# Historical fluctuations and recent observations of Northern Anchovy in the Salish Sea


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PICES

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University of Victoria

Additional data and input provided by: Cheryl Morgan, Kym Jacobson, Anna Kagley, Correigh Greene, Dianne Sandford, Duane Fagergren, Jason Assonitis, and Josh Chamberlain

# The Salish Sea

- Estuarine circulation
- Complex physical oceanography
- Epipelagic forage fish community dominated by Pacific Herring

# Impetus

- Anchovy are present but generally not considered ecologically significant in Salish Sea

- But then came 2016….

- How has Northern Anchovy abundance fluctuated in the Salish Sea and what may drive fluctuations?

Photo: Jay Assonitis



Anchovy schools are back in session, with 'phenomenal numbers' spawning in Howe Sound

KIM PEMBERTON

More from Kim Pemberton

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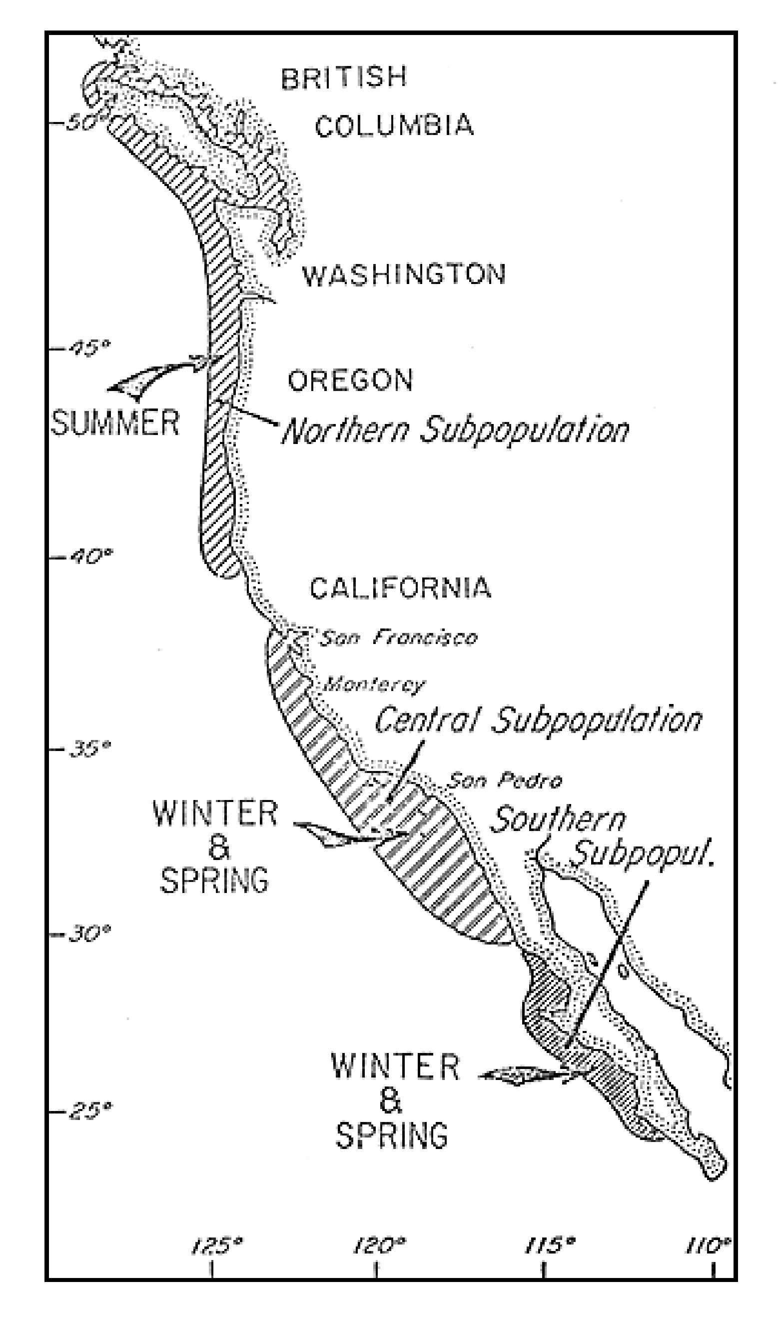
# Northern Anchovy (*Engraulis mordax*)


- **Three subpopulations**
- **High abundance linked to cool ocean**
- **Salish Sea at north end of distribution of less-studied northern subpopulation**
- **Richardson (1981) suggested northern subpopulation spawned off-shelf in Columbia Plume in summer; Fraser Plume could be another spawning habitat**
- **More recent work has suggests spawning may also occur much earlier in the year**




From: Smith and Lasker 1978

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  - Snohomish and Elwha beach seine surveys; Skagit Bay tow net surveys
  - Various other published records of surveys likely to catch anchovy based on gear, location and period.

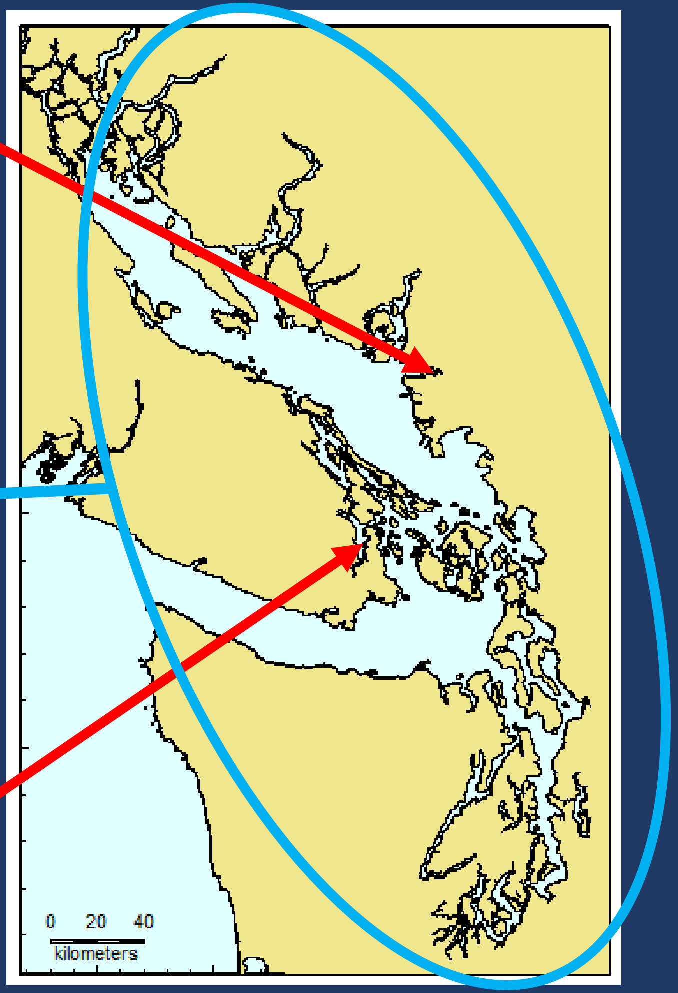
# Is low abundance the norm?

