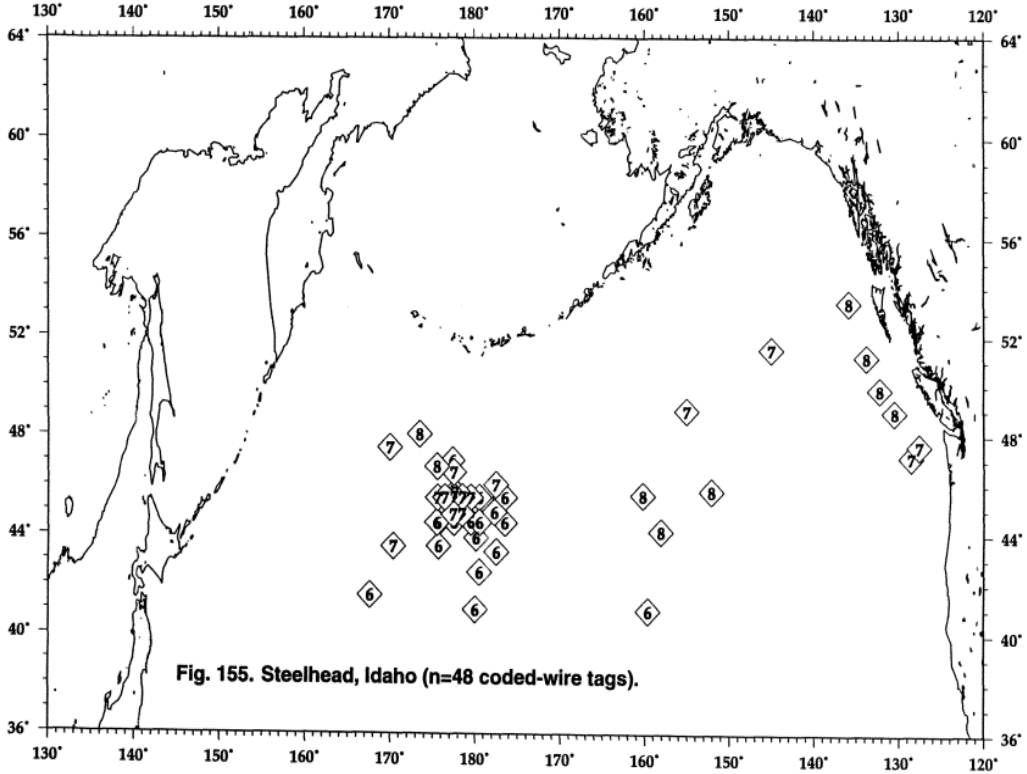


Salmon migration



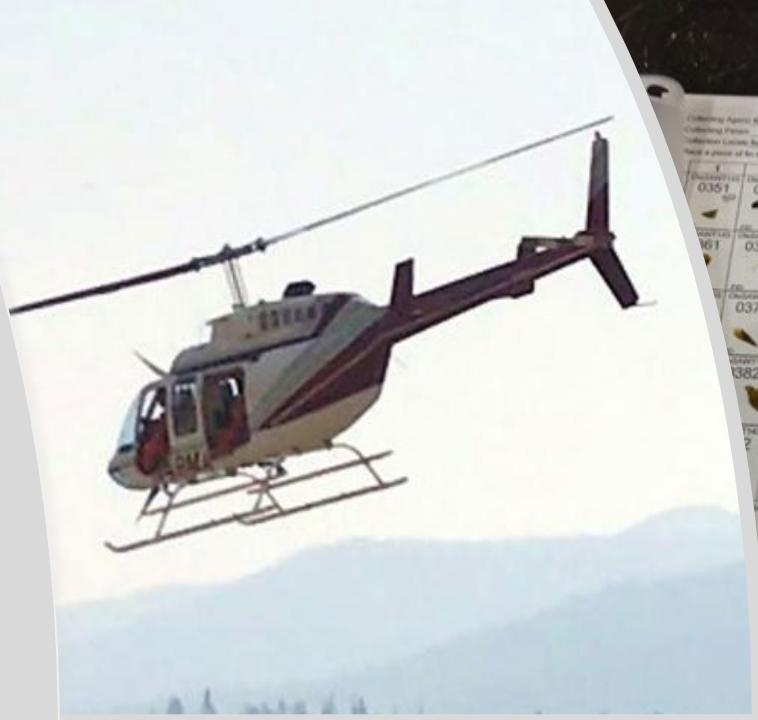
NOAA Climate.gov
Data: NOAA Fisheries

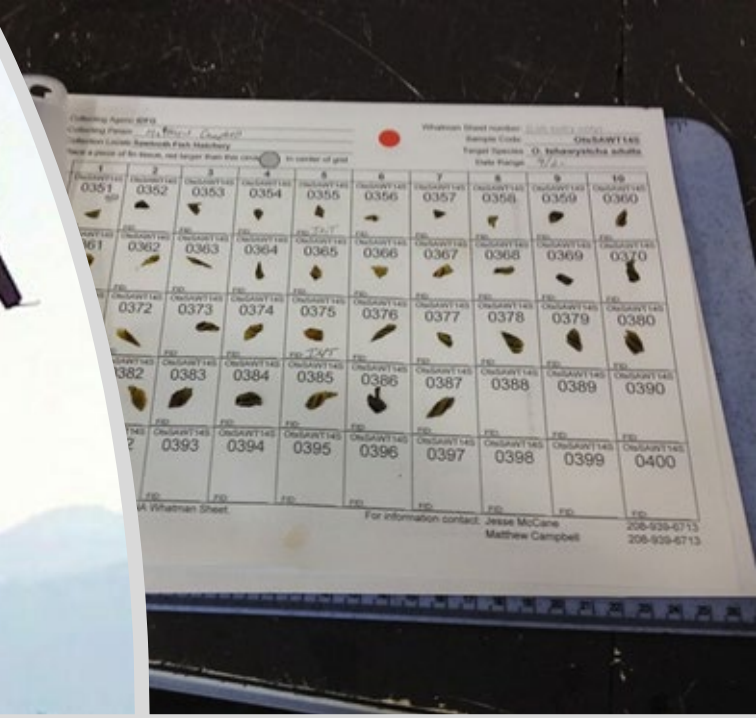


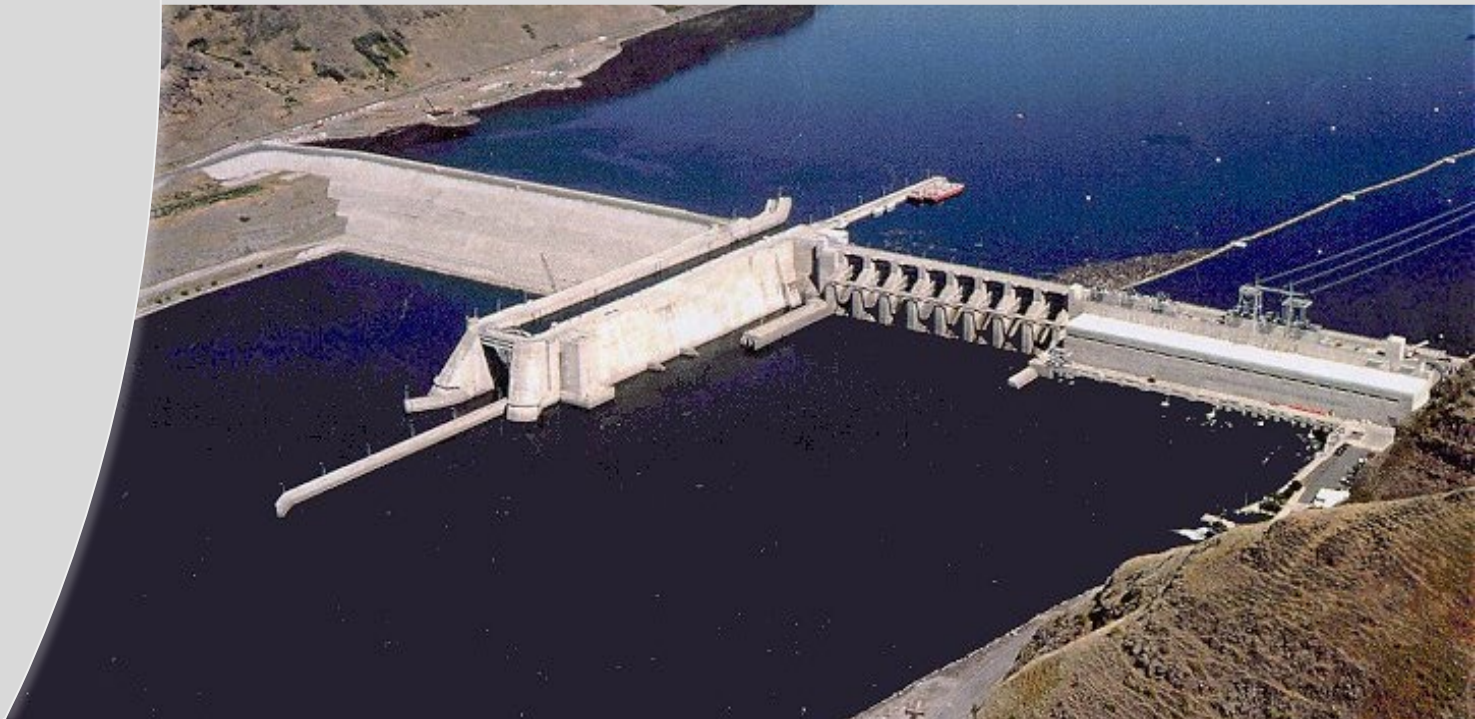
Myers et al. 1996

Adult Return Monitoring

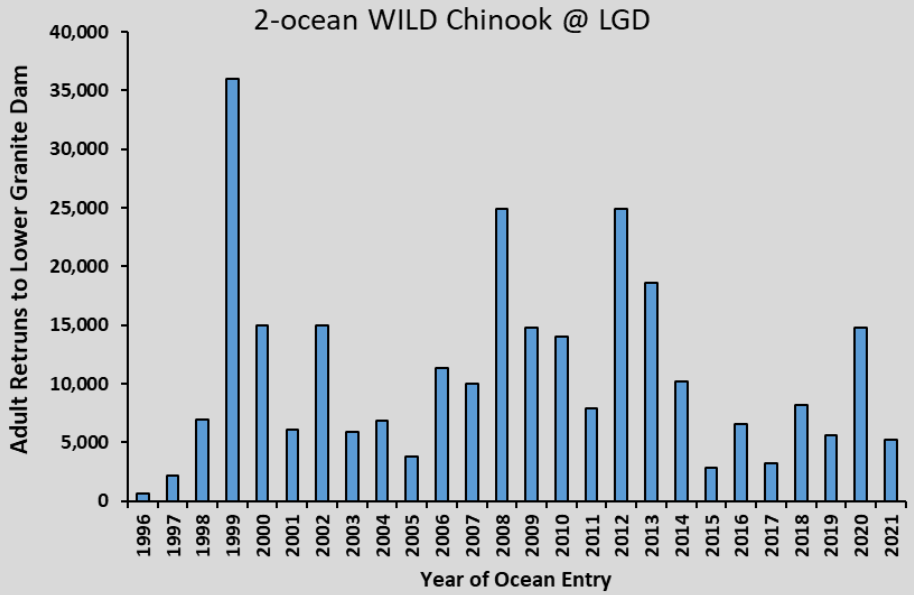
