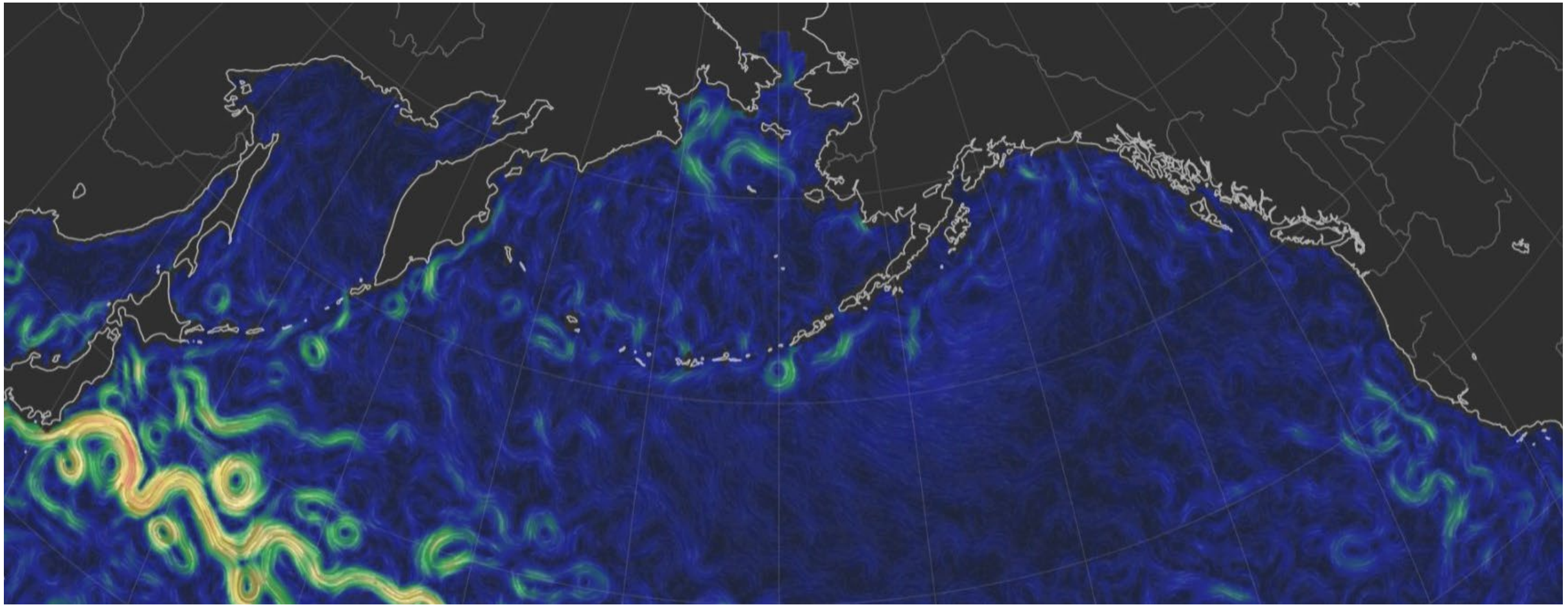


Dr. Katie Howard, Fisheries Scientist

House Fisheries Committee

February 6, 2024

Understanding Potential Contribution of Alaska Salmon Hatchery Production to Competition at Sea

“resource vacuum and altered community composition left behind as pink salmon migrate…. suggest that they have a destabilizing effect on the ecosystem” – Springer & van Vliet 2014

“The consistent pattern of findings from multiple regions of the ocean provides evidence that interspecific competition can significantly influence salmon population dynamics and that pink salmon may be the dominant competitor among salmon in marine waters.”

“All these data suggest that though salmon species consume a large amount of food, especially during periods of high abundance, their role in trophic chains is far from being highly important.”

“the potential for food resources to limit salmon production across the North Pacific continues to be vigorously debated”

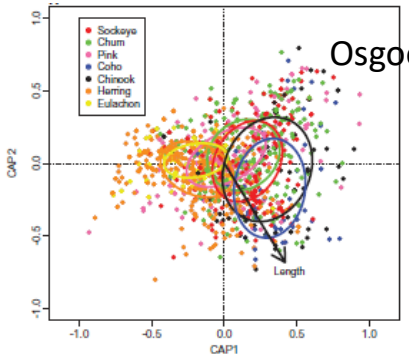
“This suggests that hatchery production has contributed to the depressed productivity of sockeye salmon in British Columbia, some of which have recently been assessed as at risk of extinction”

“Salmon input into the trophic structure of pelagic communities is generally low, and an additional several hundred thousand tons of artificially reared salmon cannot significantly change this trophic structure.”

“Unfortunately, it is difficult to argue and refute fantasies of this kind and sometimes its impossible because of their absurdity.” – Shuntov et al. 2017