## Paleosedimentary, Paleoarchaeological and early historical accounts

Pierson (2011) – Anchovy 3rd most abundant fish in First Nations middens up to 3000 years old

Mckenchie and Moss (2016) – Anchovy present in 37% Of 94 First Nations Archaeological sites from the Salish Sea

O'Connell (1998) – Anchovy scales present in majority of laminated strata in Saanich Inlet from 1861-1900; very scarce in 20th century



# Is low abundance the norm?

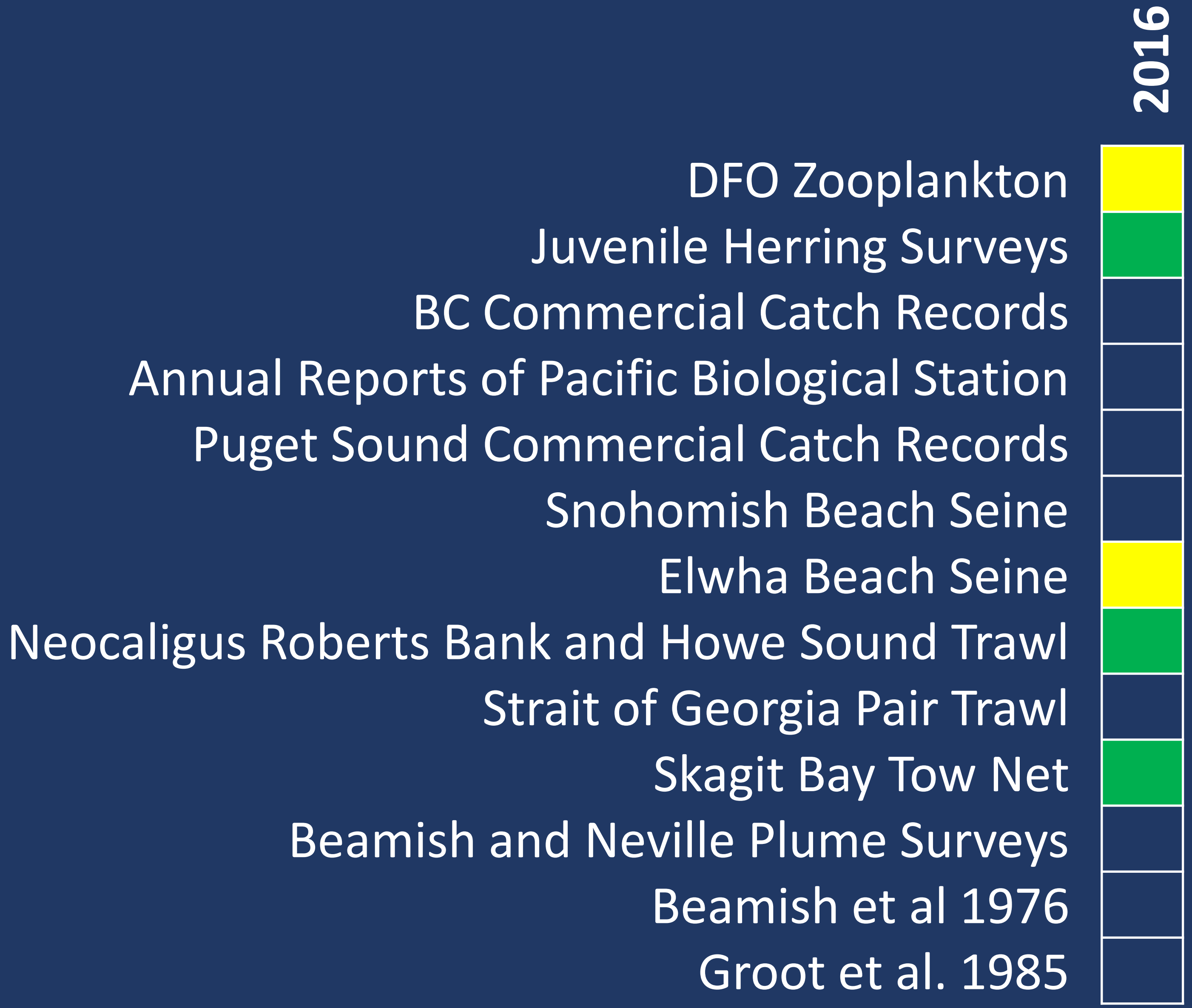
## Paleosedimentary, Paleoarchaelogical and early historical accounts

“Anchovy:- This fish is only second to the oulachan or houlican in its abundance. During the autumn it abounds in the harbours and inlets, and may be taken with great ease in any quantity.” -1872 - Annual report of the Department of Marine and Fisheries - The Honorable H.L. Langevin

“The anchovy come to Puget Sound in enormous quantities, and during their season, from May to November, every bay and inlet is crowded with them….. I have known them to be in such masses … that they could be dipped up with a common water bucket” – 1893 US Fish Commission Report

# Timeline of available data, abundant, present, absent or very scarce

*Generally based on frequency of presence in catch*



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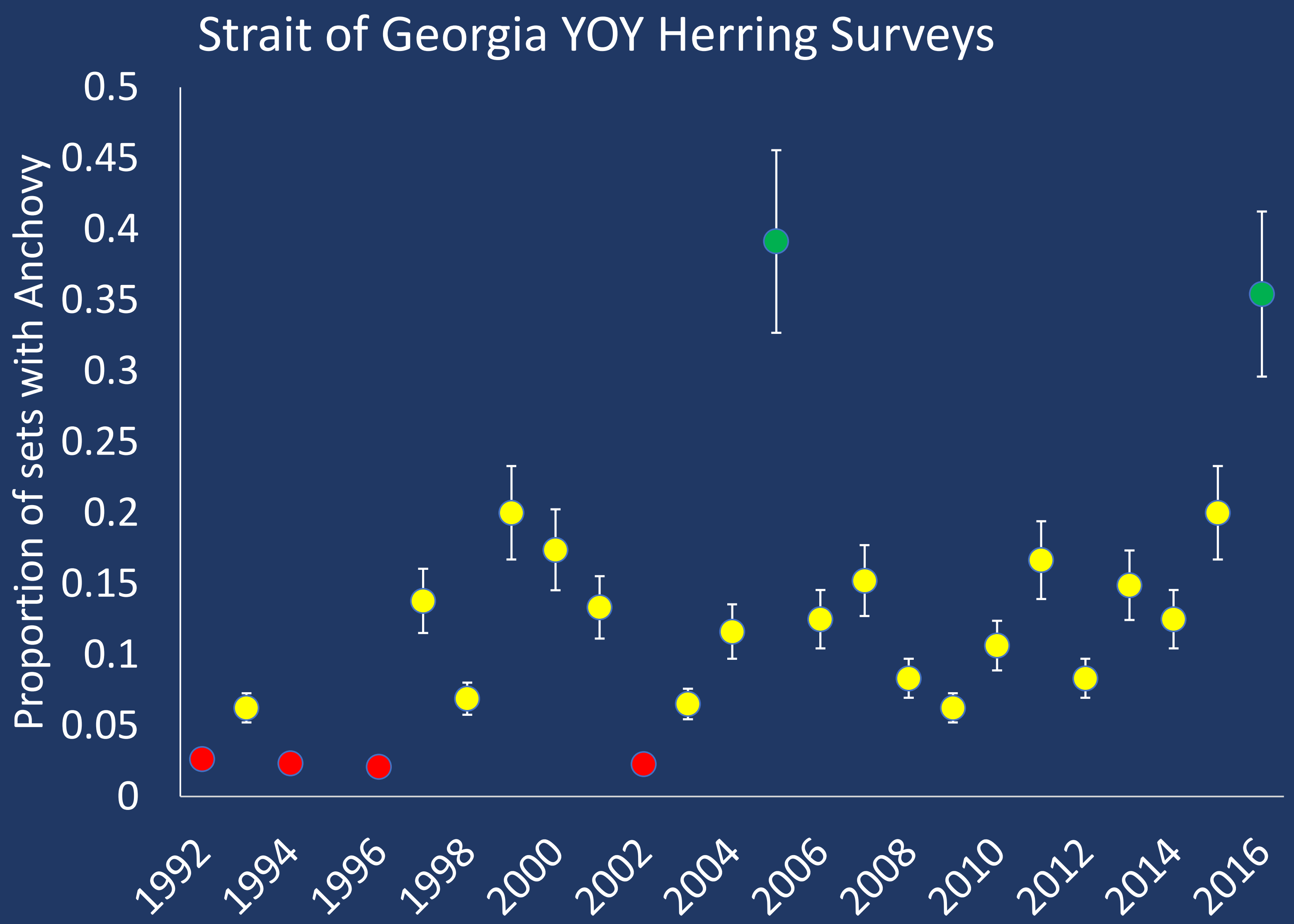