- Counts at Lower Granite Dam (estimated returns of all species by age)
- Genetic tools since 2009
  - GSI and PBT fully implemented
- Redd surveys

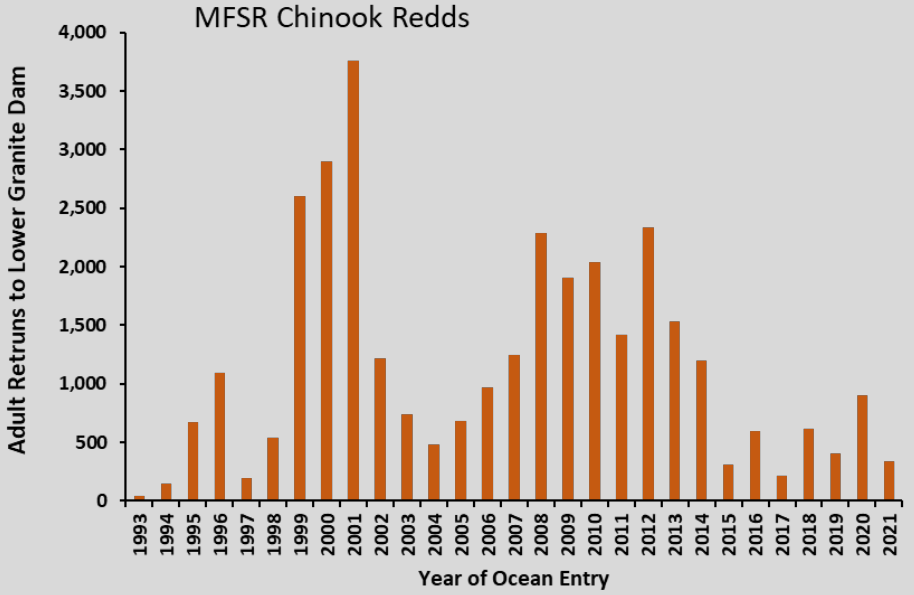






Adult Return Trends





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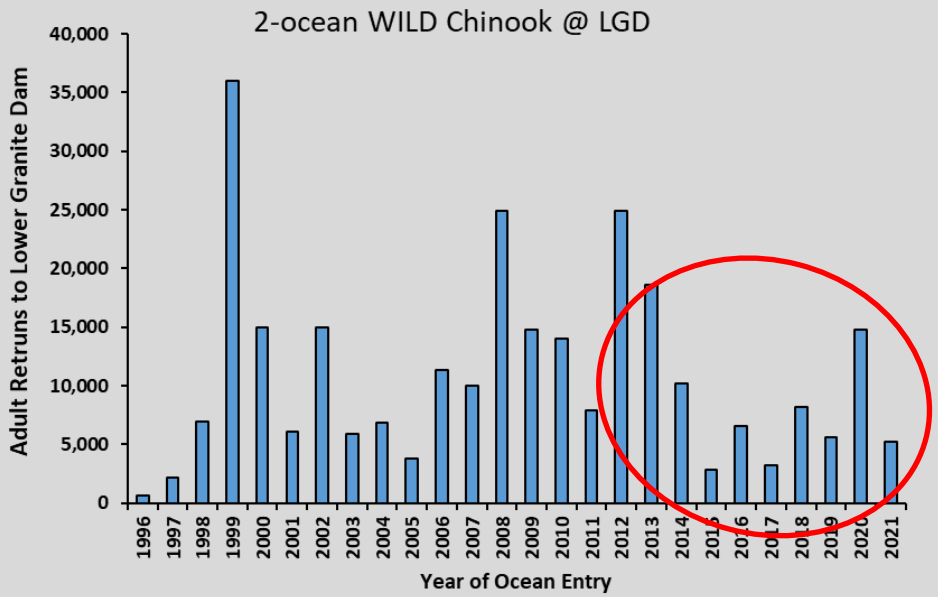

