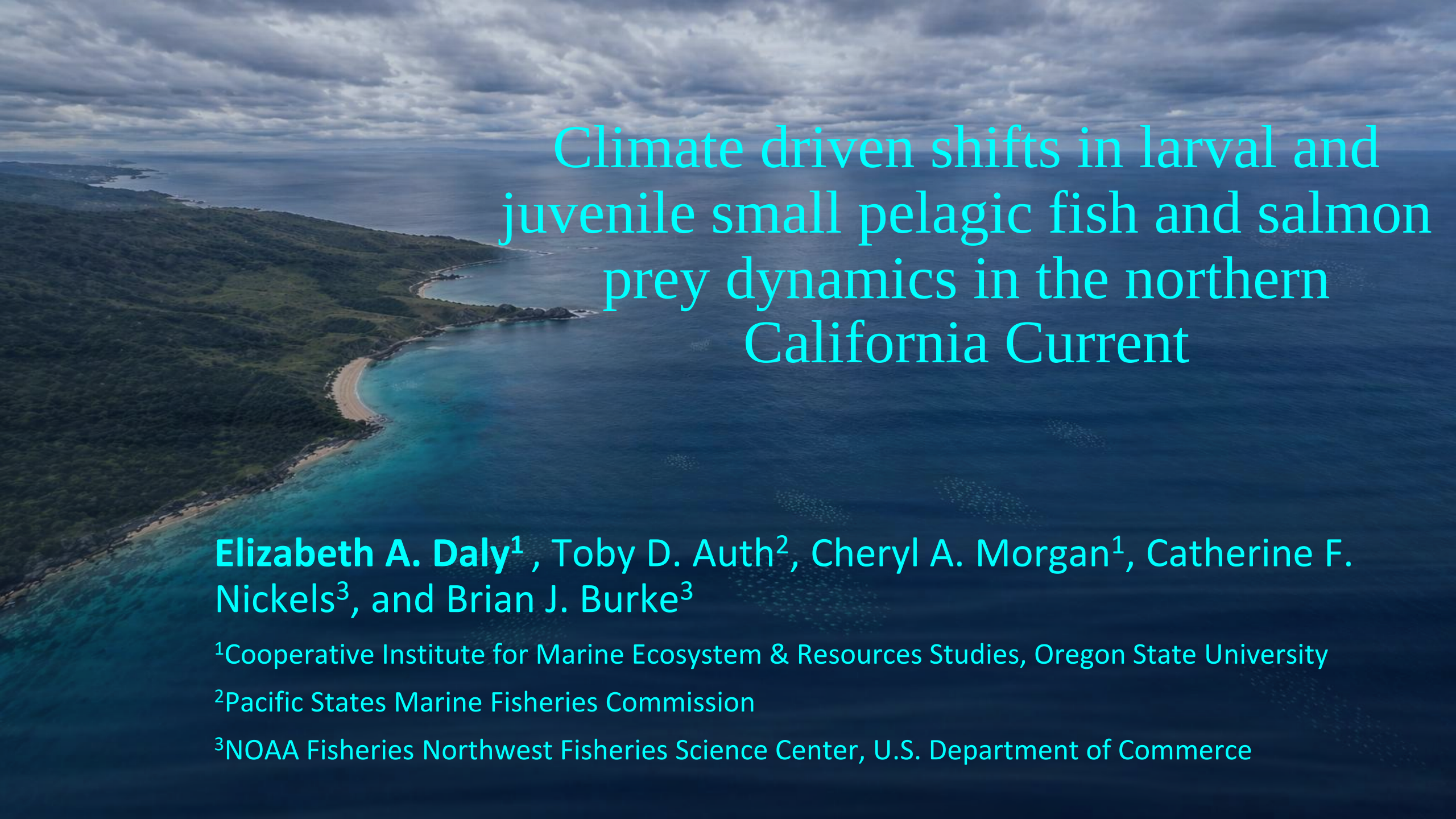

# Climate driven shifts in larval and juvenile small pelagic fish and salmon prey dynamics in the northern California Current

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# Research Objectives:

1. Has larval and juvenile Small Pelagic Fish (SPF) **abundance and timing shifted** in the northern California current (NCC) since 1998?