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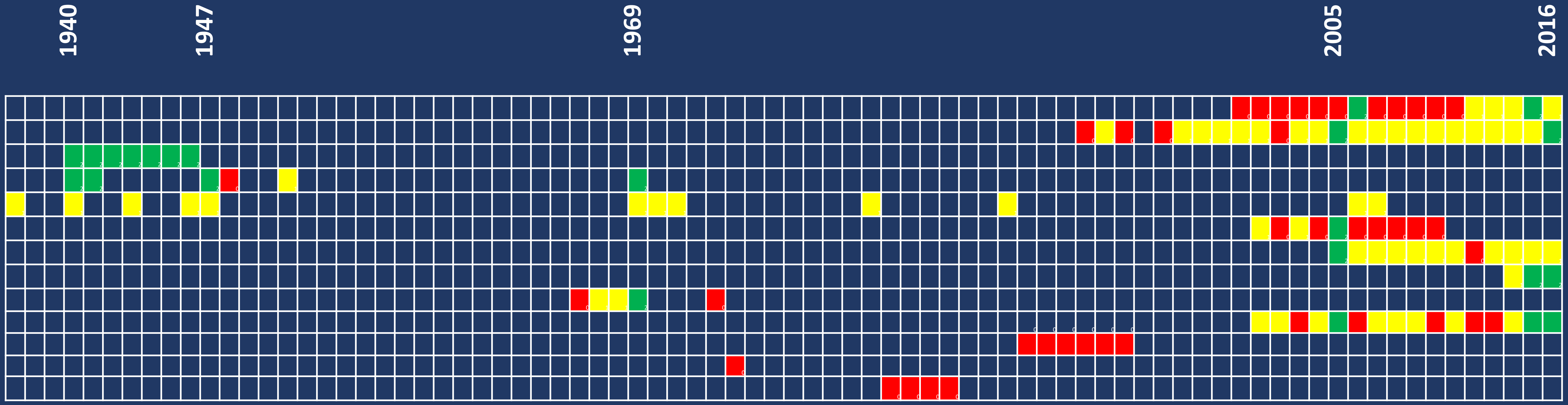
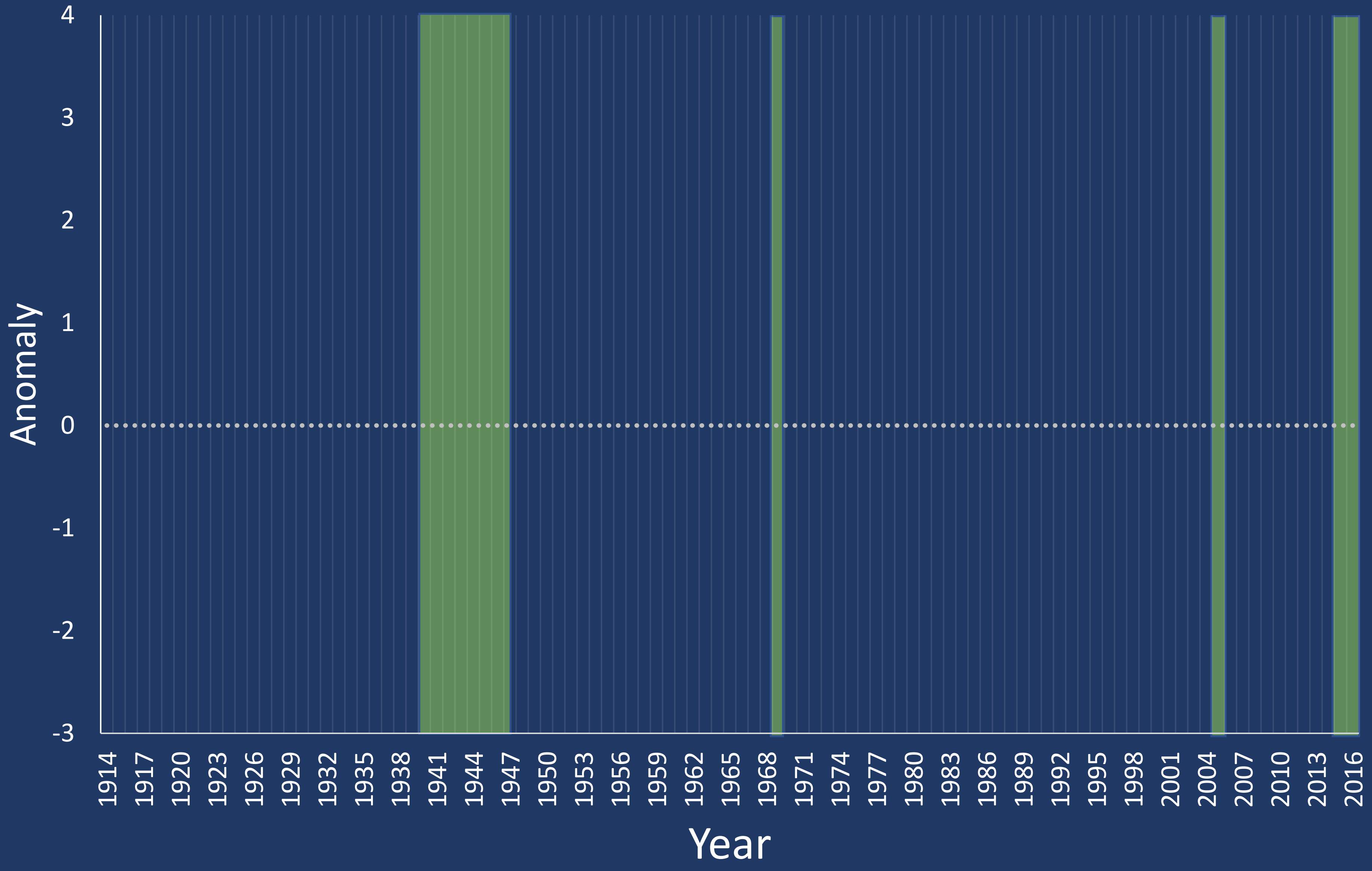
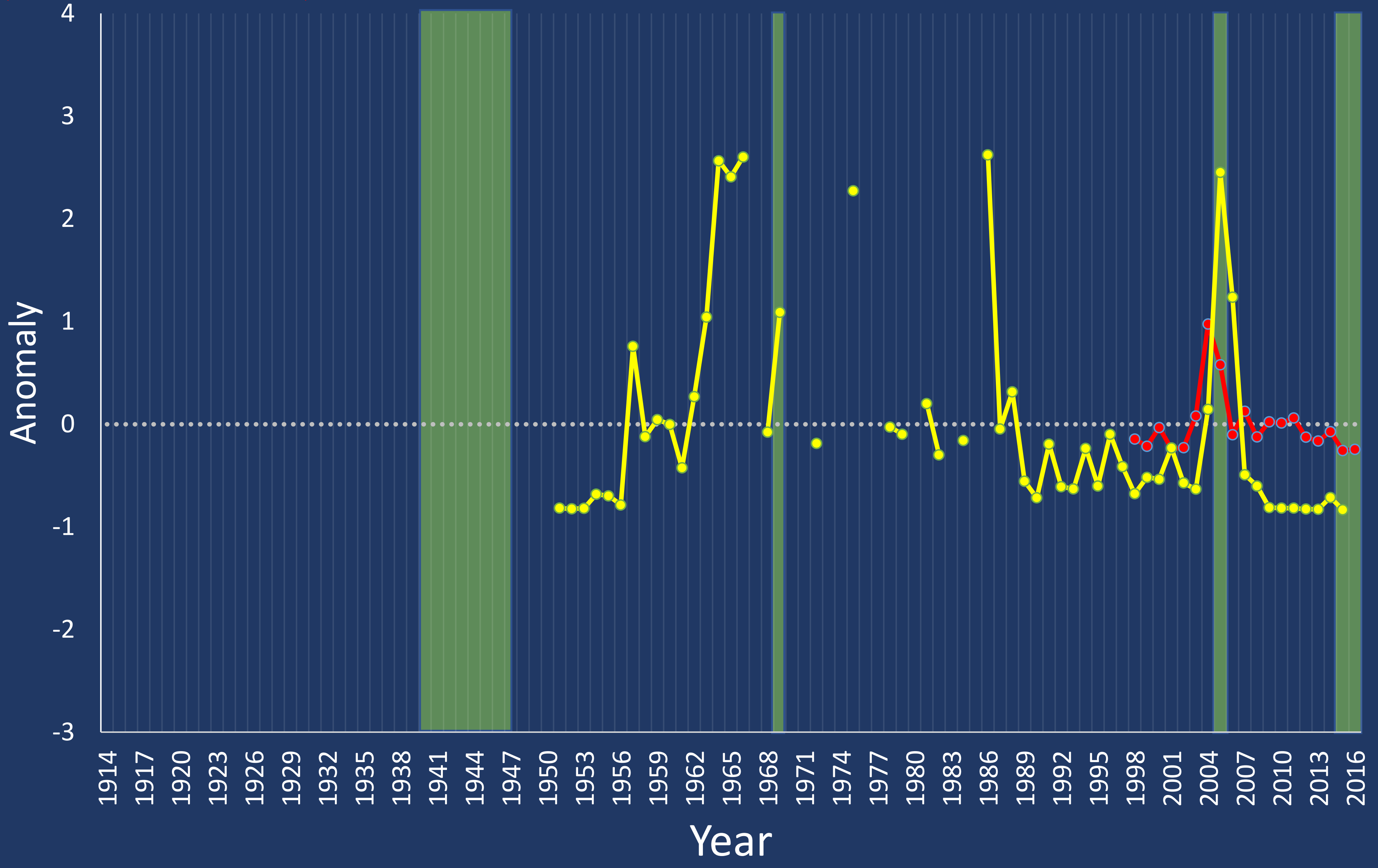