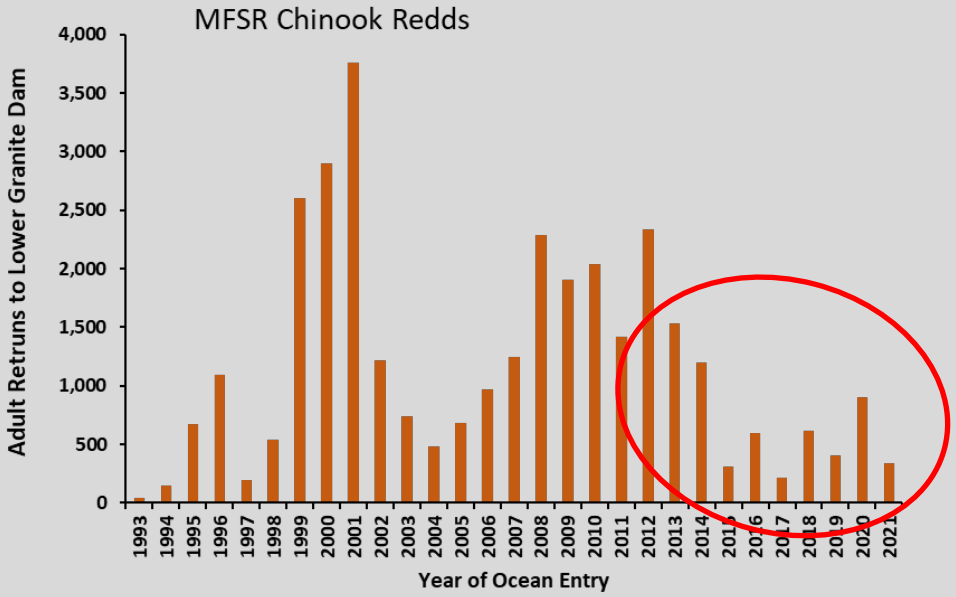

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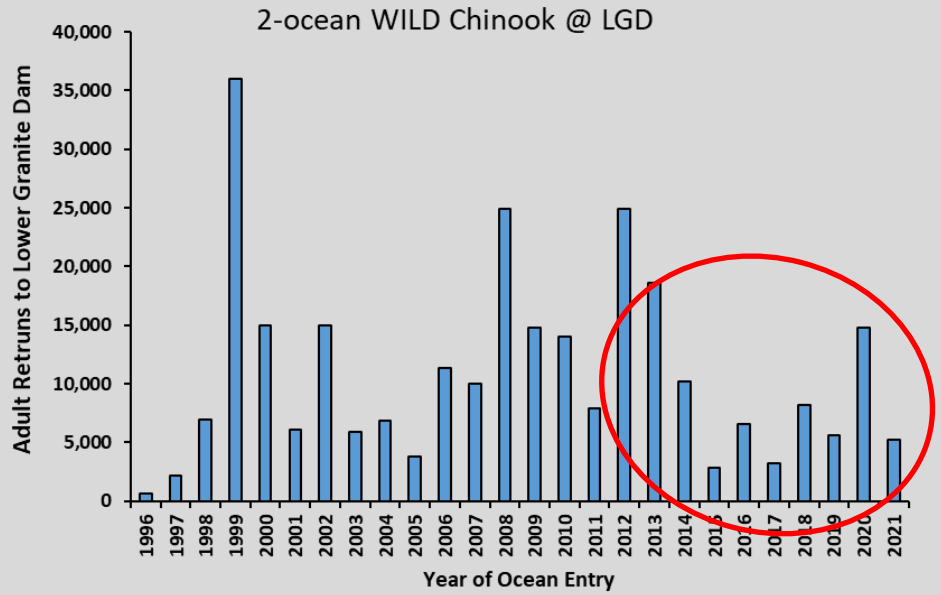

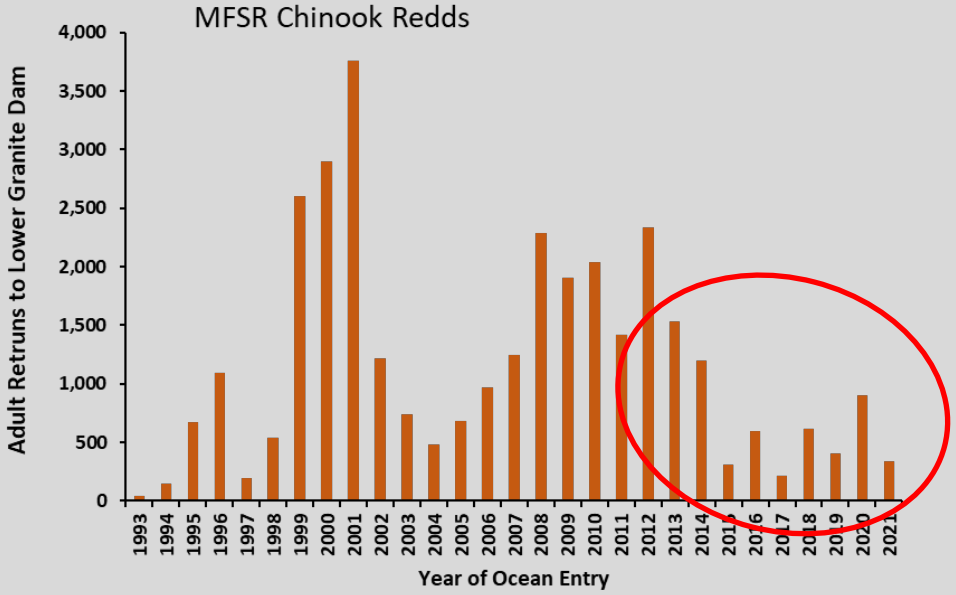

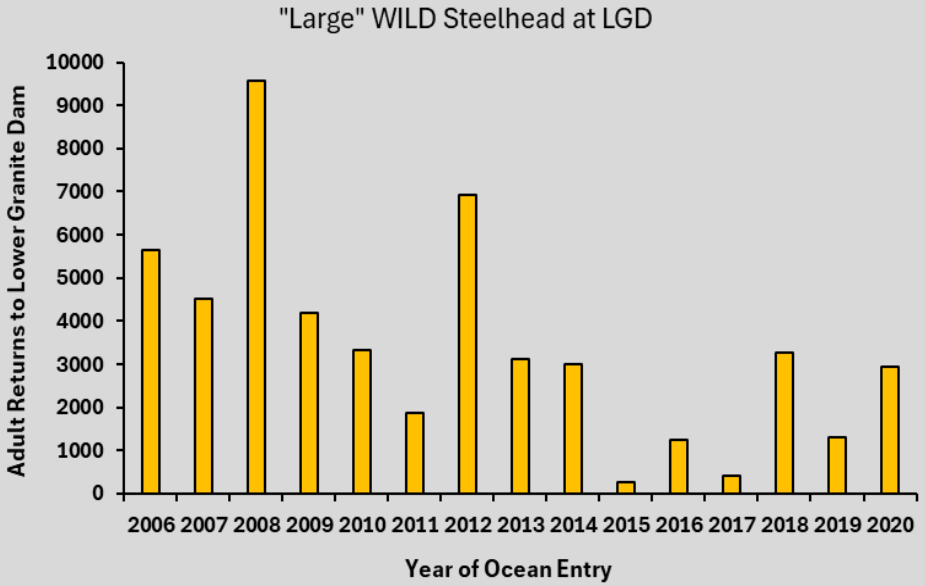

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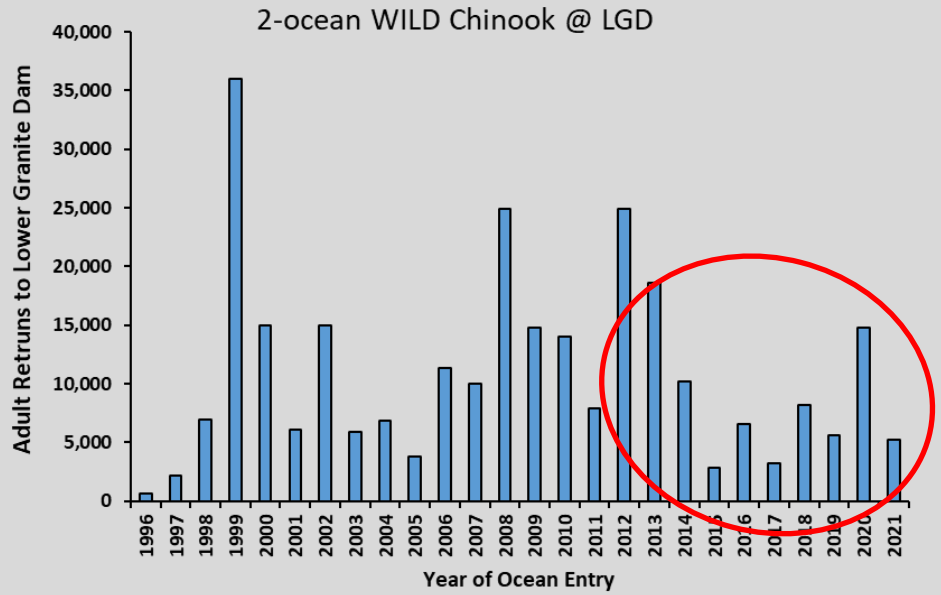