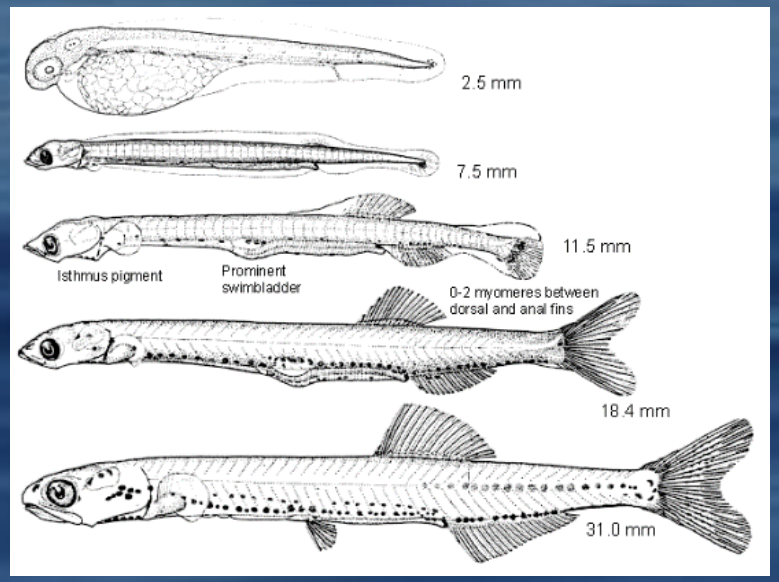
2. Can we determine if **ocean conditions** are associated with observed changes in SPF?

3. Does the **condition** of SPF differ between years and has **predator-prey dynamics** of a piscivorous predator shifted with observed SPF changes?

# Small pelagic fishes of our study

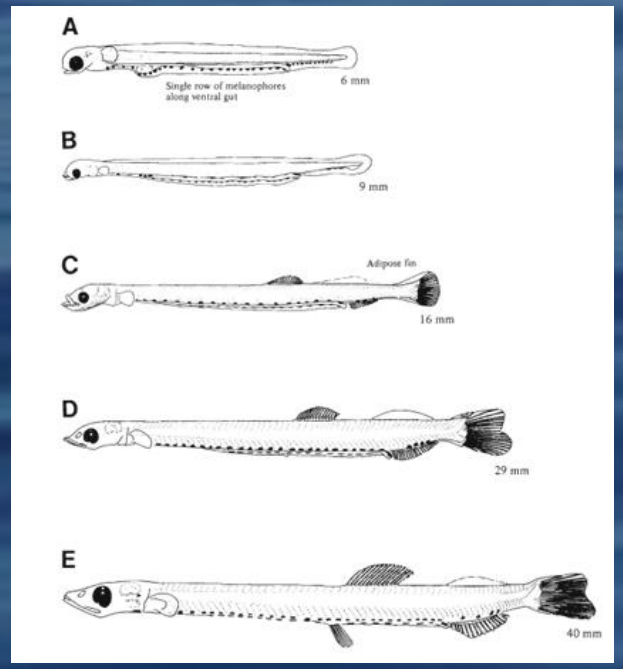
## northern anchovy

Spawn in spring & summer in offshore waters of the NCC




## Smelts (6 taxa)

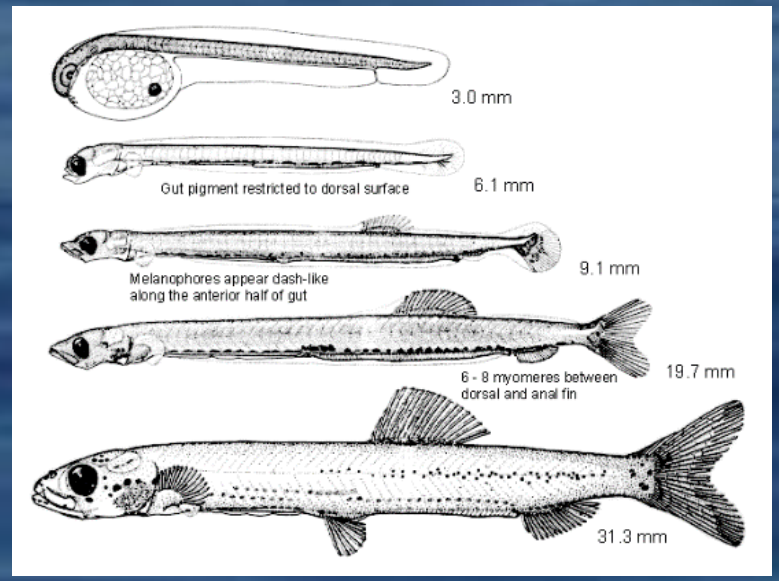
Spawn in winter-spring in nearshore water of the NCC