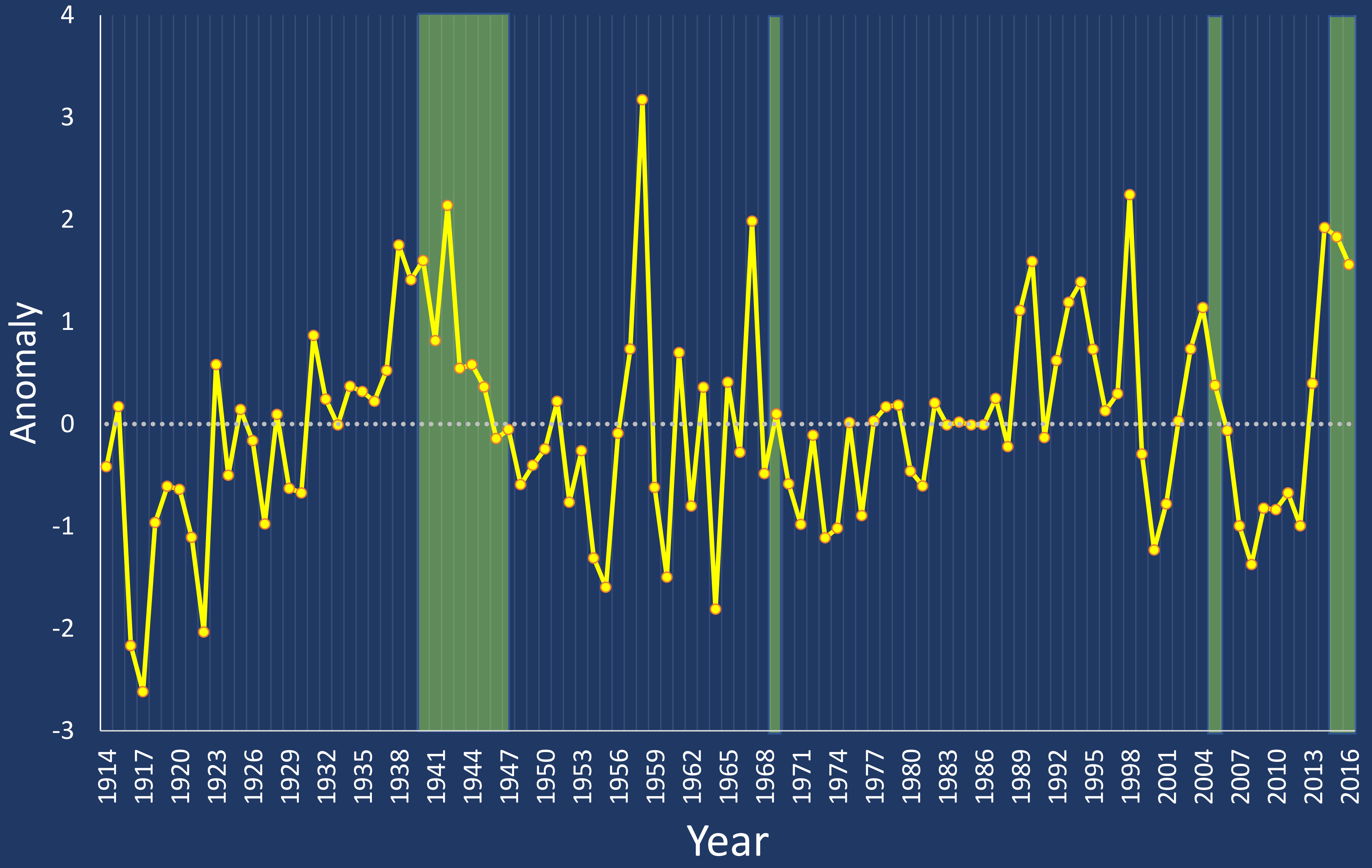
# Green boxes indicate inferred periods of high abundance in Salish Sea – other periods may or may not have occurred



**Standardized central subpoplulation biomass based on egg and larval surveys** (Thayer et al. 2016)
**Standardized log (density+1) for anchovy in June Columbia River plume surface trawls (courtesy Cheryl Morgan)**