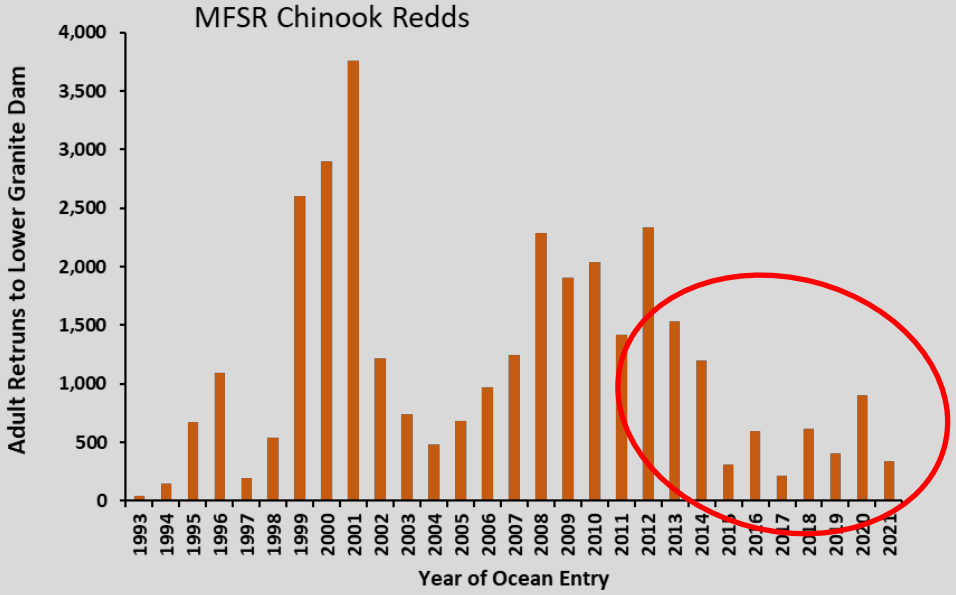

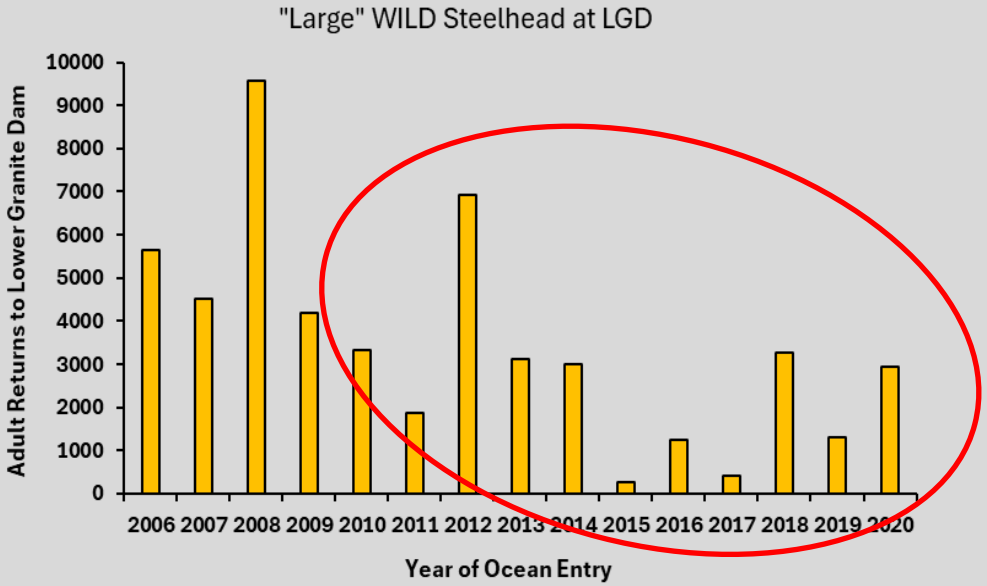

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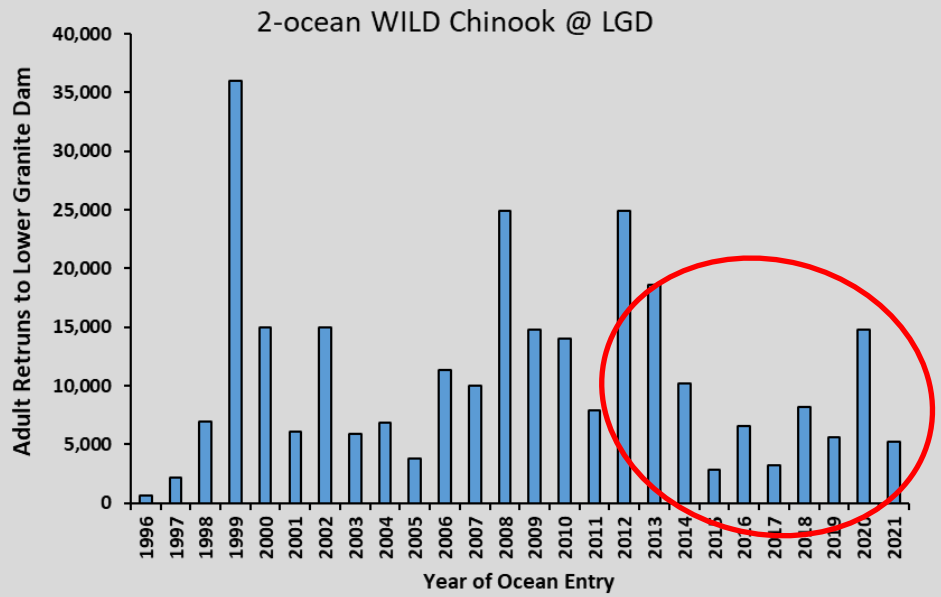
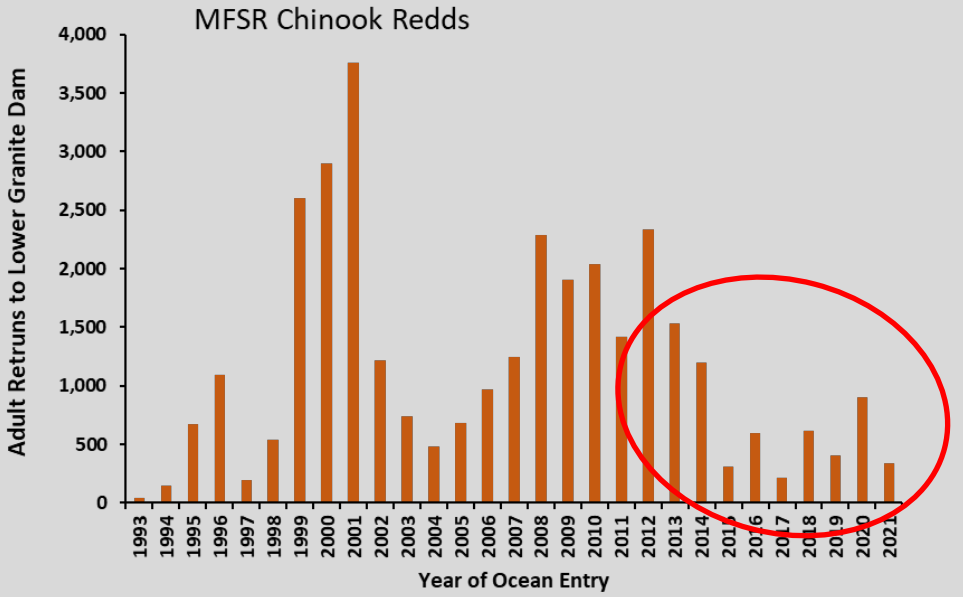
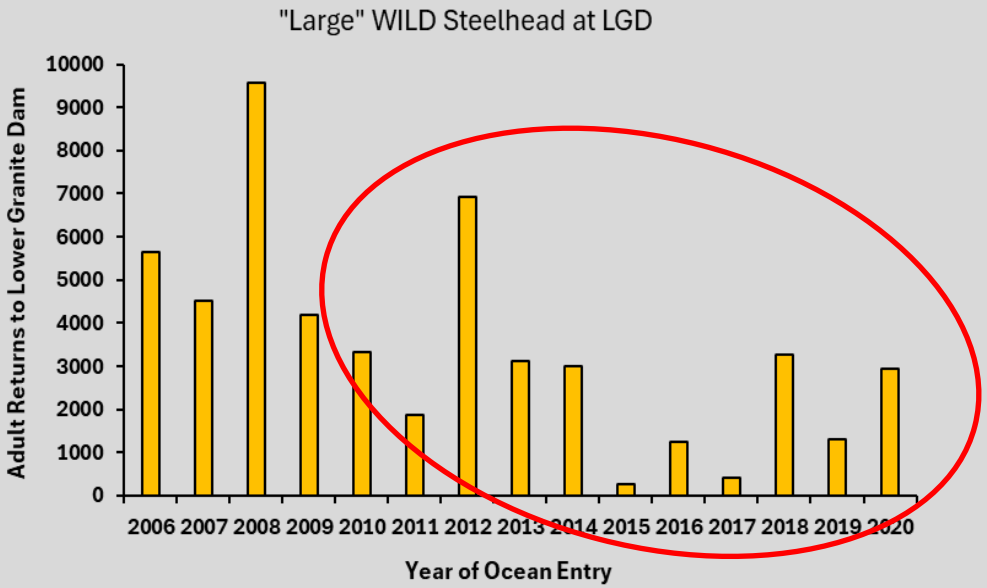
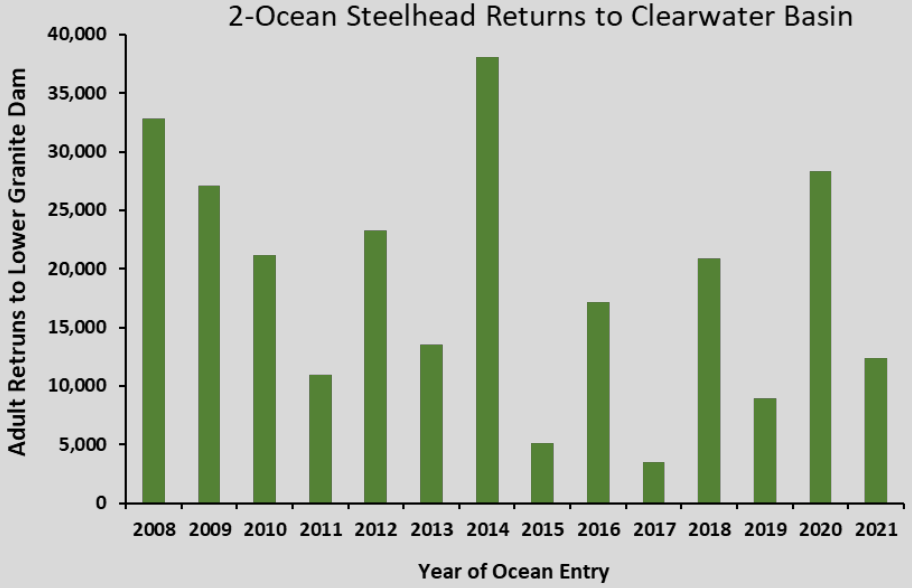