Evidence for Interspecific Salmon Competition

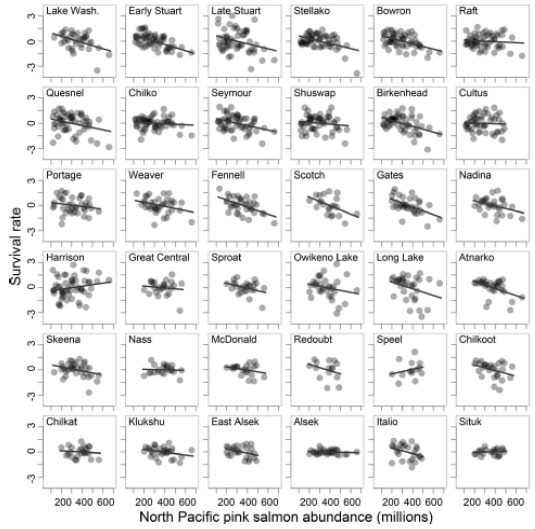
1. Diet overlap and diet shift



Osgood et al. 2016

2. Species abundances react differently (species A ↑, species B ↓)

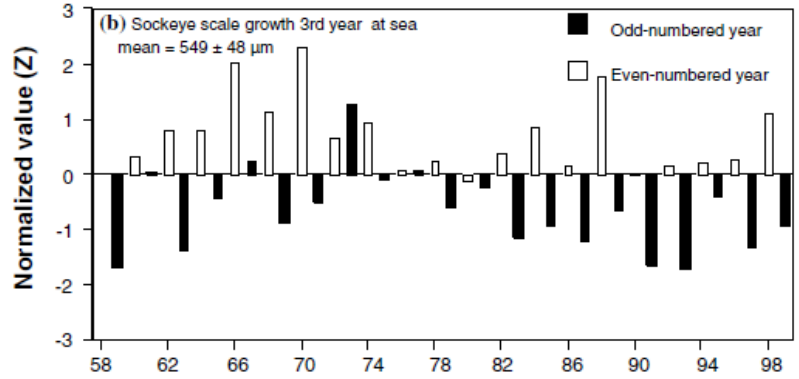
Ruggerone & Connors 2015



3. Competitor abundance associated with growth patterns

species A numbers ↑

species B growth ↓

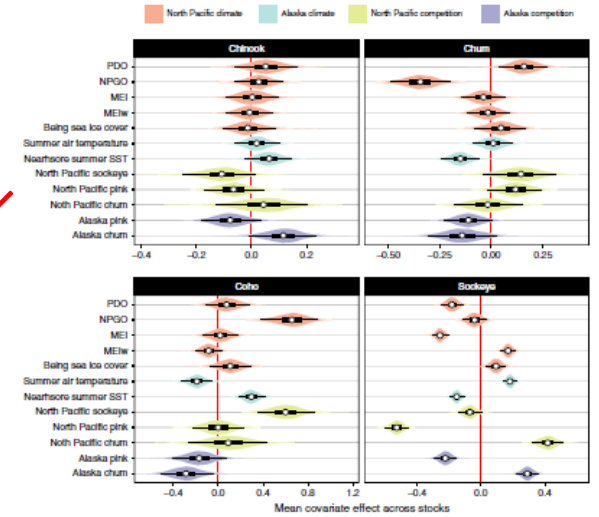


Ruggerone & Nielsen 2004

4. Competitor abundance associated with age at return

species A numbers ↑

species B maturity age ↓



Oke et al. 2020

Opposing Perspectives

Convinced

- Evidence generally based on correlations; direct assessment not required/possible
- Evidence found consistently across multiple situations
- Salmon-centric
- Odd/even lifecycle pattern (pink salmon) viewed as natural experiment
- Largely draws from English-written journals

Not Convinced

- Assessing cause should include direct evidence for/against causal links
- Evidence of *no relationship* often ignored/not published
- Pelagic ecosystem-centric
- Alternative 2-year patterns should be considered (e.g., other species like squid)
- Draws from English and non-English language journals

Correlative Evidence

"Correlative evidence is strongest when

(1) correlation is high,

(2) it is found consistently across multiple situations,

(3) there are not competing explanations, and

(4) the correlation is consistent with mechanistic explanations that can be supported by experimental evidence"

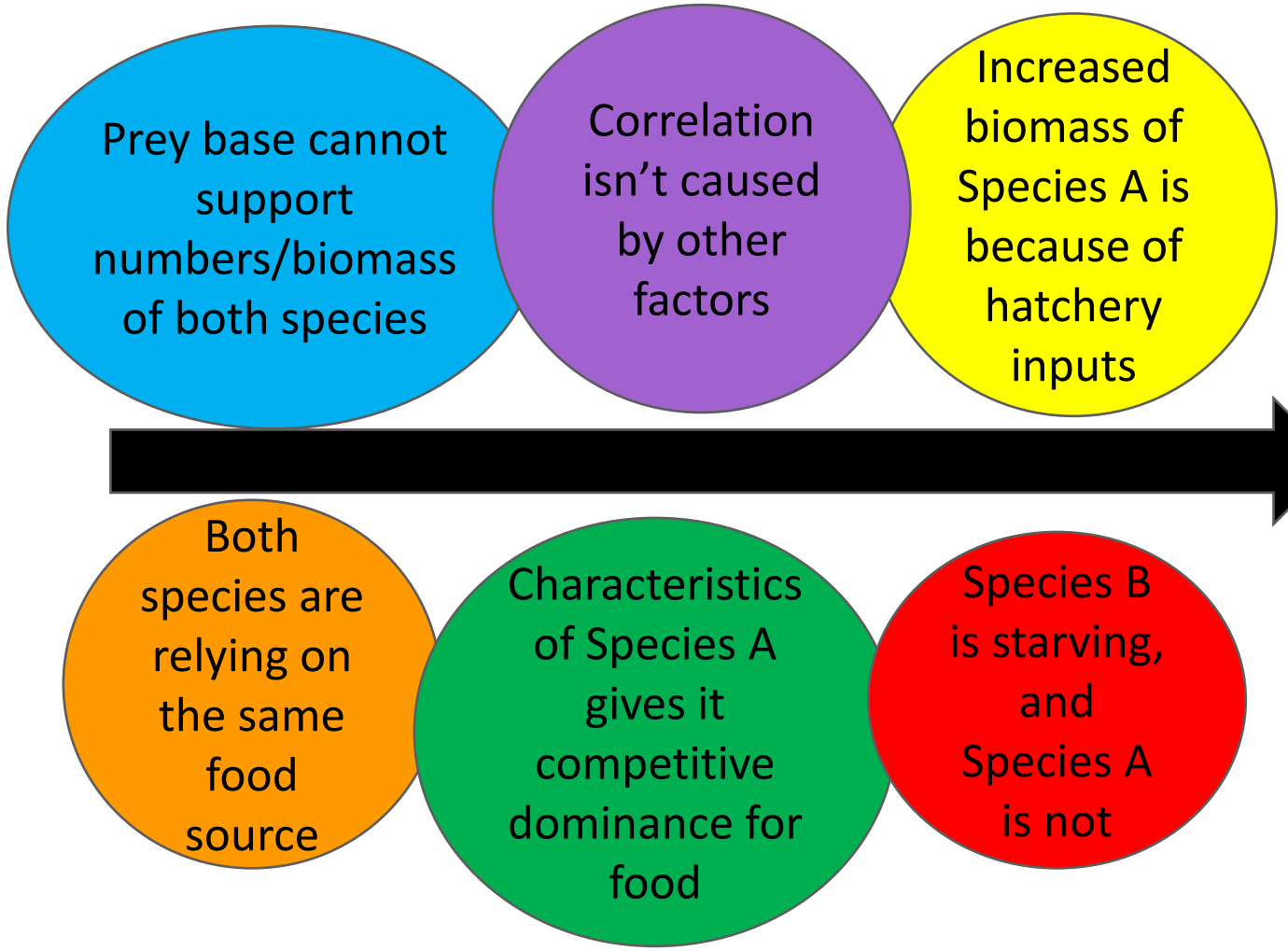
(Hilborn 2016)