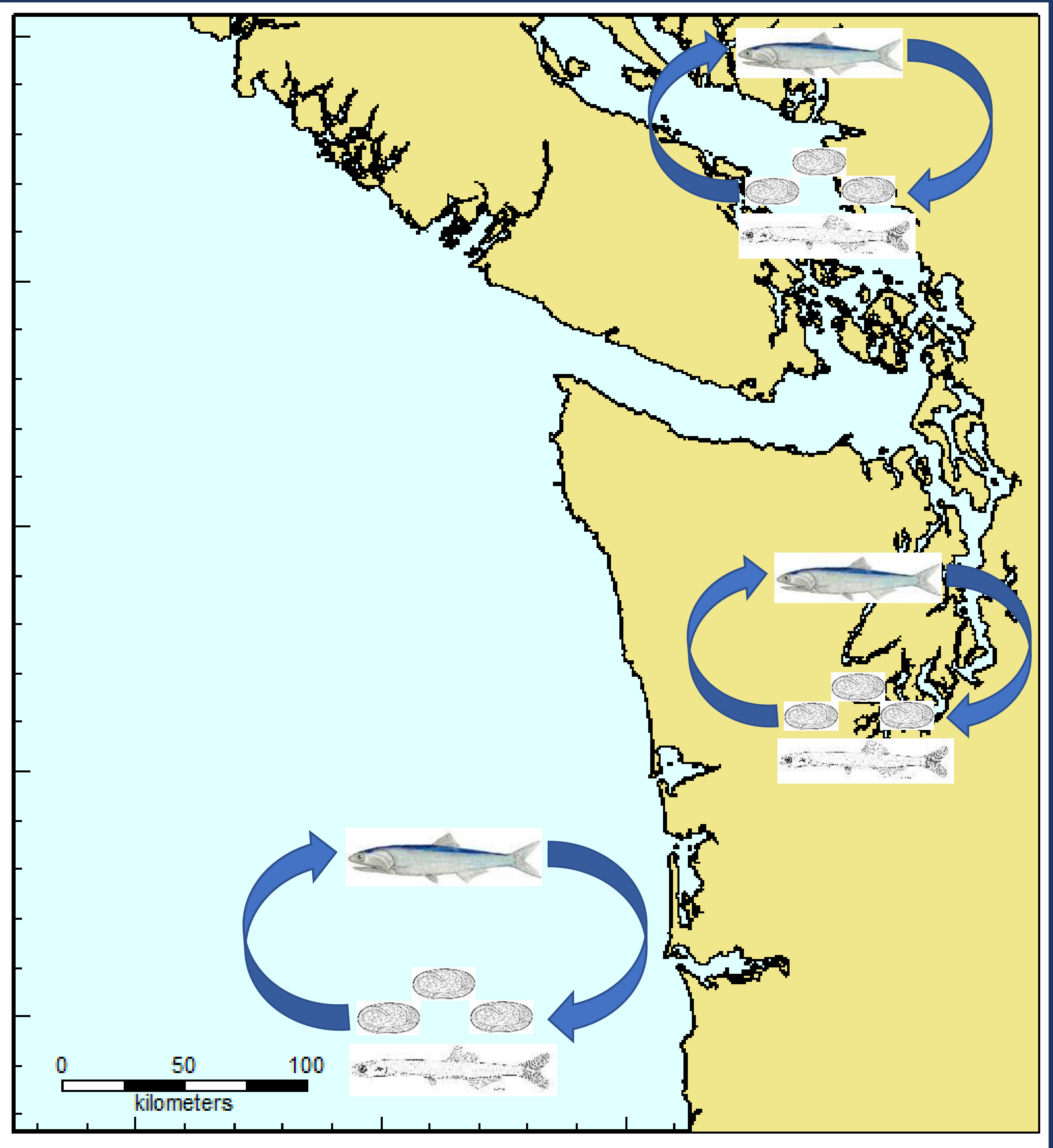


**Standardized annual average surface temperature at Pacific Biological Station in the Strait of Georgia**



# Where is Abundance Controlled?

- Spawning and Recruitment within Salish Sea Basins



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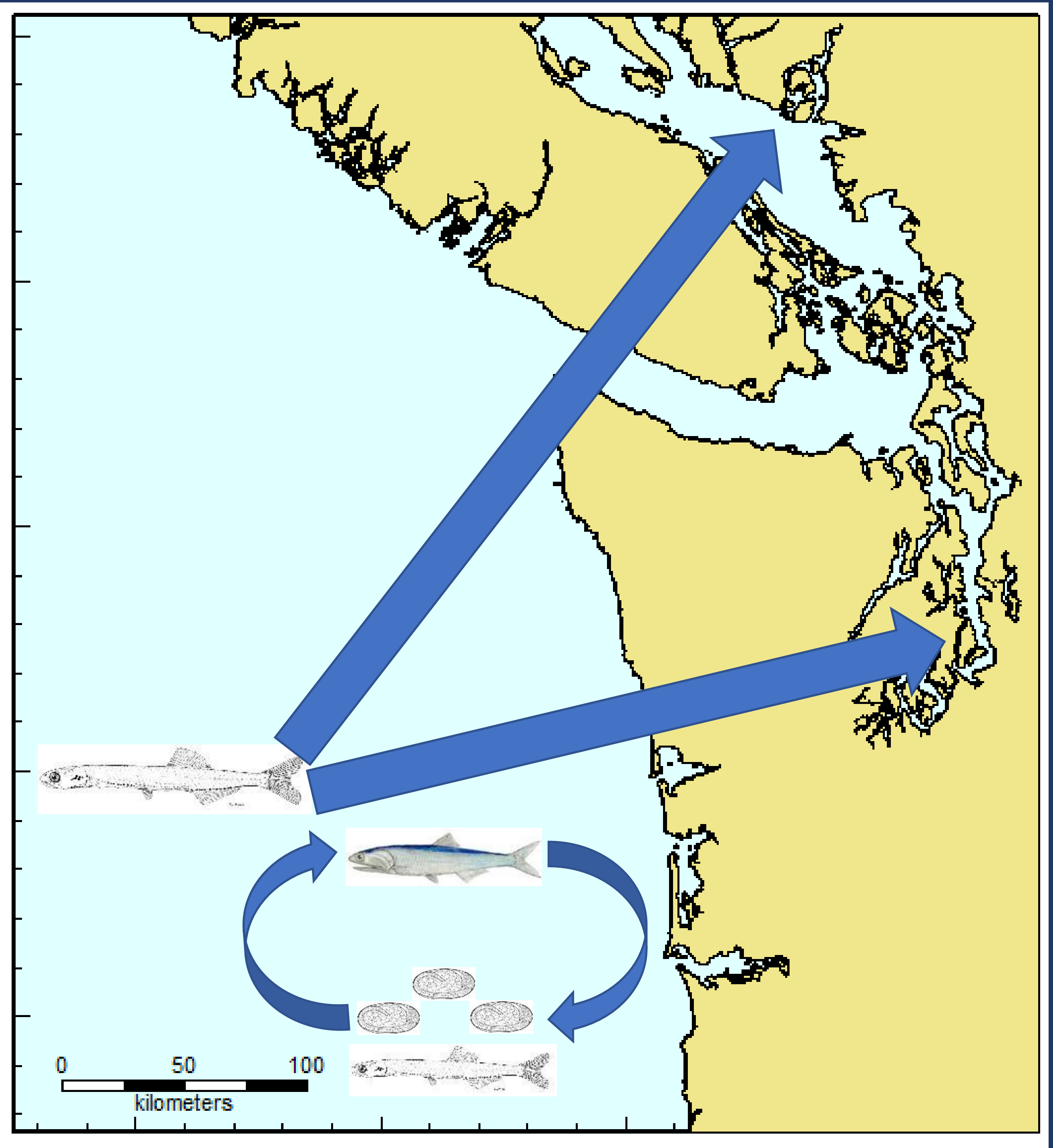