Relevant Research

Odd year Pink Salmon abundance in N. Pacific growing, at all-time high (Rand and Ruggerone, 2024)

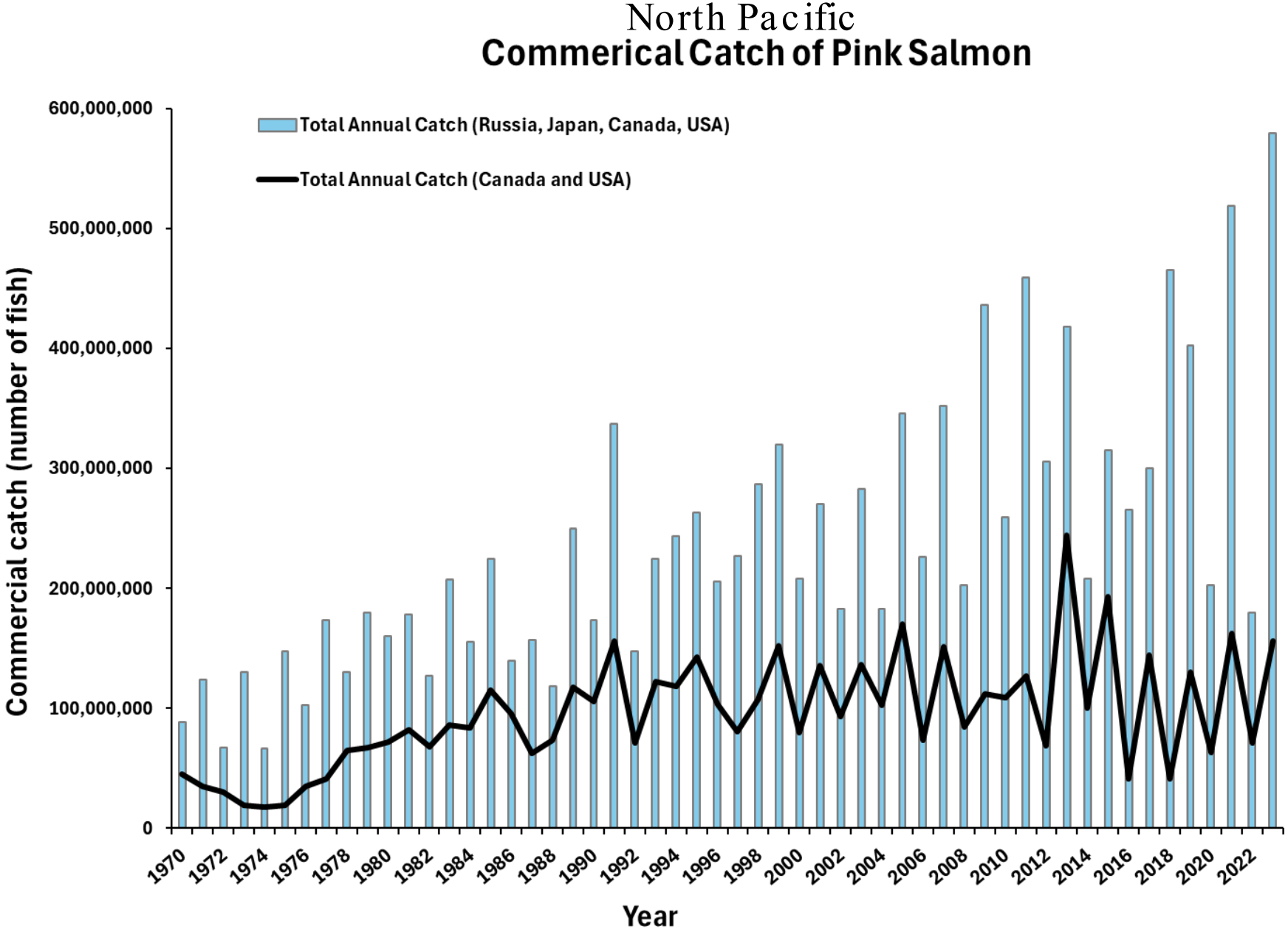
Estimated that Pink Salmon comprise up to 80% of all Pacific Salmon

Odd year Pink Salmon abundance found to have negative impacts on combination of abundance, growth, and reproductive success of numerous species (Litz et al. 2021; Buckner et al. 2023; Ruggerone et al. 2023)

Squid	Forage fish	Seabirds	Whales	Steelhead	All other Pacific Salmon

Increases in Pink Salmon abundance since mid 1950's correlated with N. Pacific heat content (Rand and Ruggerone, 2024)

Pink Trends


North Pacific
Commerical Catch of Pink Salmon
Total Annual Catch (Russia, Japan, Canada, USA)
Total Annual Catch (Canada and USA)
Commercial catch (number of fish)
600,000,000
500,000,000
400,000,000
300,000,000
200,000,000
100,000,000
0
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
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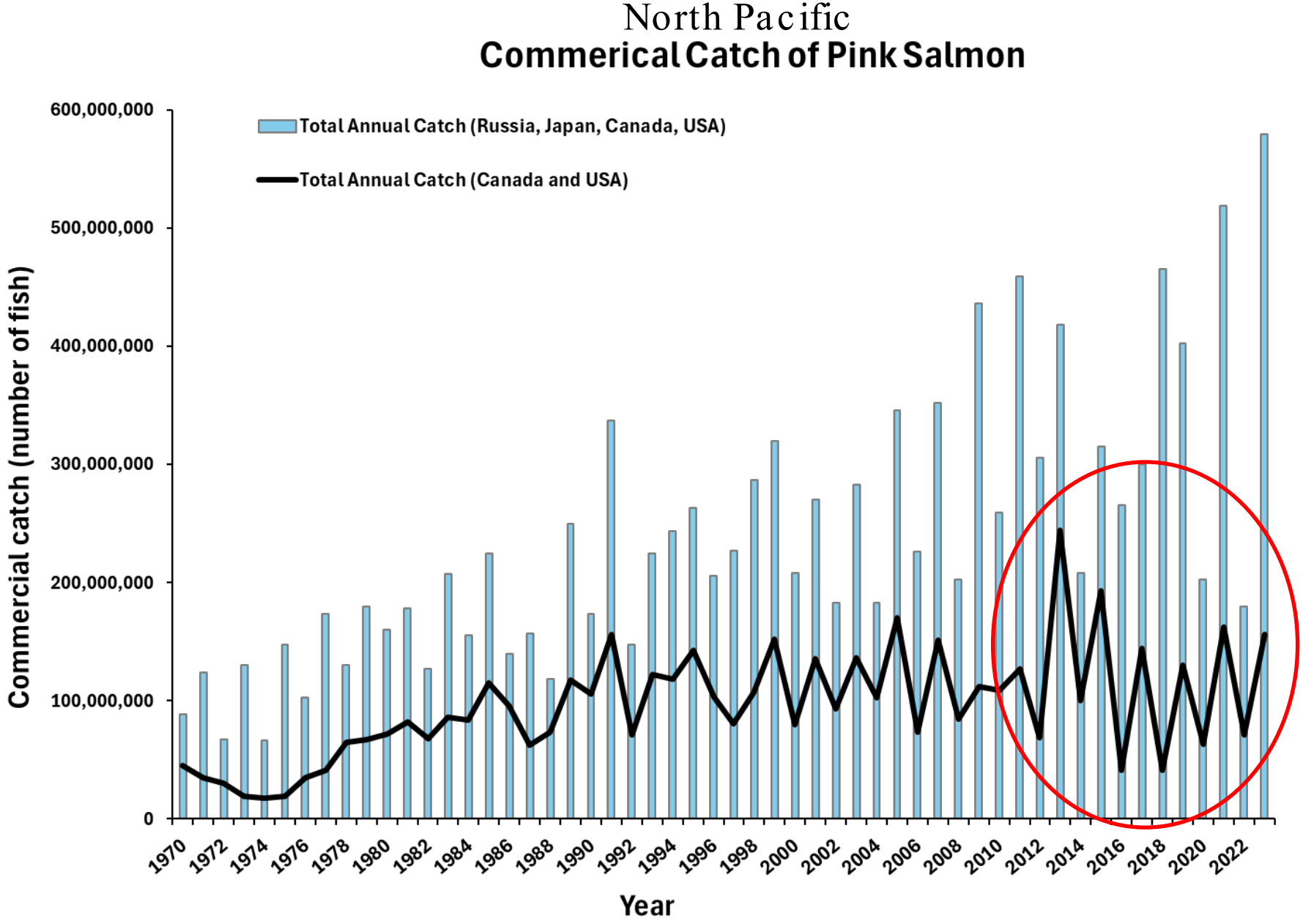
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
Year