Observation

Proposed Rationale

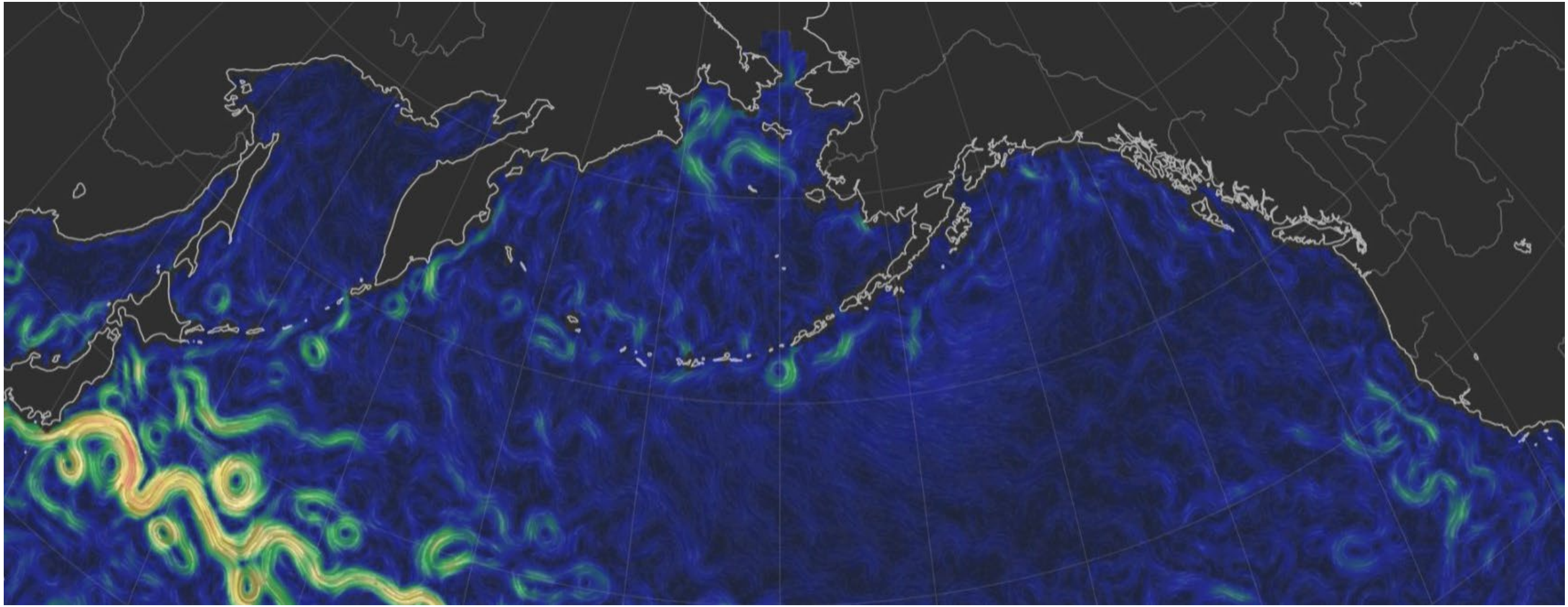
Conclusion

Species A ↑ when Species B ↓



Hatchery ↑ in Species A **causes** ↓ in Species B

What Can Alaska's Decision-Makers Do



Good Decisions Need Clear Objectives and Expectations

1. What is the intended outcome?
   - Reduce competition for food on the high seas where many stocks and species are co-mingling?
   - Reduce competitive interactions (food, breeding space, etc.) between wild and hatchery stocks in local areas where hatchery fish are concentrated as fry or adults?

2. What levers are available for each of these scenarios?
   - Which levers to use?
   - How far to move them?
   - How big of an effect will it have?

3. What are the risks, trade-offs, and benefits of a particular action?
   - Precautionary actions consider biological, cultural, social, and economic factors

Example: Exploring the AK pink salmon hatchery lever to address high seas competition for food

This is partly a function of:

- The relative abundance of pink salmon compared to other species with overlapping diets
- How much of the pink salmon are hatchery-origin fish?
- How much of the hatchery-origin pink salmon come from Alaska hatcheries?

Best source of data:

- Ruggerone & Irvine (2018) Numbers and Biomass of Natural and Hatchery-Origin Pink, Chum and Sockeye Salmon
  - Most comprehensive assessment of available data
  - Used by majority of studies of at sea competition
  - Provide estimates of
    - Hatchery and wild
    - Major species only: pink, chum, sockeye
    - Adult abundance and biomass
    - Adult and immature (total) biomass
    - Cannot account for overlapping non-salmon species in the North Pacific Ocean that share food resources

Understanding Different Hatchery + Wild Measurements

Adult Abundance

sockeye salmon
88.3 million / 13.6%

chum salmon
131.5 million / 20.1%

pink salmon
445.0 million / 66.3%

e.g., Local competition for redd space

Adult Biomass

sockeye salmon
231.5 kt / 17.7%

chum salmon
455.8 kt / 34.5%

pink salmon
637.7 kt / 47.7%

e.g., Harvest

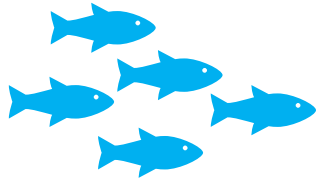
Adult & Immature Biomass

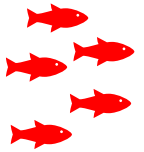
sockeye salmon
775.7 kt / 18.2%

chum salmon
2,577.9 kt / 59.8%

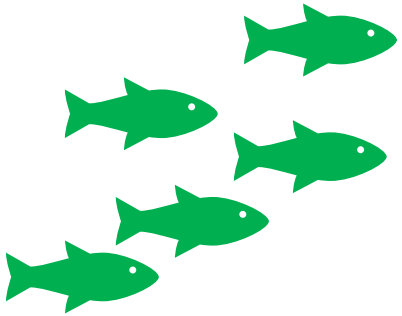
pink salmon
945.0 kt / 21.9%

e.g., High seas competition for food





In food web studies, productivity is measured in either units of energy (e.g., calories) or in biomass, because biomass represents stored energy



1990-2015 from Ruggerone & Irvine (2018) supplementary data

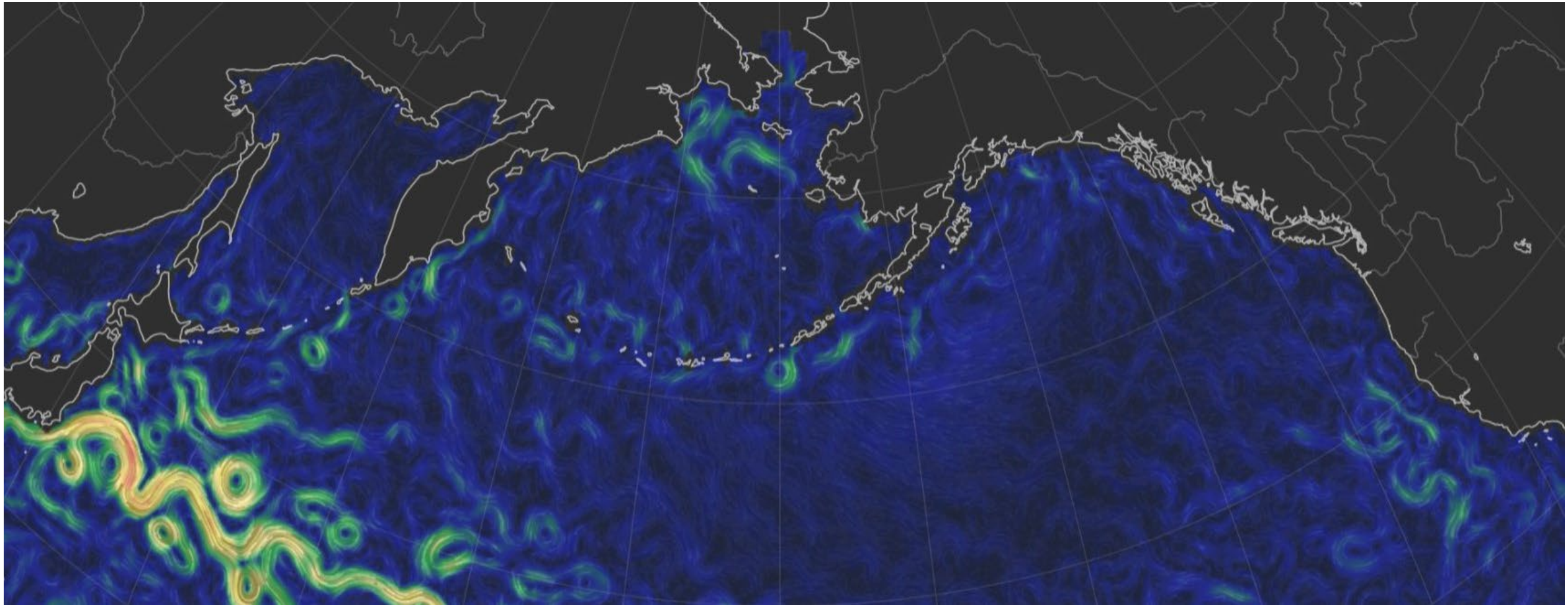
Size of the Hatchery Pink Salmon Lever

Total Adult & Immature Biomass in North Pacific (1990–2015)