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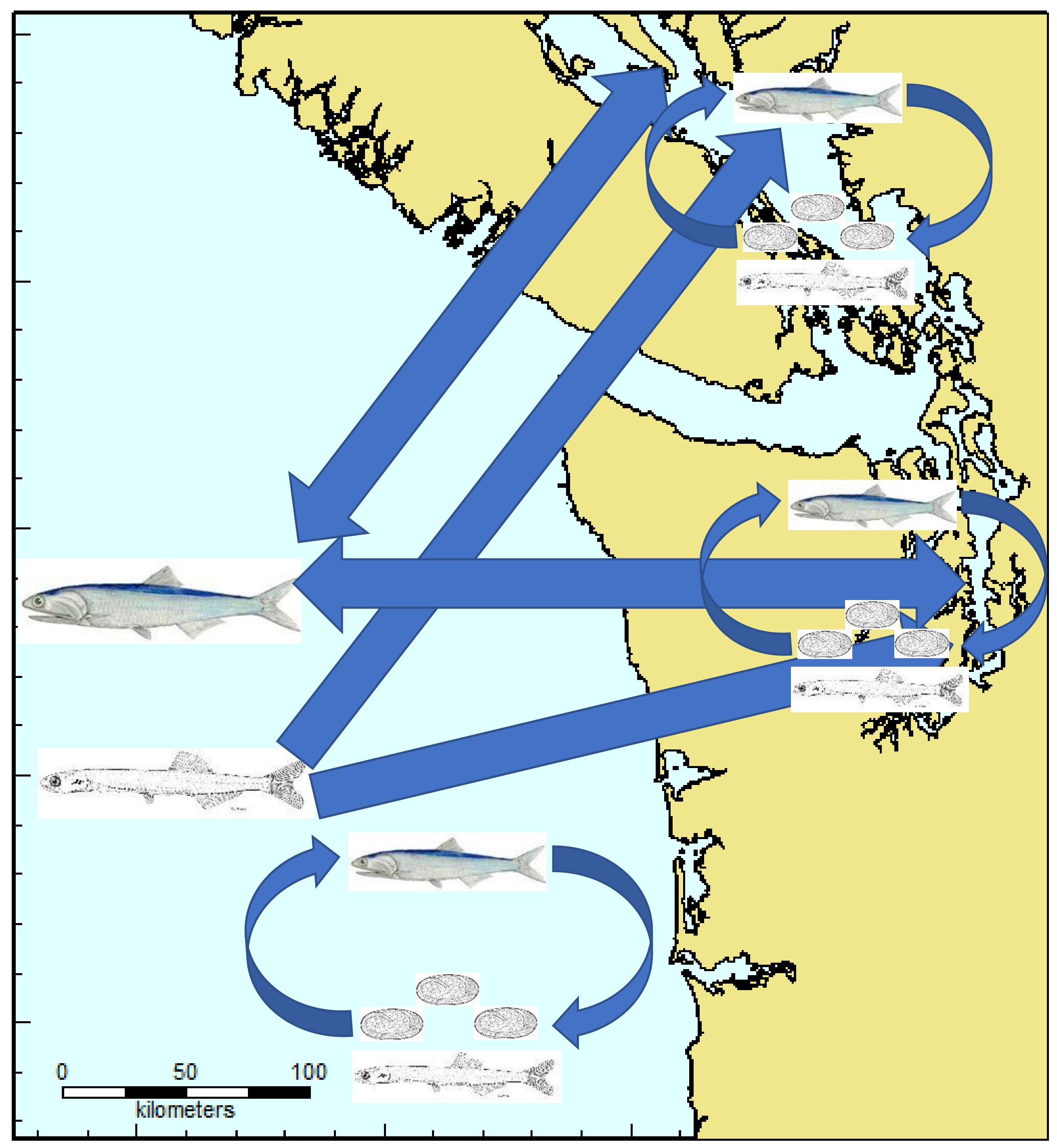
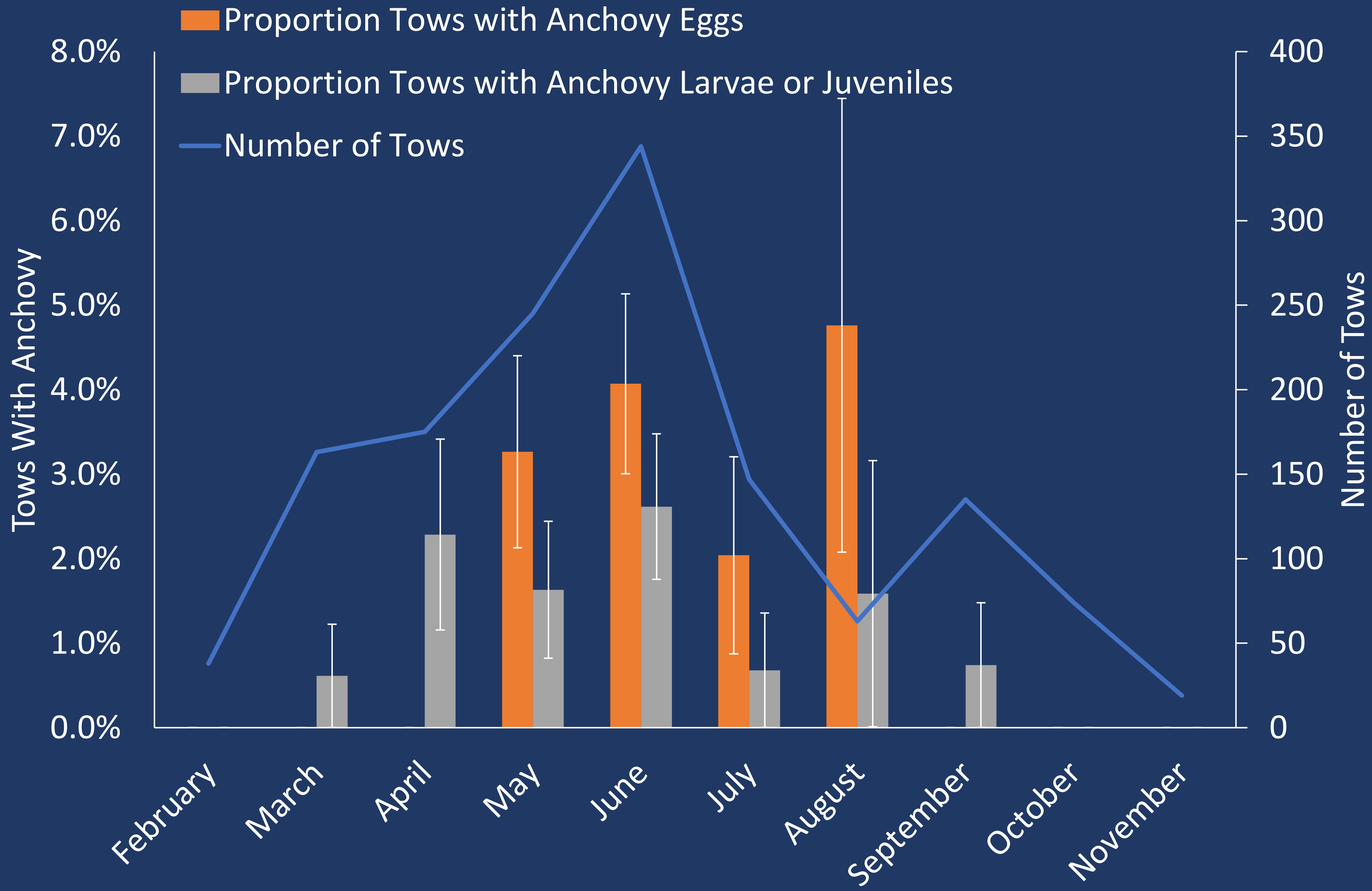
- Combination of resident and migratory populations or population components