Matarese et al. 1989

## Pacific sardine

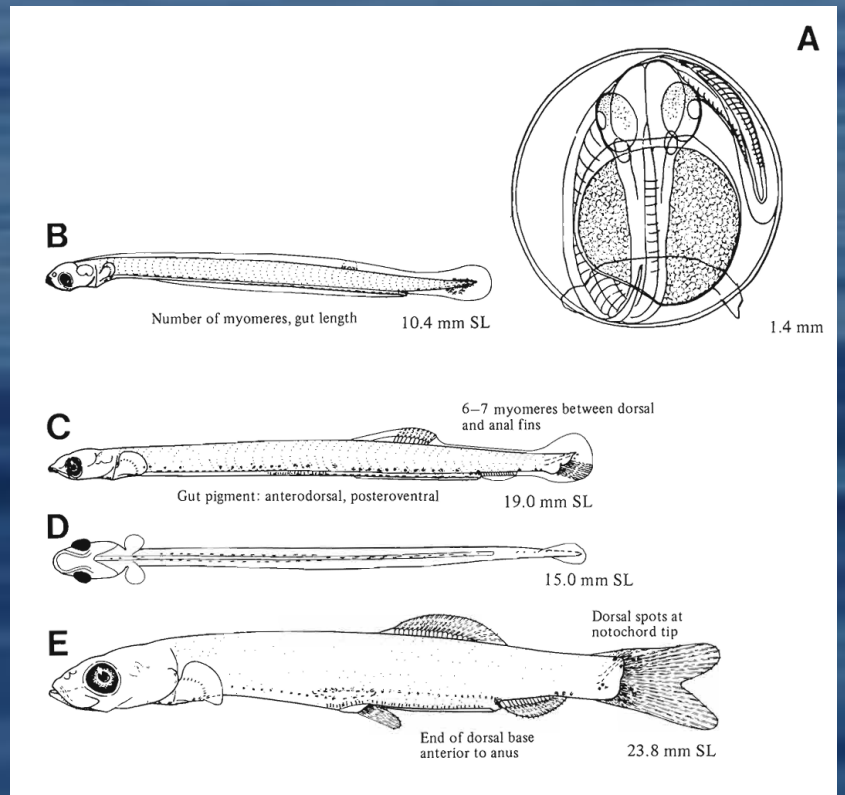
Spawn in spring & summer in offshore waters of the NCC