***The size of the lever will be different if the intended outcome is focused on local areas/impacts**

1990-2015 from Ruggerone & Irvine (2018) supplementary data

New Efforts to Address Data Gaps

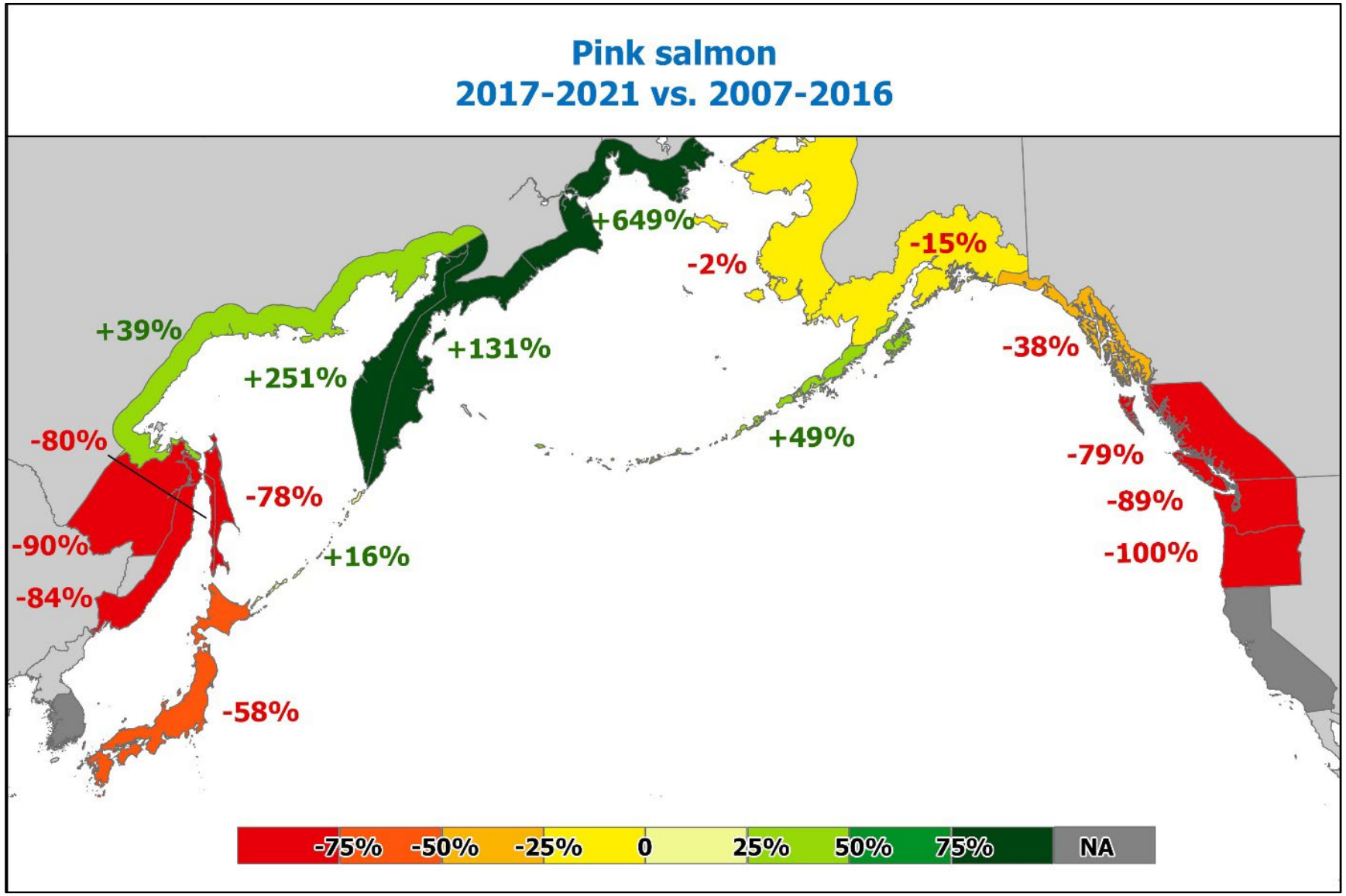


Salmon Ocean Ecology Program

Diet and prey analyses in partnership with UAF

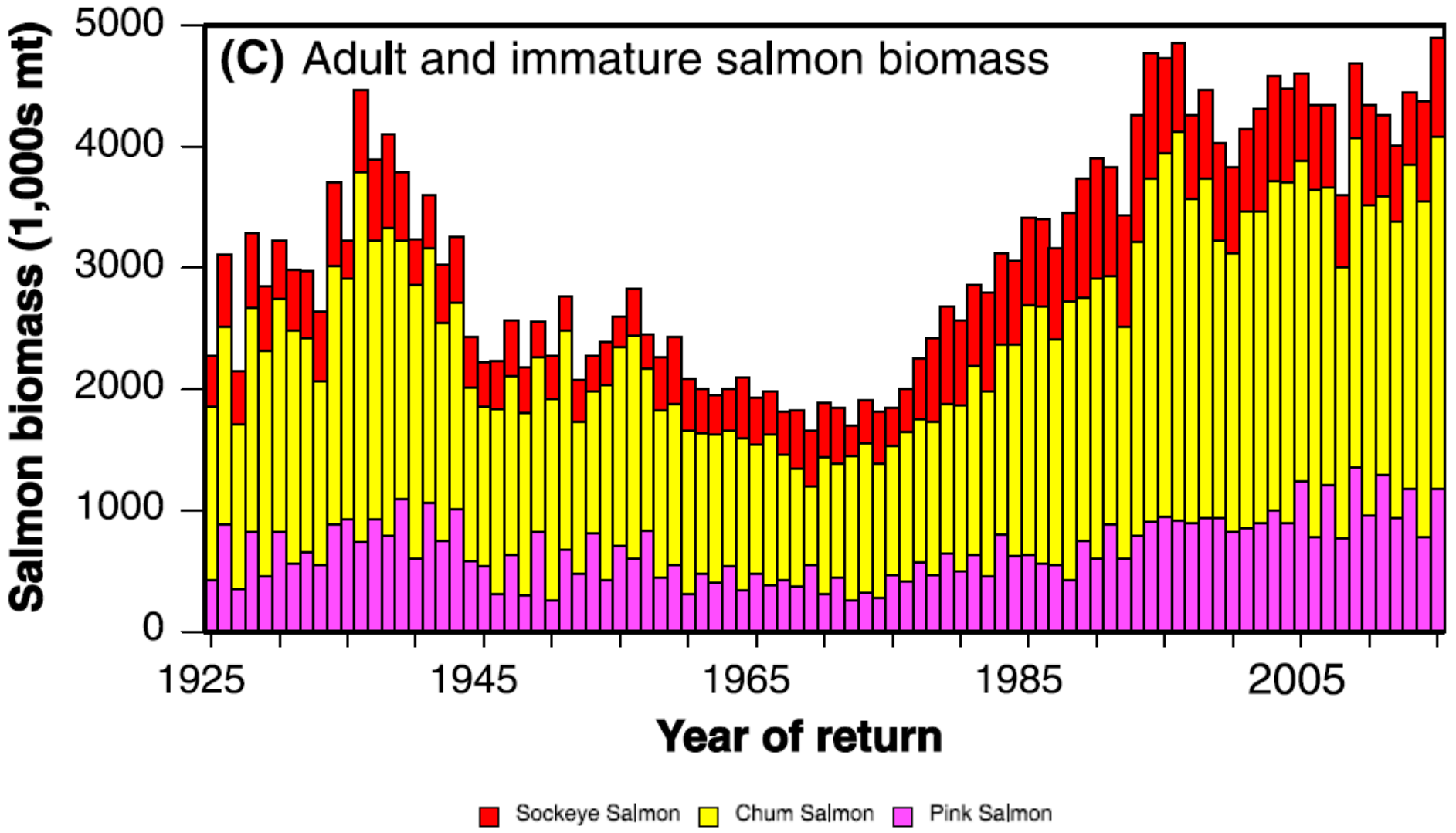
Pacific-wide Synthesis of Stock Assessment Information