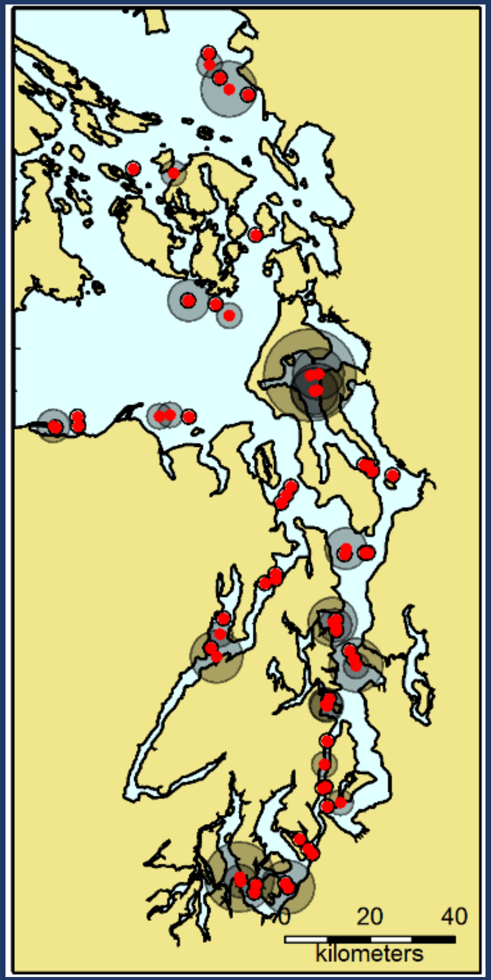


# Does Successful Reproduction occur in the Salish Sea?

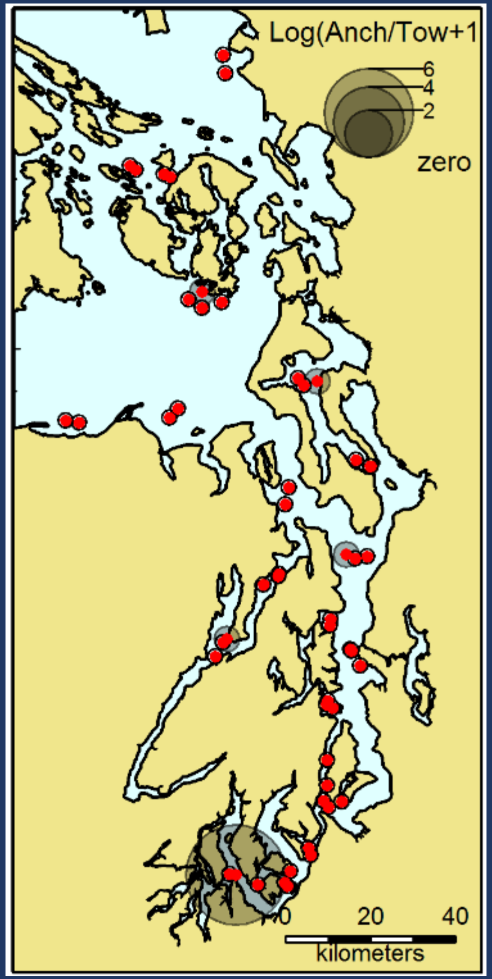
*DFO Zooplankton Tows 2006 and 2012-16*



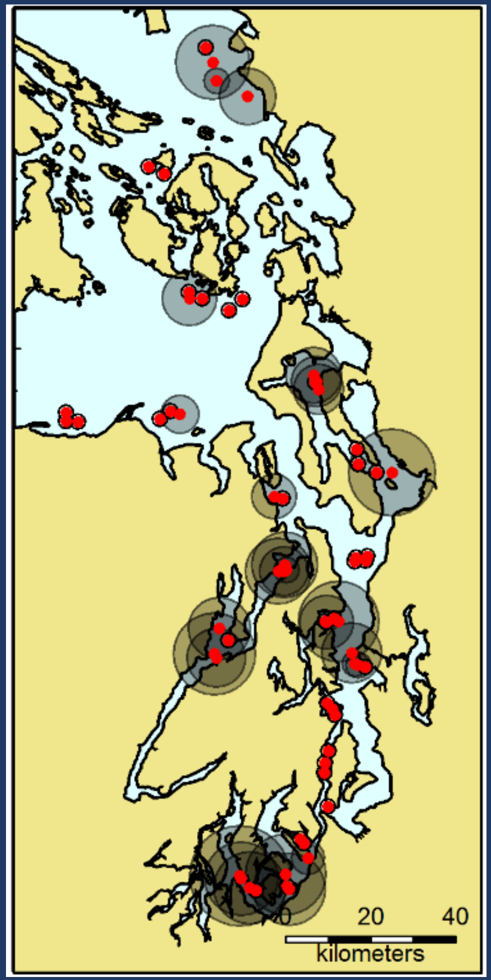

# What About Migration? Puget Sound Midwater Trawl Survey 2016




February-April




June-August

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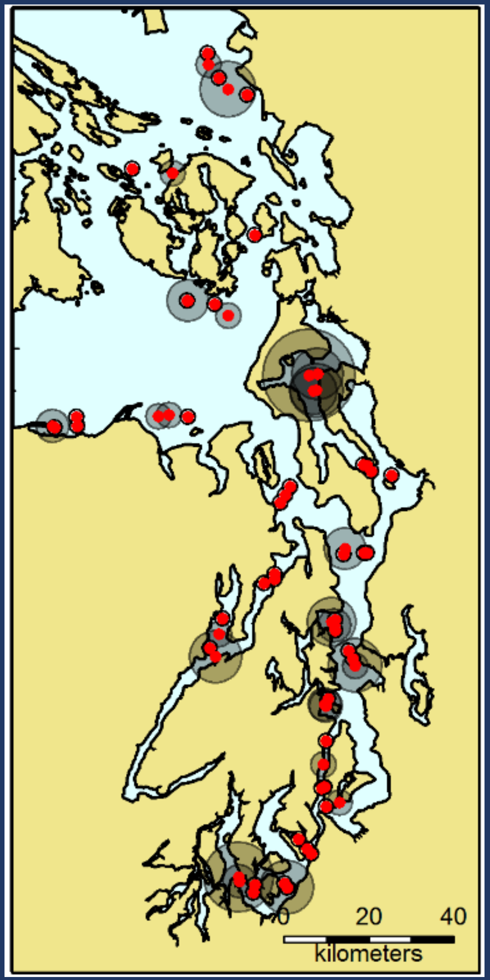


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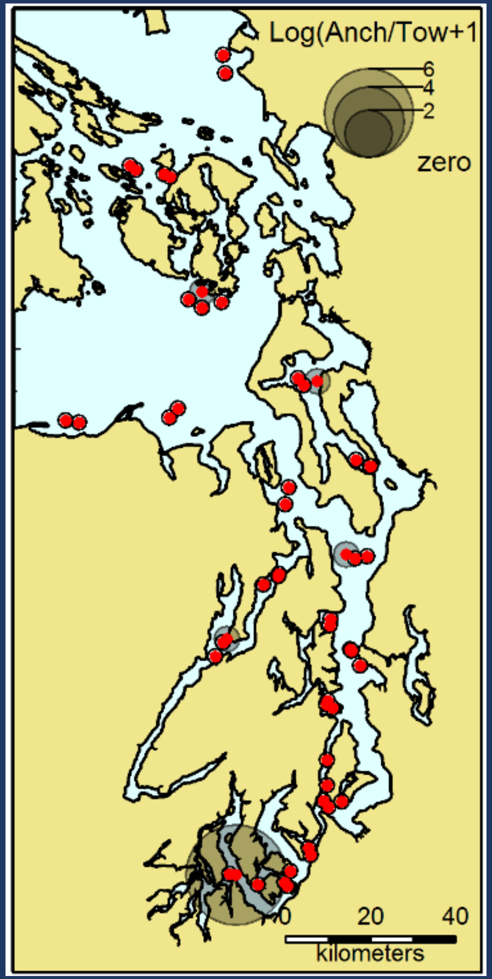


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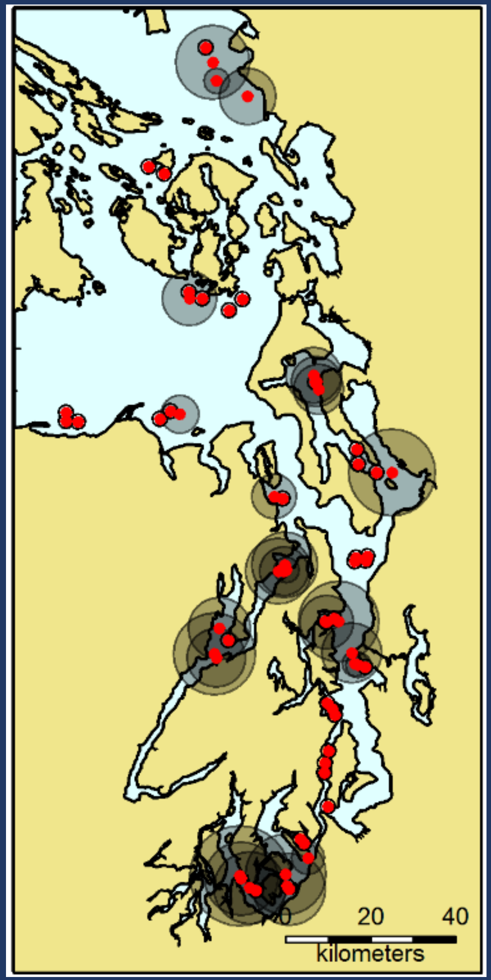