# Other small pelagic fishes in our coastal study area (not part of the talk)

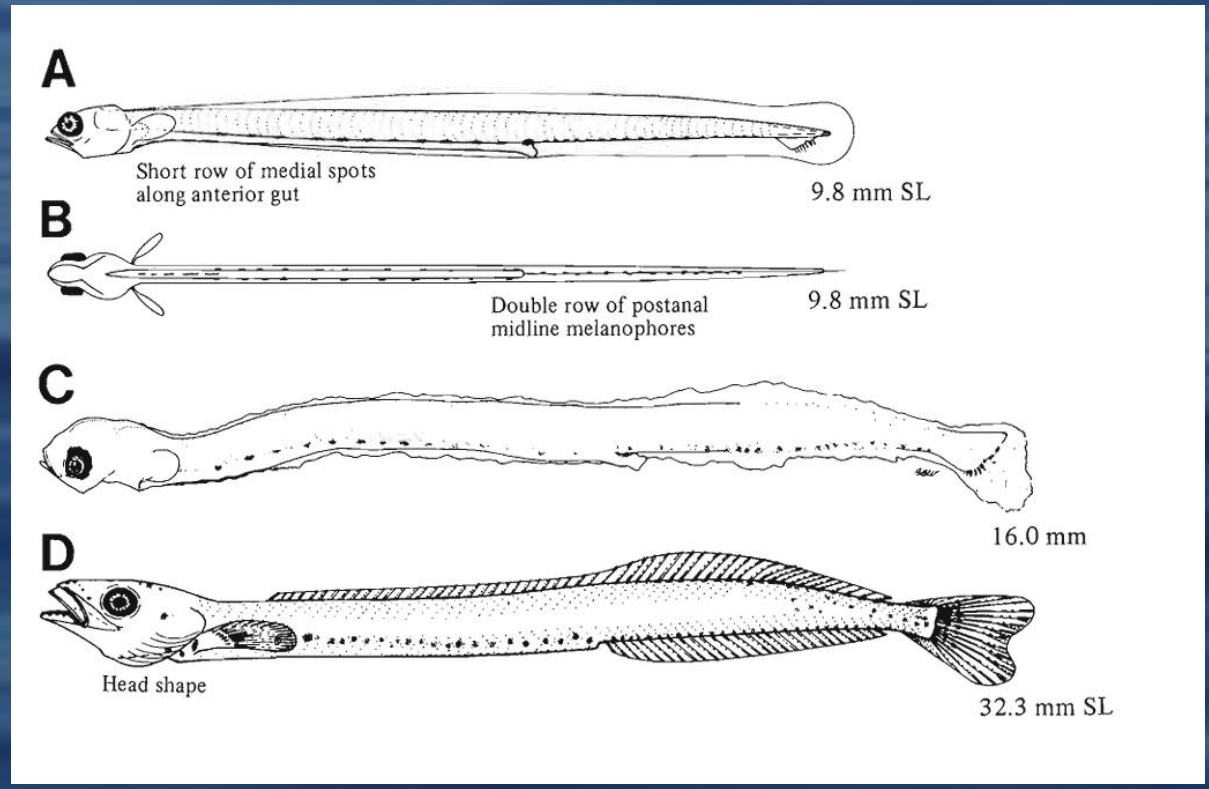
## Pacific herring

Winter bay spawners in the NCC




## Pacific sand lance

Winter nearshore spawners in the NCC

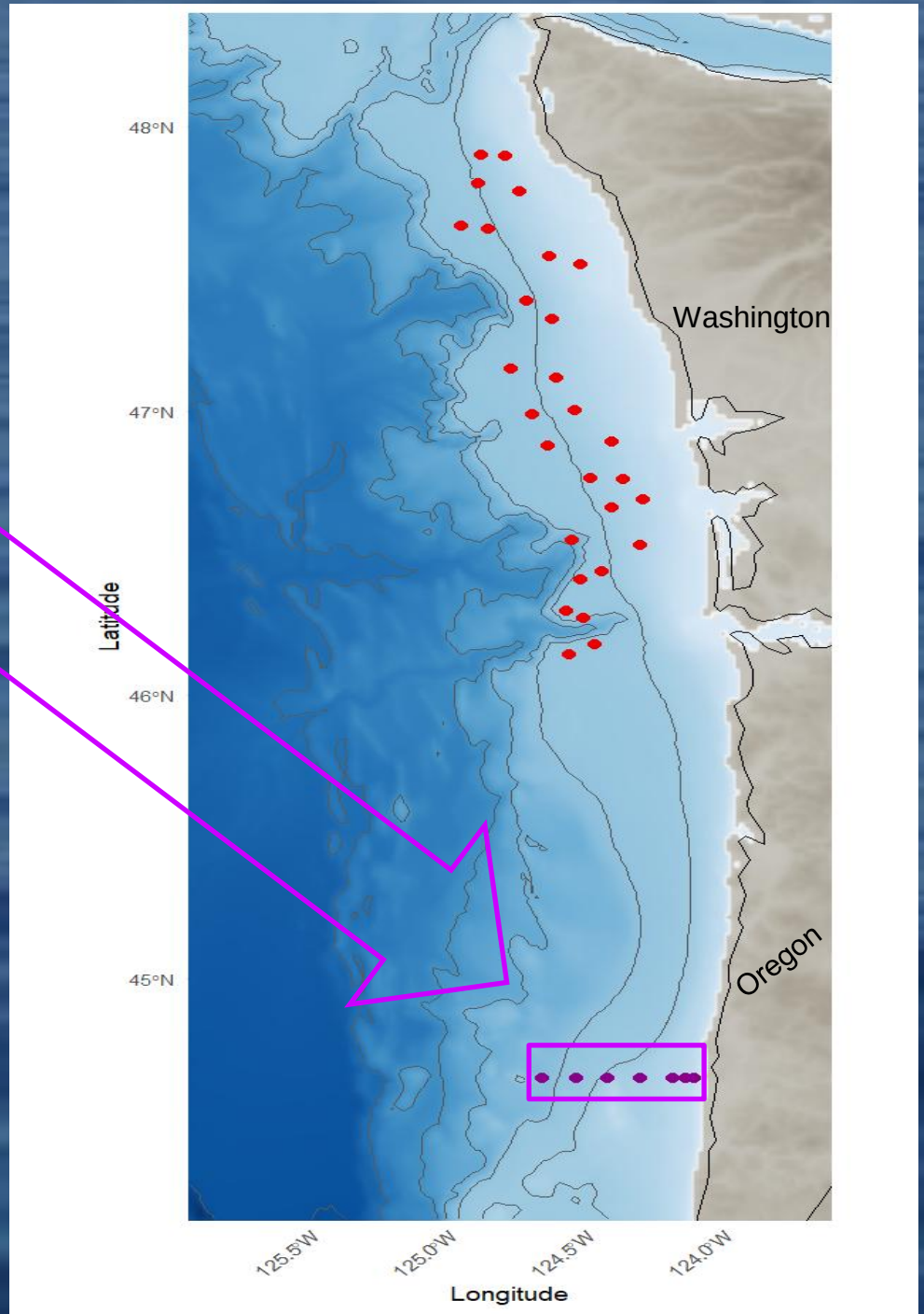



Matarese et al. 1989

# Data on ichthyoplankton were from:

Newport Hydrographic (NH) line (44.65° N)