Pink Trends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400,000,000
300,000,000
200,000,000
100,000,000
0
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
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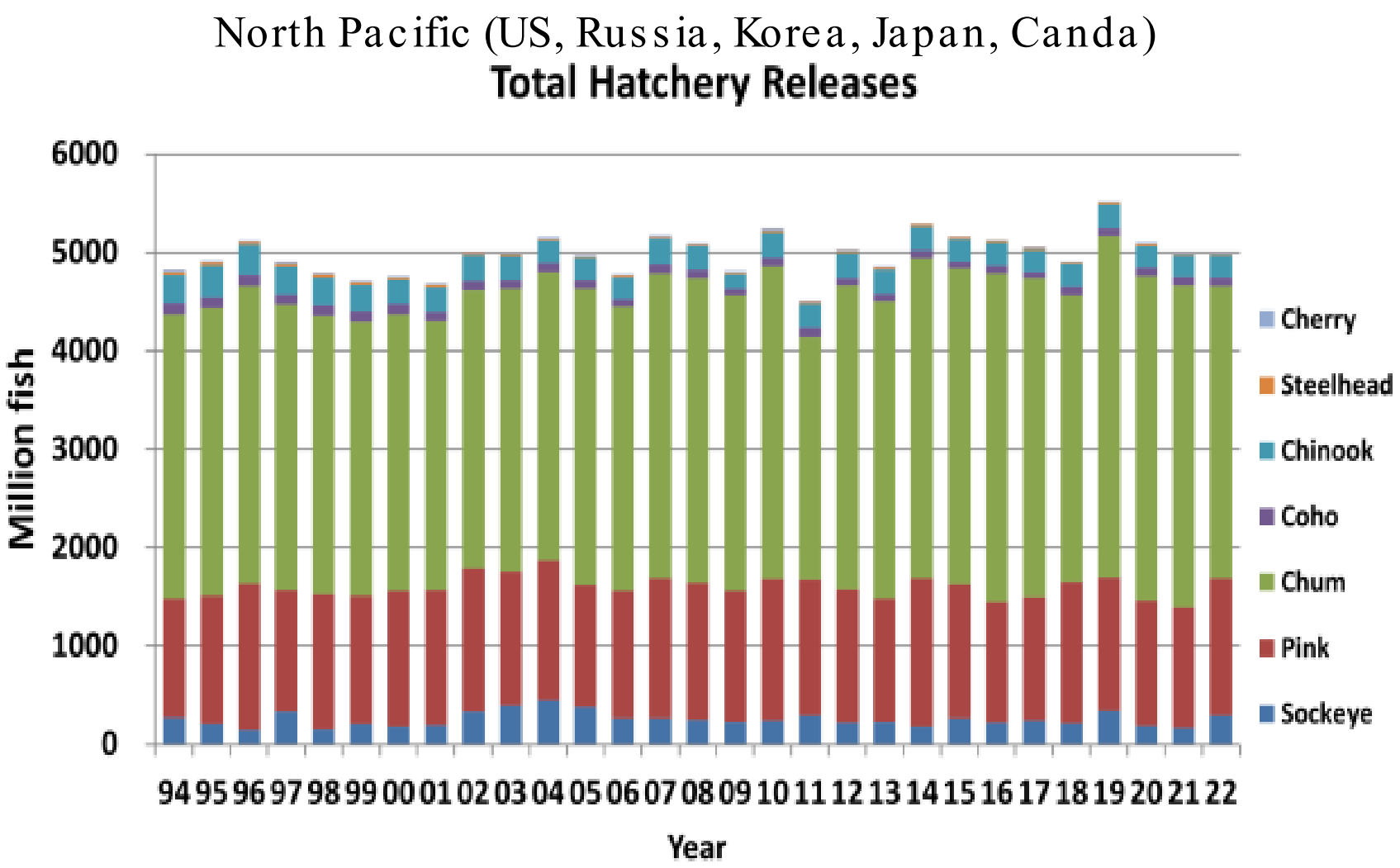
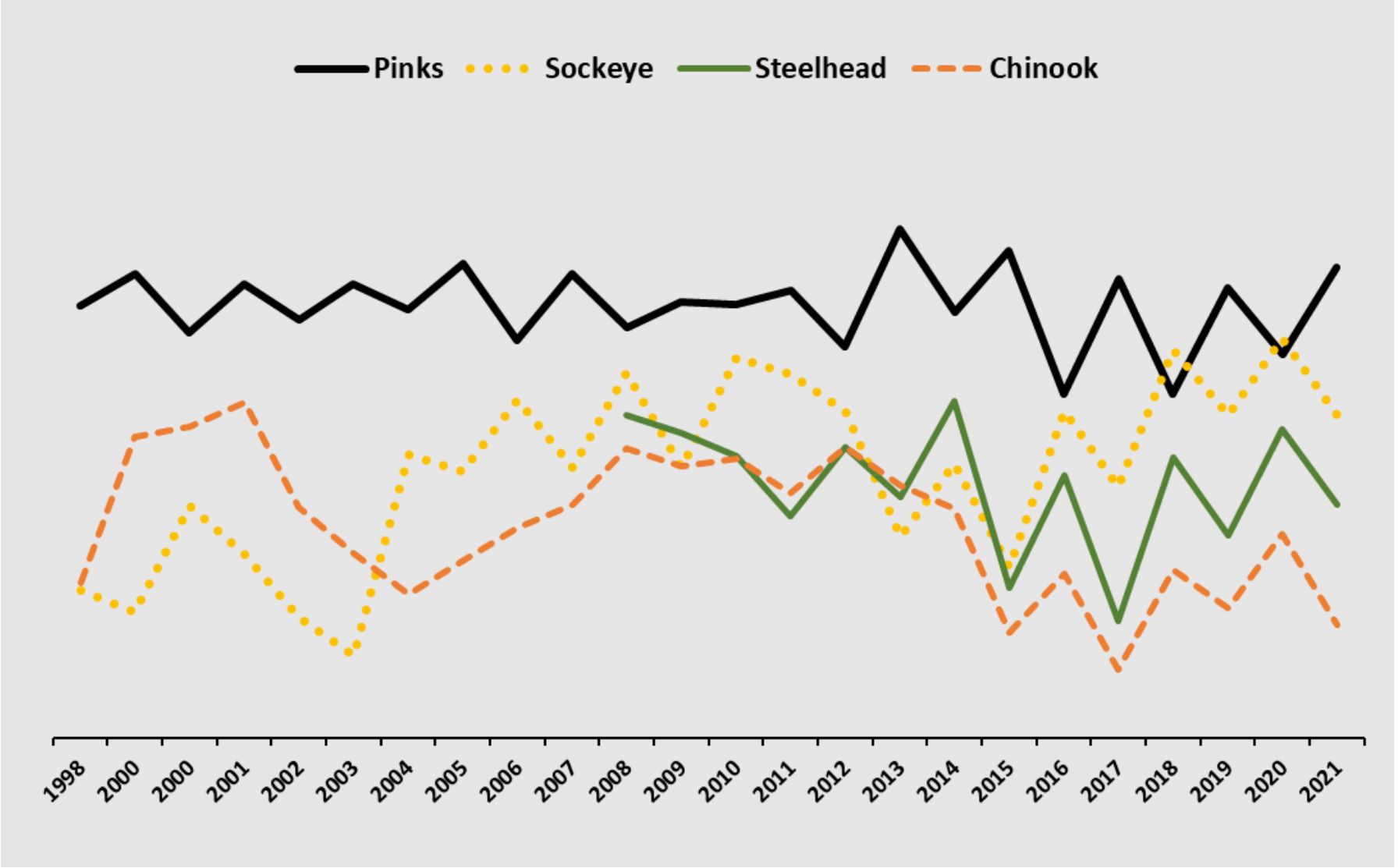
2022
Year