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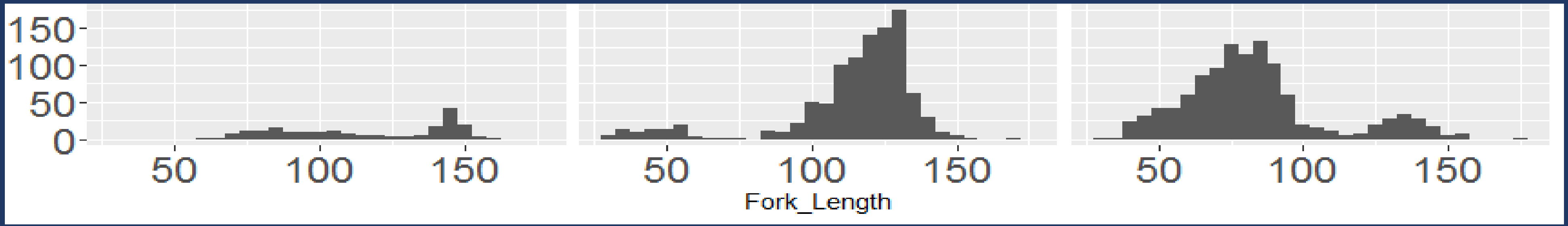

# 2005 vs 2016

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| **Planktonic eggs/larvae detected in current/ recent years?** | No | Yes |
| **Abundant Central subpopulation?** | Yes | No |
| **Abundant Northern subpop. (Columbia Plume)?** | Yes | No? |
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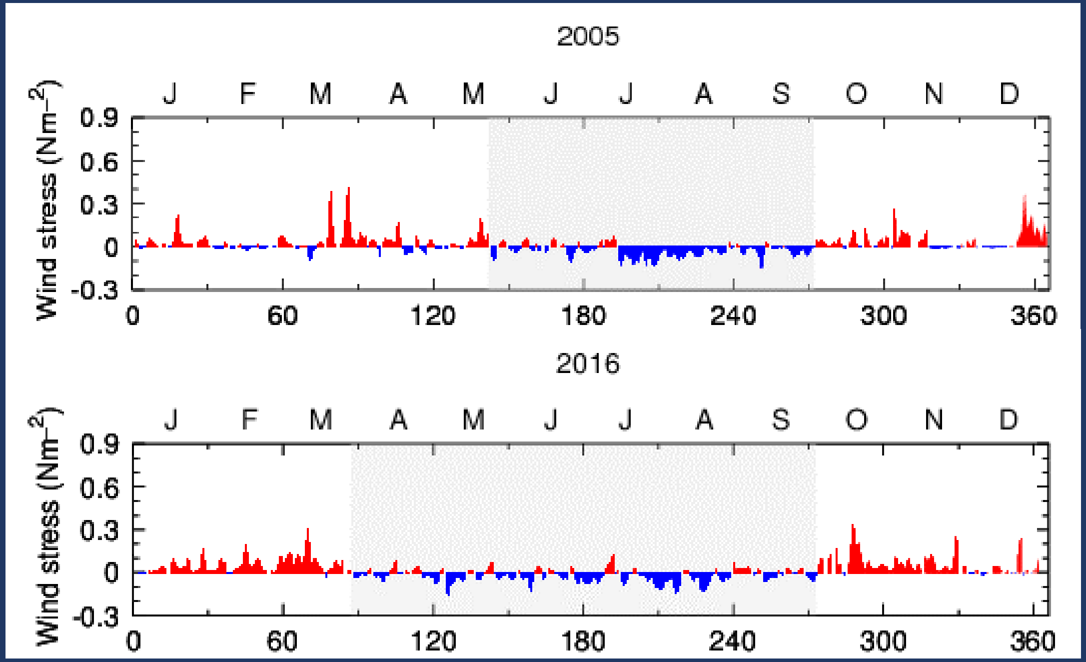

Pierce and Barth, Oregon State University

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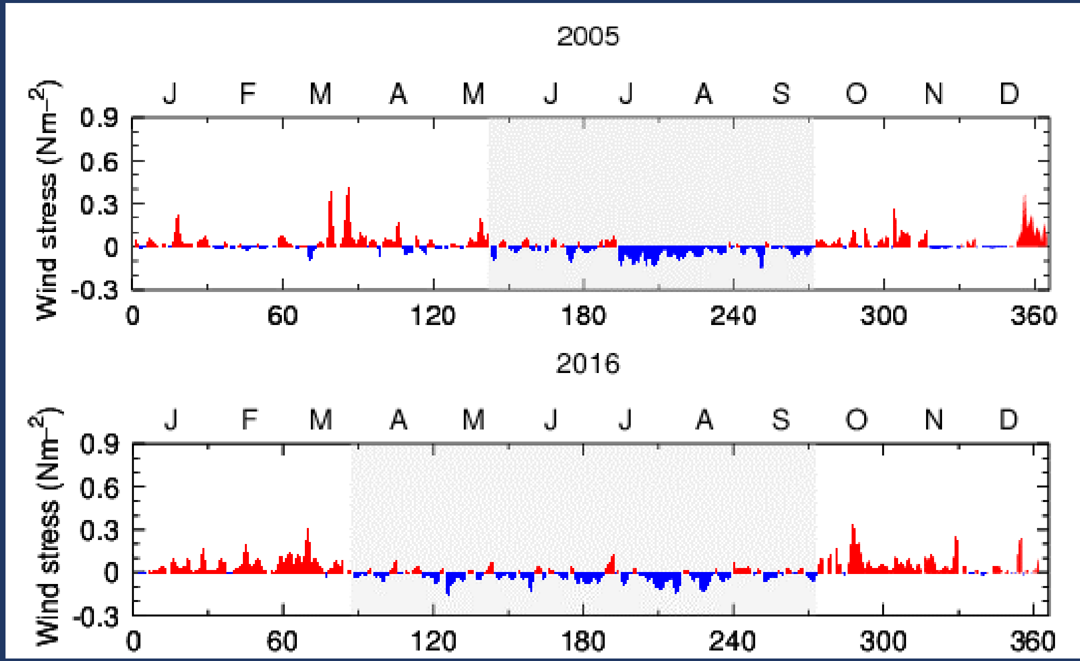
| **Juvenile size in SOG in Fall** | Larger | Smaller |

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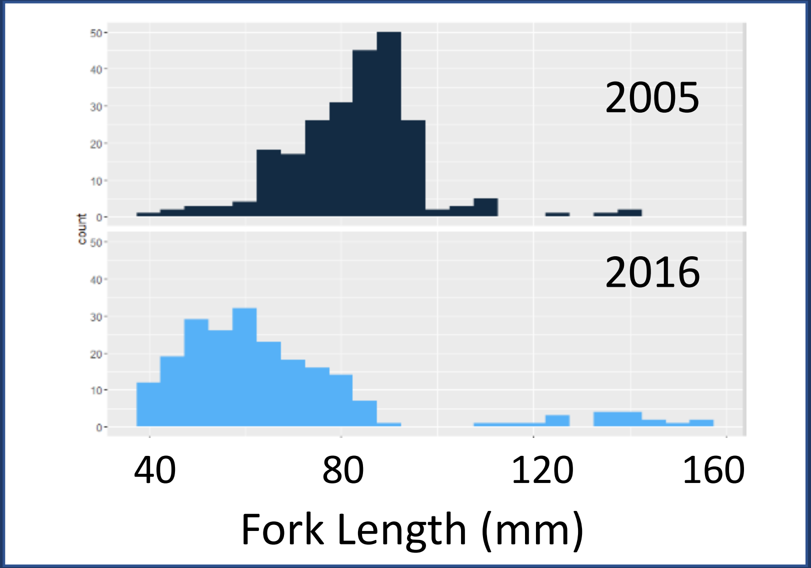

# Outstanding Research Questions

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- Mechanism limiting persistence in Strait of Georgia

  - Summer reproductive phenology and growth?

  - Winter temperature limitation?

Photos Dianne Sandford, Strait of Georgia January 2017

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**Ontogenetic shifts in the diets of juvenile Chinook Salmon: new insight from stable isotopes and fatty acids**

Marisa N. C. Litz • Jessica A. Miller • Louise A. Copeman • David J. Teel • Laurie A. Weitkamp • Elizabeth A. Daly • Andrew M. Claiborne

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  - Summer reproductive phenology and growth?

  - Winter temperature limitation?

- Implications of persistent future presence in Salish Sea?

# QUESTIONS?