NPAFC's Working Group on Stock Assessment



Improved Abundance Accounting for Salmon Across the Pacific

NPAFC's Working Group on Stock Assessment



Ruggerone & Irvine 2018

International Year of the Salmon

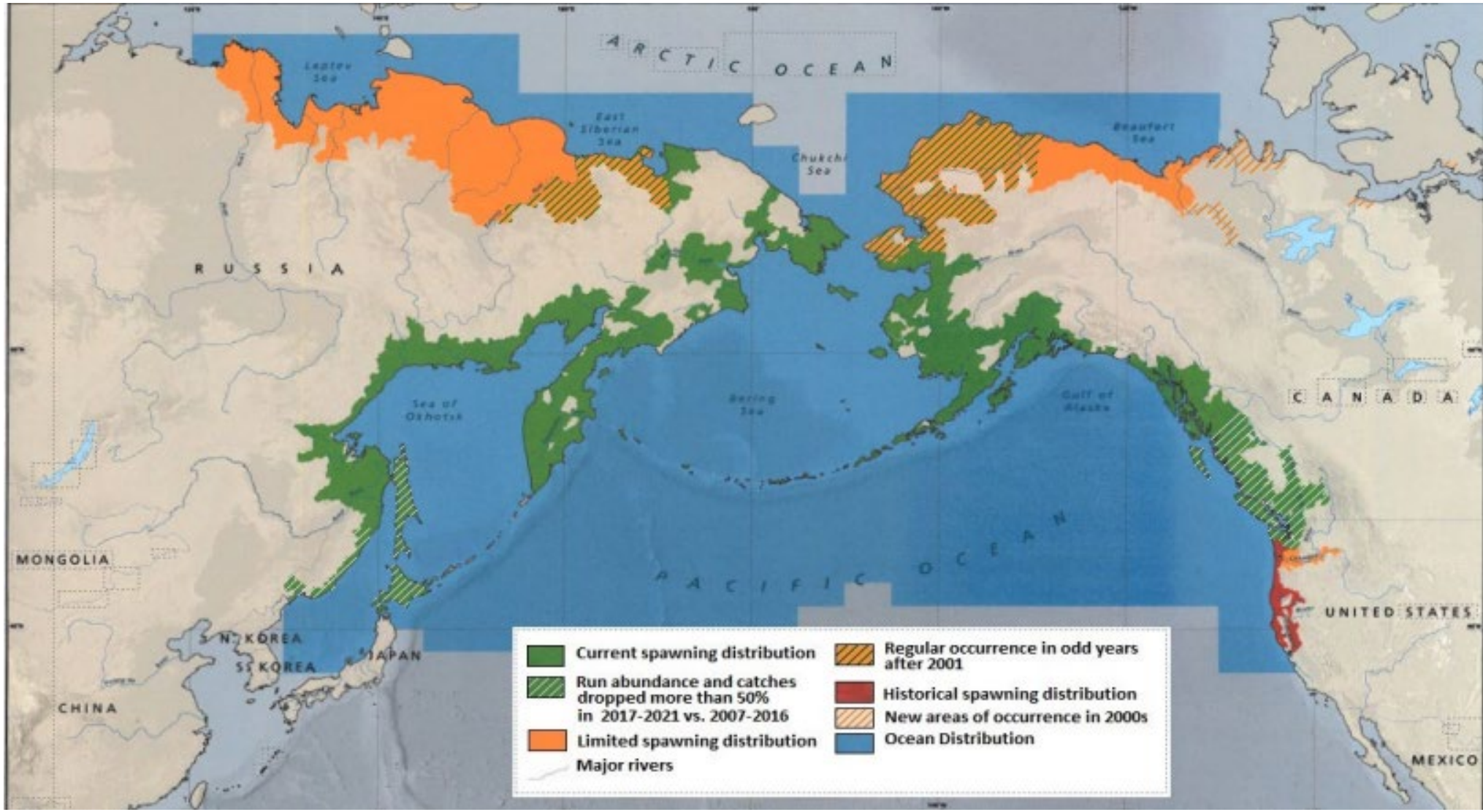
INTERNATIONAL YEAR OF THE SALMON

NPAFC

5-year initiative to support resilience for salmon and the people who depend on them by collectively generating and sharing knowledge across the international community