Pink Trends


North Pacific (US, Russia, Korea, Japan, Canda)
Total Hatchery Releases
Million fish
6000
5000
4000
3000
2000
1000
0
94 95 96 97 98 99 00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22
Year
Cherry
Steelhead
Chinook
Coho
Chum
Pink
Sockeye

Pink Trends


Pinks
Sockeye
Steelhead
Chinook
1998
2000
2000
2001
2002
2003
2004
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2006
2007
2008
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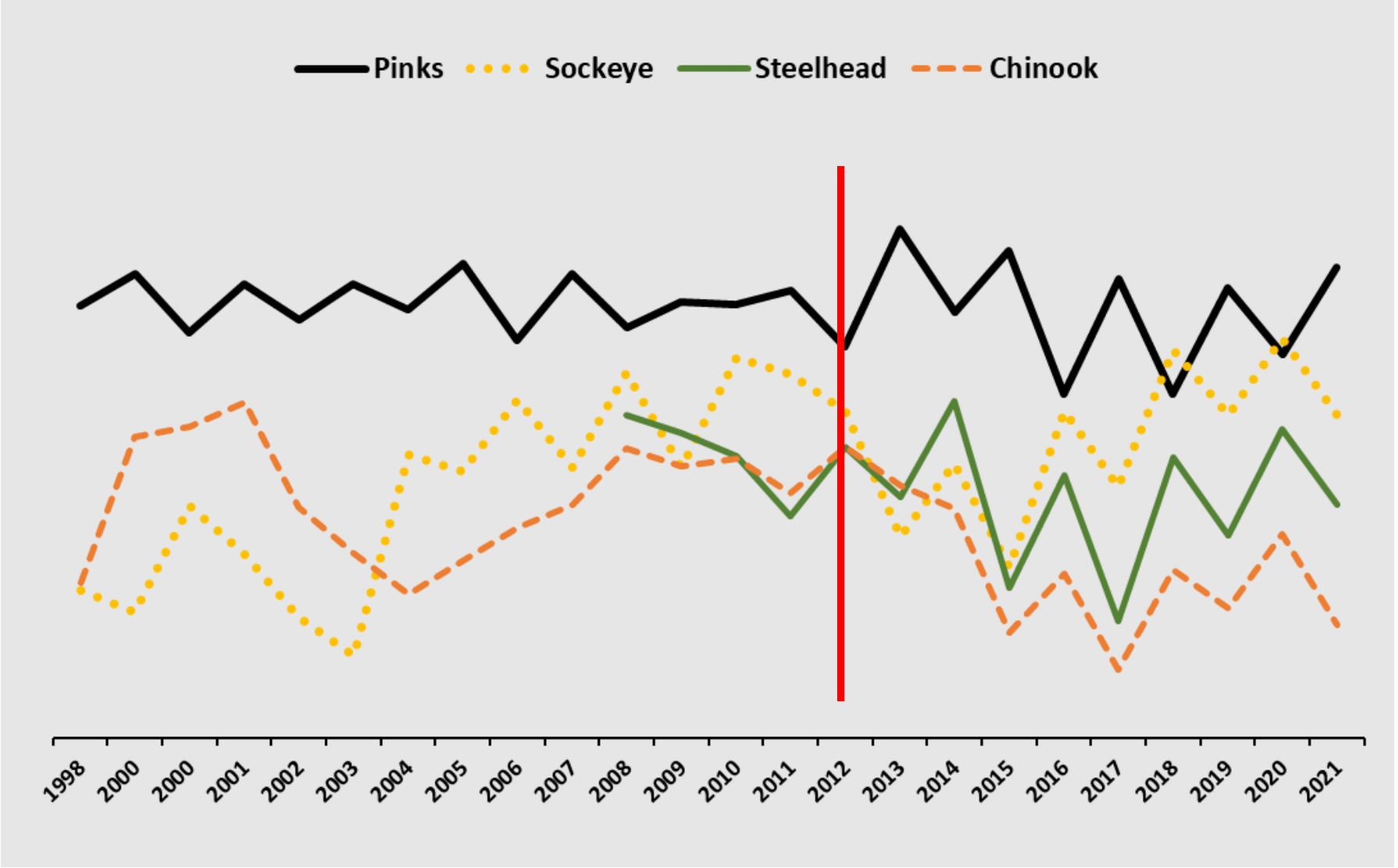
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021

Pink Trends


Pinks
Sockeye
Steelhead
Chinook
1998
2000
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2019
2020
2021

Methods

State space model

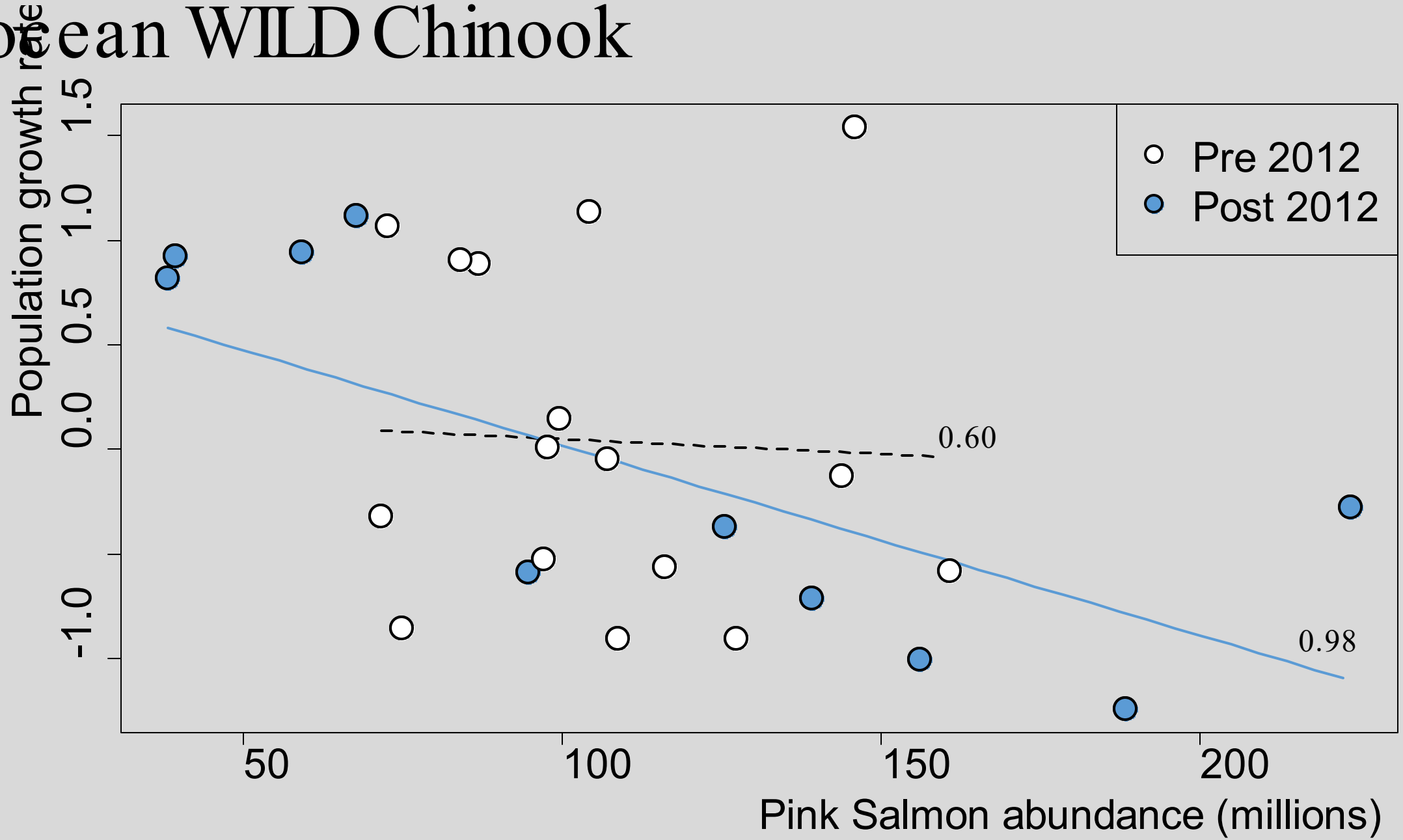
$$\log(N_t) \sim normal(\log(N_{t-1}) + r_t)$$