Northern Hemisphere Pink Salmon Expert Group

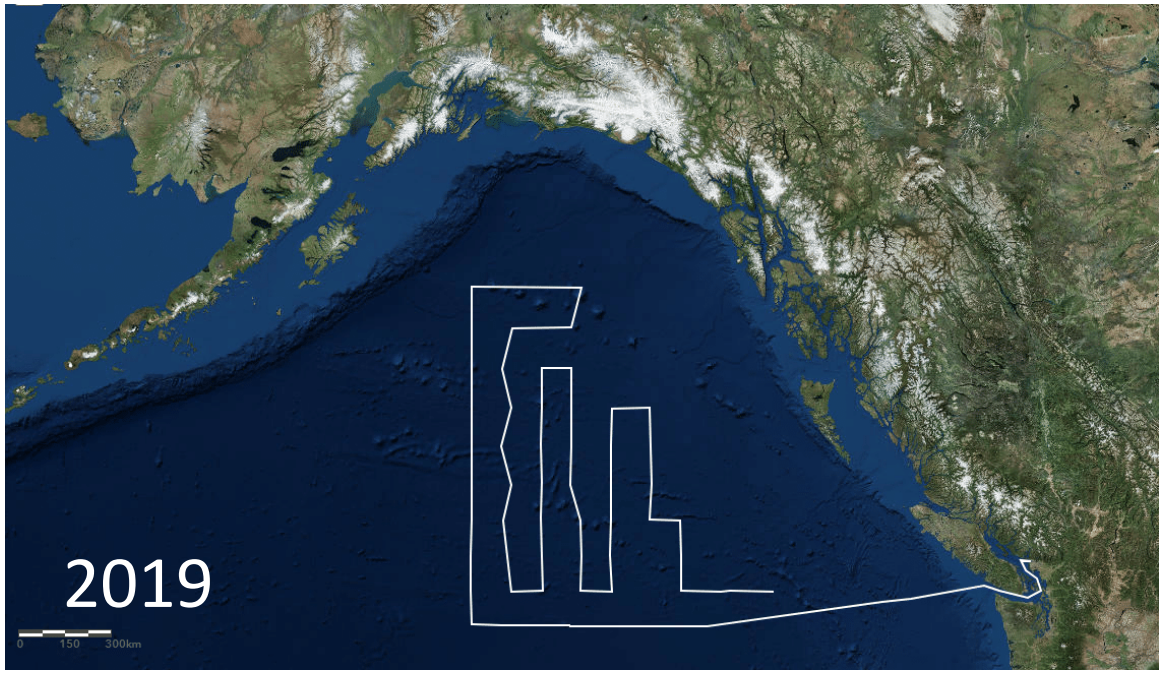
Pink Salmon Distribution

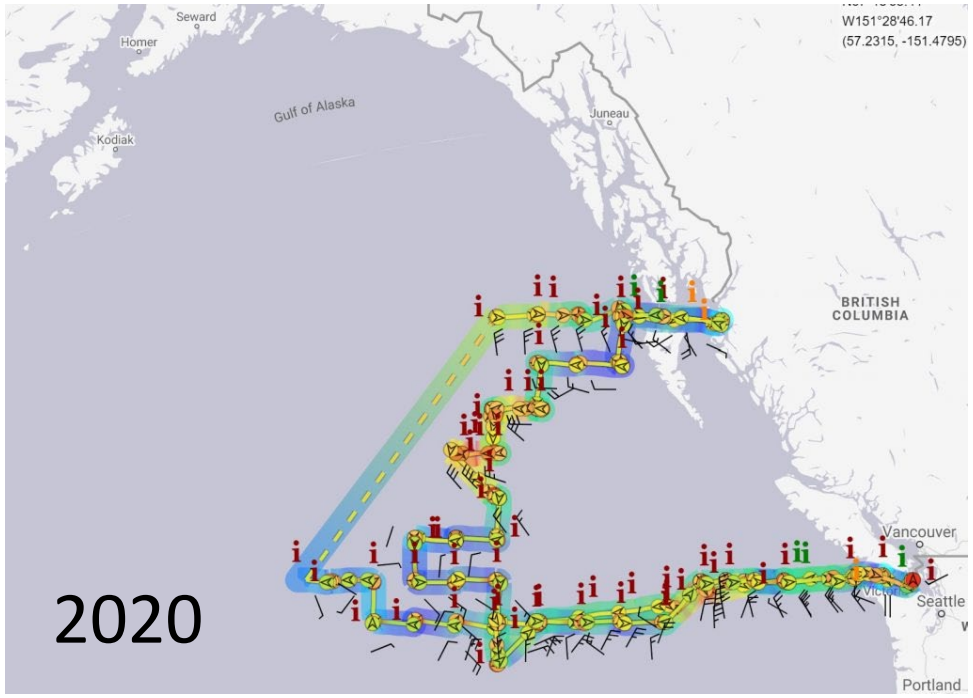


INTERNATIONAL YEAR OF THE SALMON

https://npafc.org/wp-content/uploads/Technical-Report-21.pdf

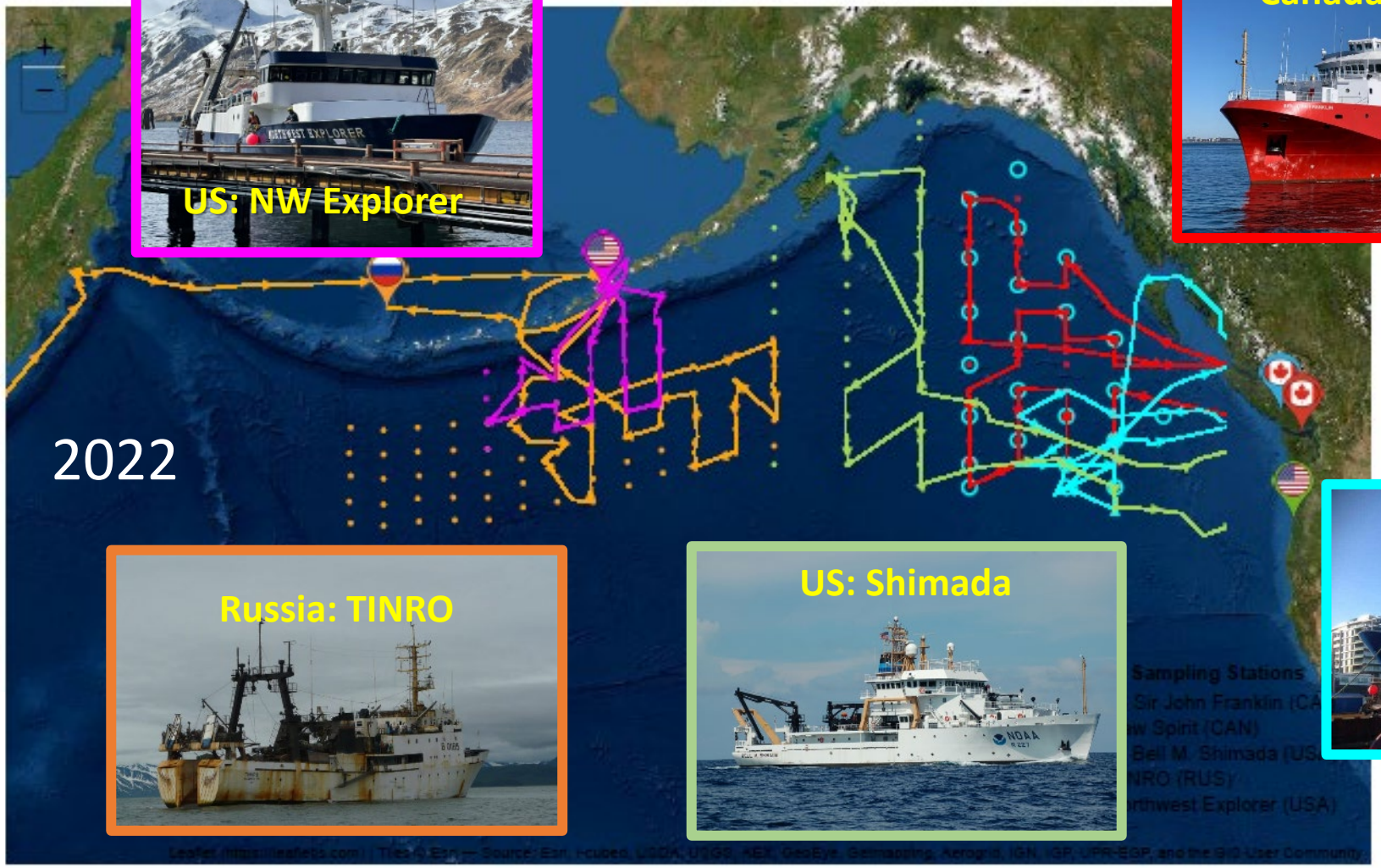
Eastern North Pacific surveys in Winter of 2019 and 2020