- N_t = abundance in year t
- r = intrinsic rate of increase

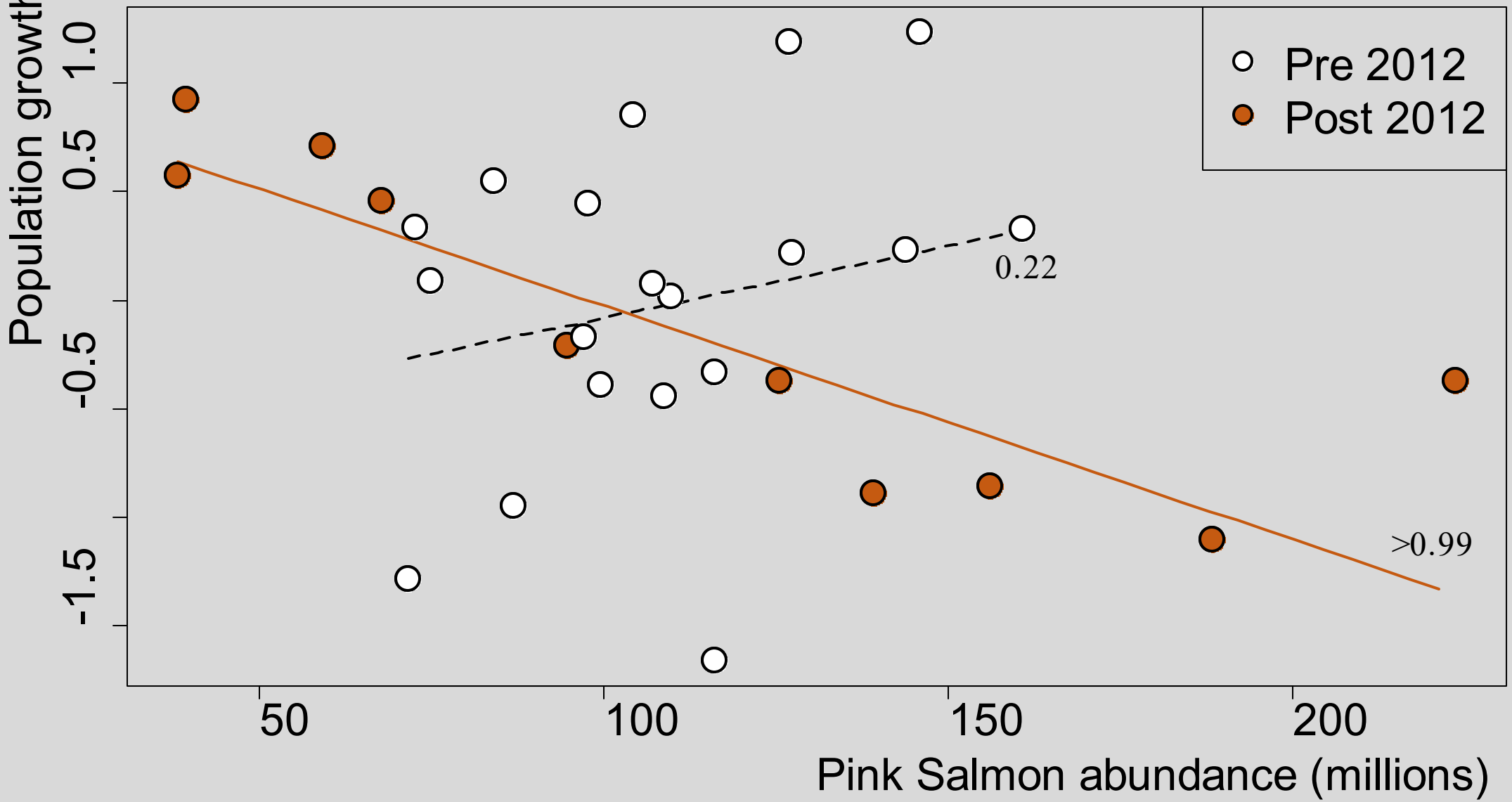
$$r_t = \beta_0 + \beta_1 x_t + \varepsilon$$

- β_0 = intercept
- β_1 = slope
- x_t = Pink Salmon abundance
- ε = residual error

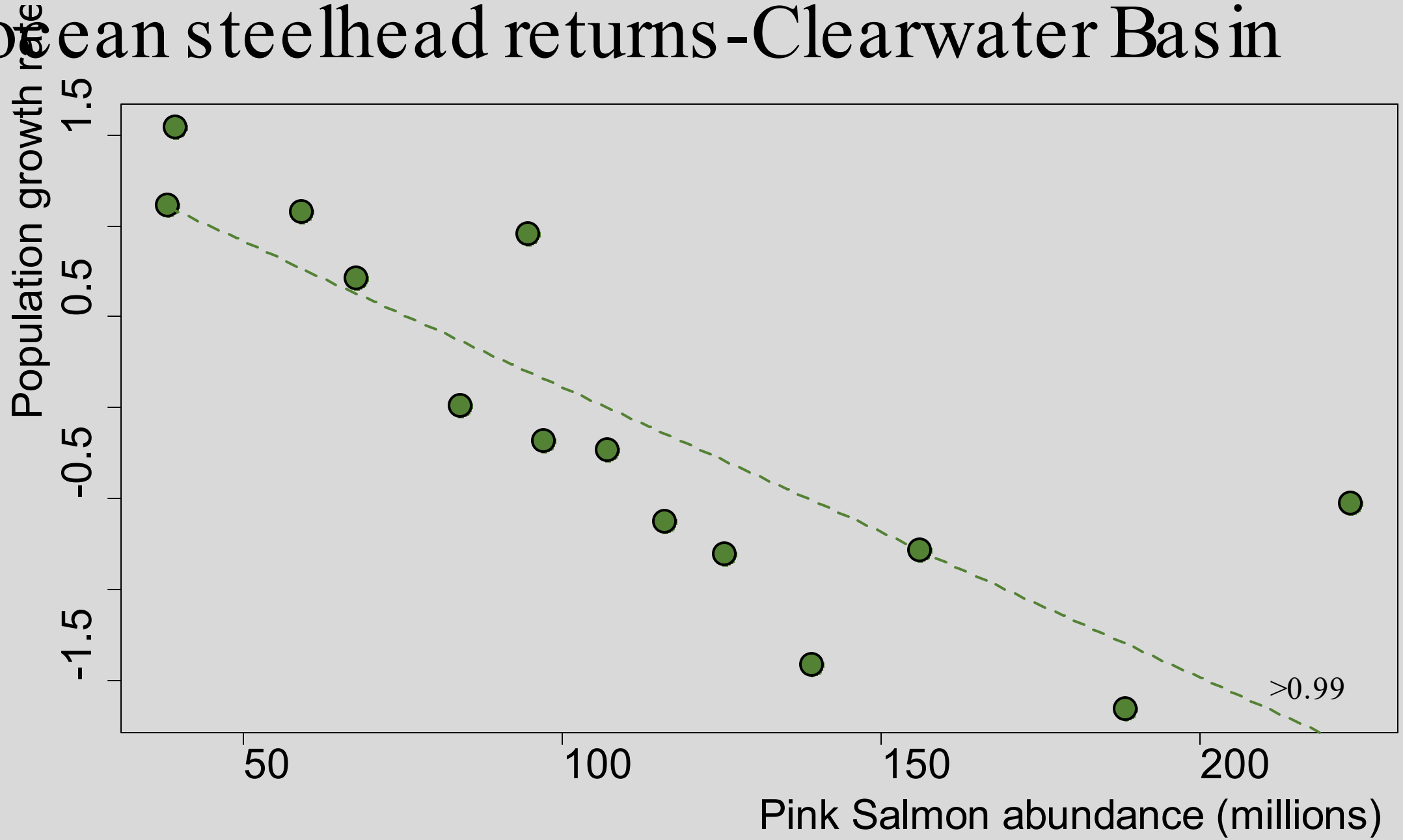
2-ocean WILD Chinook



MF Salmon Chinook Redds



2-ocean steelhead returns-Clearwater Basin



- Cycles in adult steelhead length suggest interspecific competition in the North Pacific Ocean – Vosbigian et al. 2024
  - 2-ocean Snake R. steelhead that migrate during odd yrs, 16.9 mm shorter than even-year migrants as adults
  - Odd year returns: 54.3% age-1, 44.5% age-2
  - Even year returns: 31.8% age-1, 66.9% age-2
  - Gonatid squid diet overlap
  - Warmer seas surface my increase dietary needs of steelhead
  - Changing climate may favor pink salmon

Summarize

- Pink Salmon ocean abundance shown to have impacts on multitude of species in the north Pacific Ocean
- Recent high odd year Pink Salmon ocean abundance (year of ocean entry) is negatively correlated with adult returns of some Snake River anadromous runs
  - Relationship exists for both hatchery and natural origin spring/summer Chinook Salmon, Sockeye Salmon, and hatchery and natural 2-ocean steelhead
    - Largest impact on steelhead
  - Relationship amplified in wild populations by decreased natural production every other year?
- What role does a changing climate have on:
  - Pink Salmon population growth and expansion? Even/Odd year dominance?
  - Snake River anadromous stock survival and productivity
- Highlights the complexity of multijurisdictional species management and priorities
- Management implications?

Questions?