INTERNATIONAL YEAR OF THE SALMON

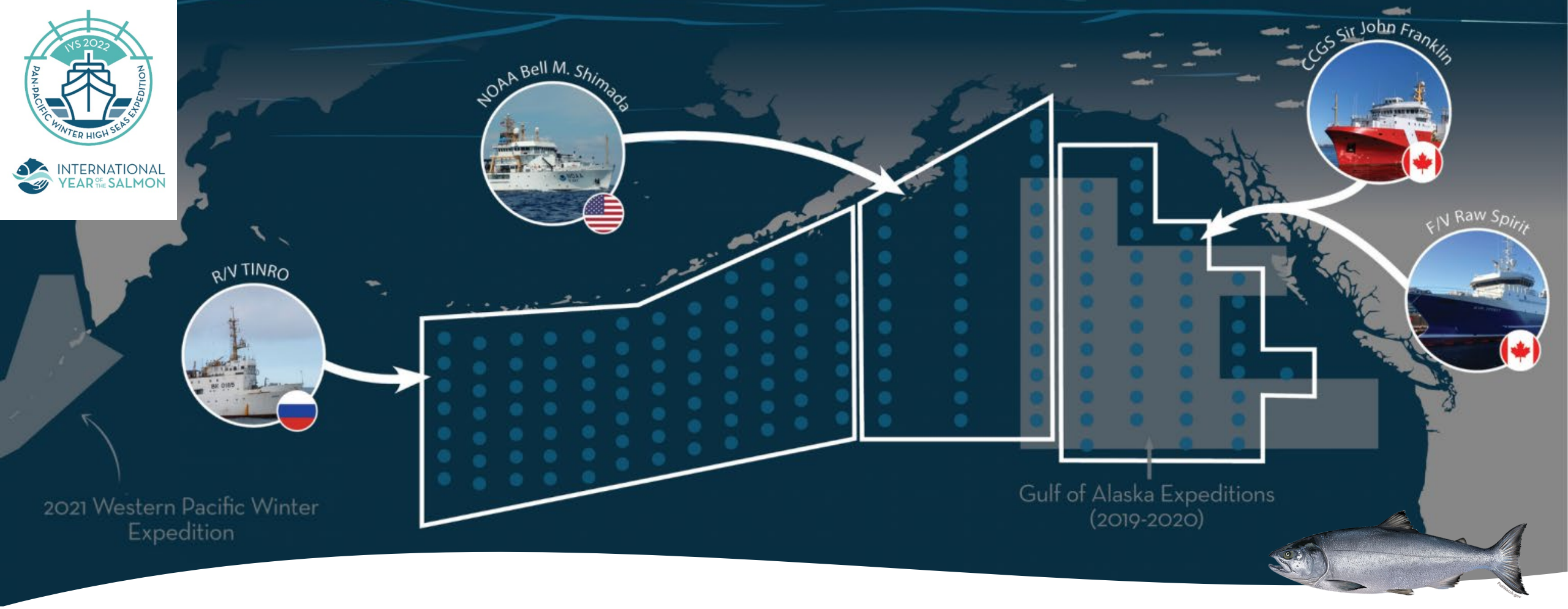
Central and Eastern North Pacific survey in winter of 2022
(covering 2.5 million km2)



INTERNATIONAL YEAR OF THE SALMON

https://npafc.org/wp-content/uploads/Public-Documents/2023/2060USA.pdf

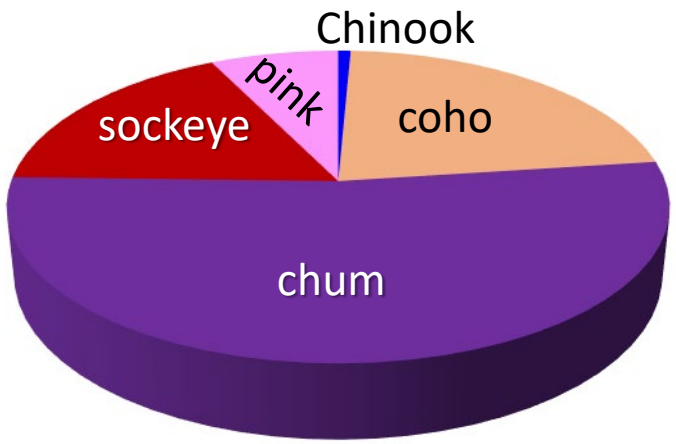
Weitkamp et al. 2023

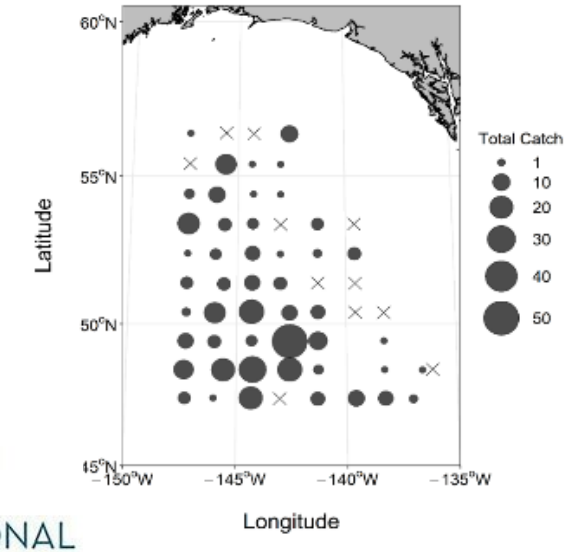


Use IYS survey data from winter (when competition should be highest) to directly measure spatial overlap and trophic competition between AYK chum and other species/stocks

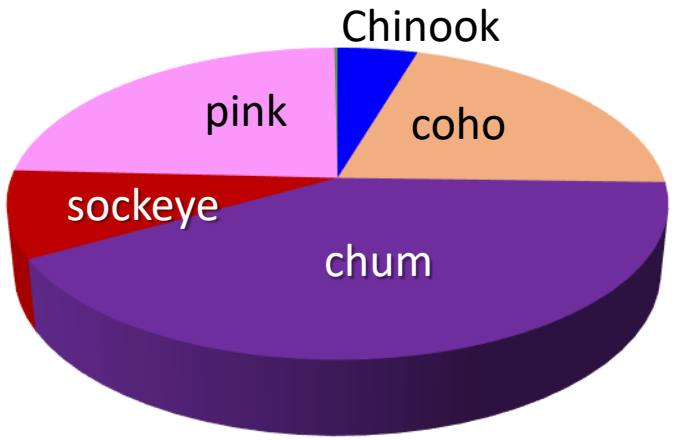
International Year of the Salmon

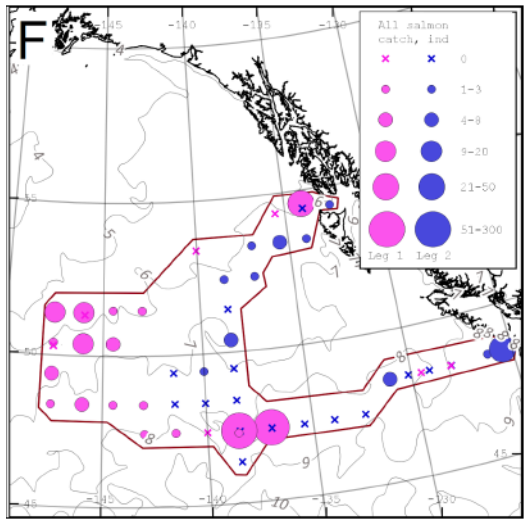
2019 (423)



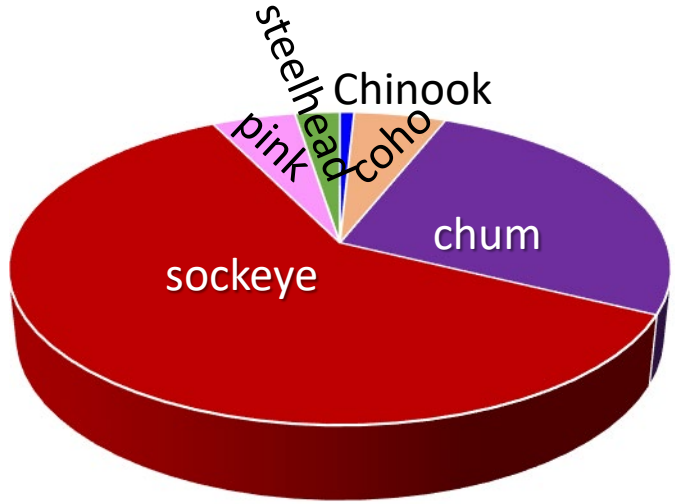


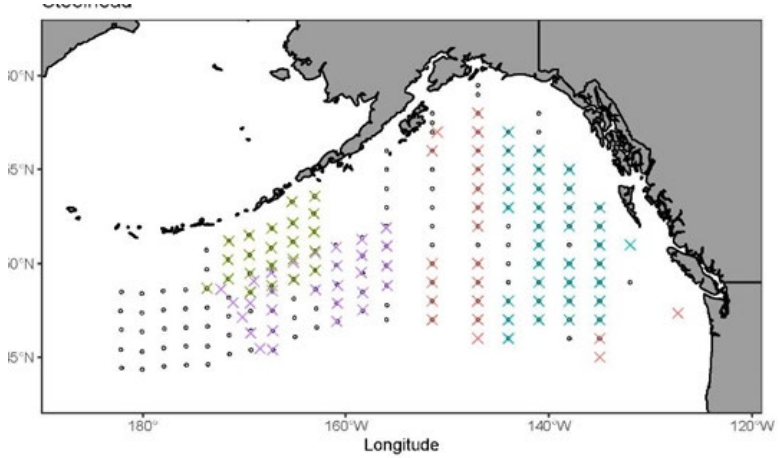
2020 (566)





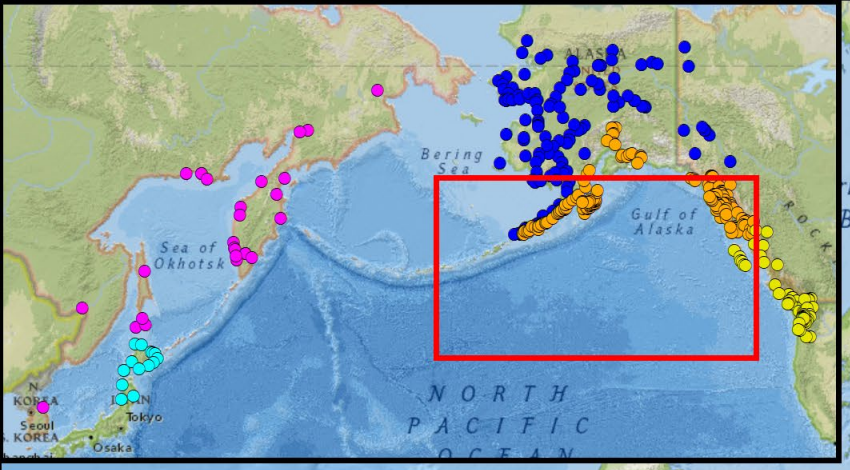
2022 (2,323)





Weitkamp et al. 2023

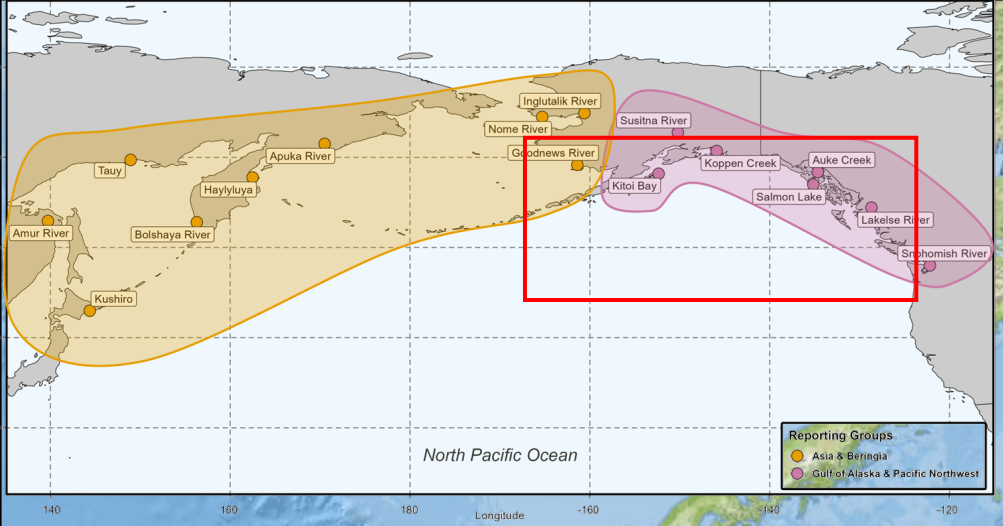
Chum Salmon Stock Distribution



All Vessels, scaled (n=566)

Gilk-Baumer et al. 2022

Pink Salmon Stock Distribution



All Vessels (n=98)

- Gilk-Baumer et al. 2022

THANK YOU

Dr. Katie Howard, Fisheries Scientist
Alaska Department of Fish & Game
kathrine.howard@alaska.gov