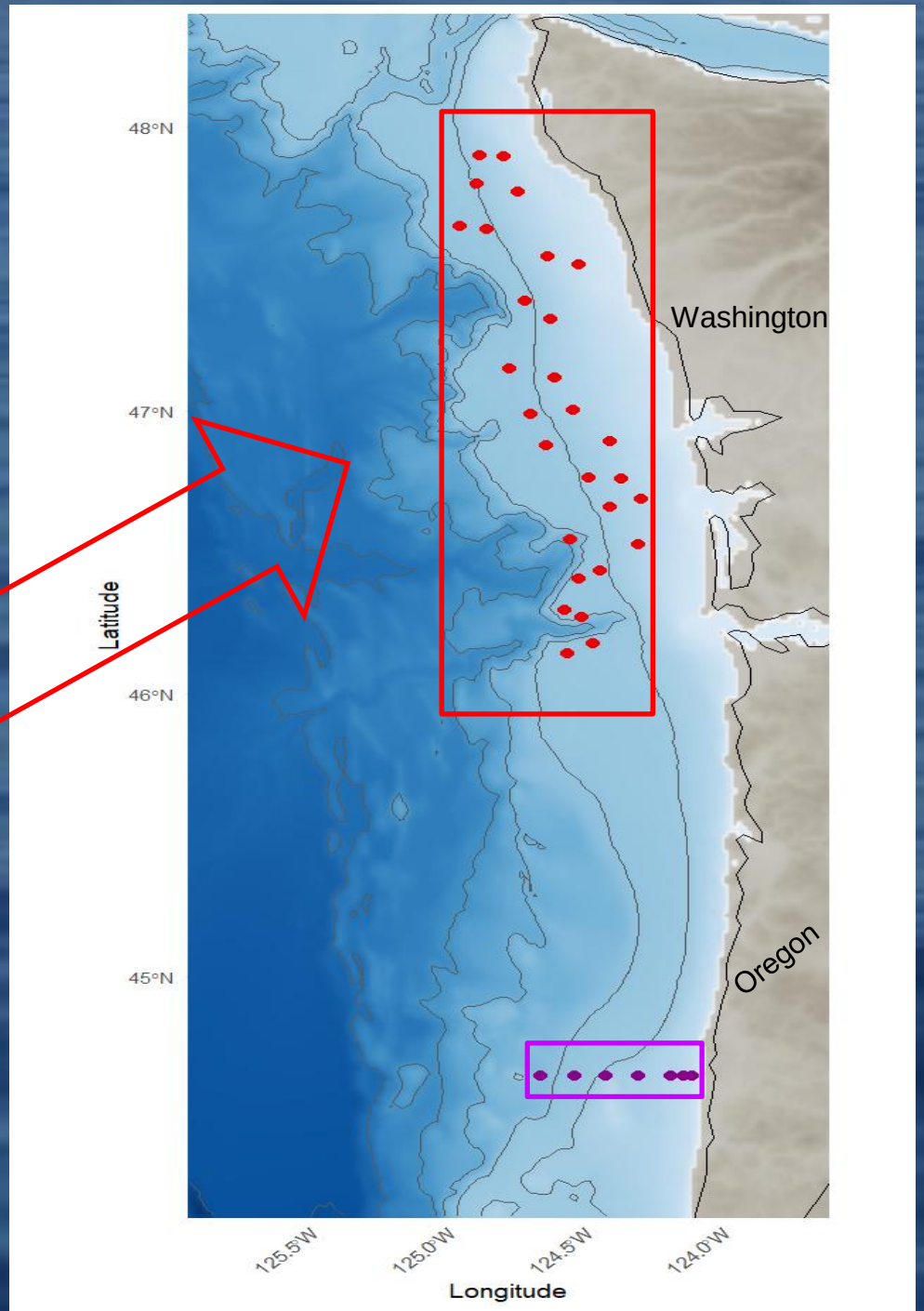
- 60-cm bongo net with 333-µm mesh towed obliquely to 30-m depth central Oregon coast 1998-2025 **bi-weekly**



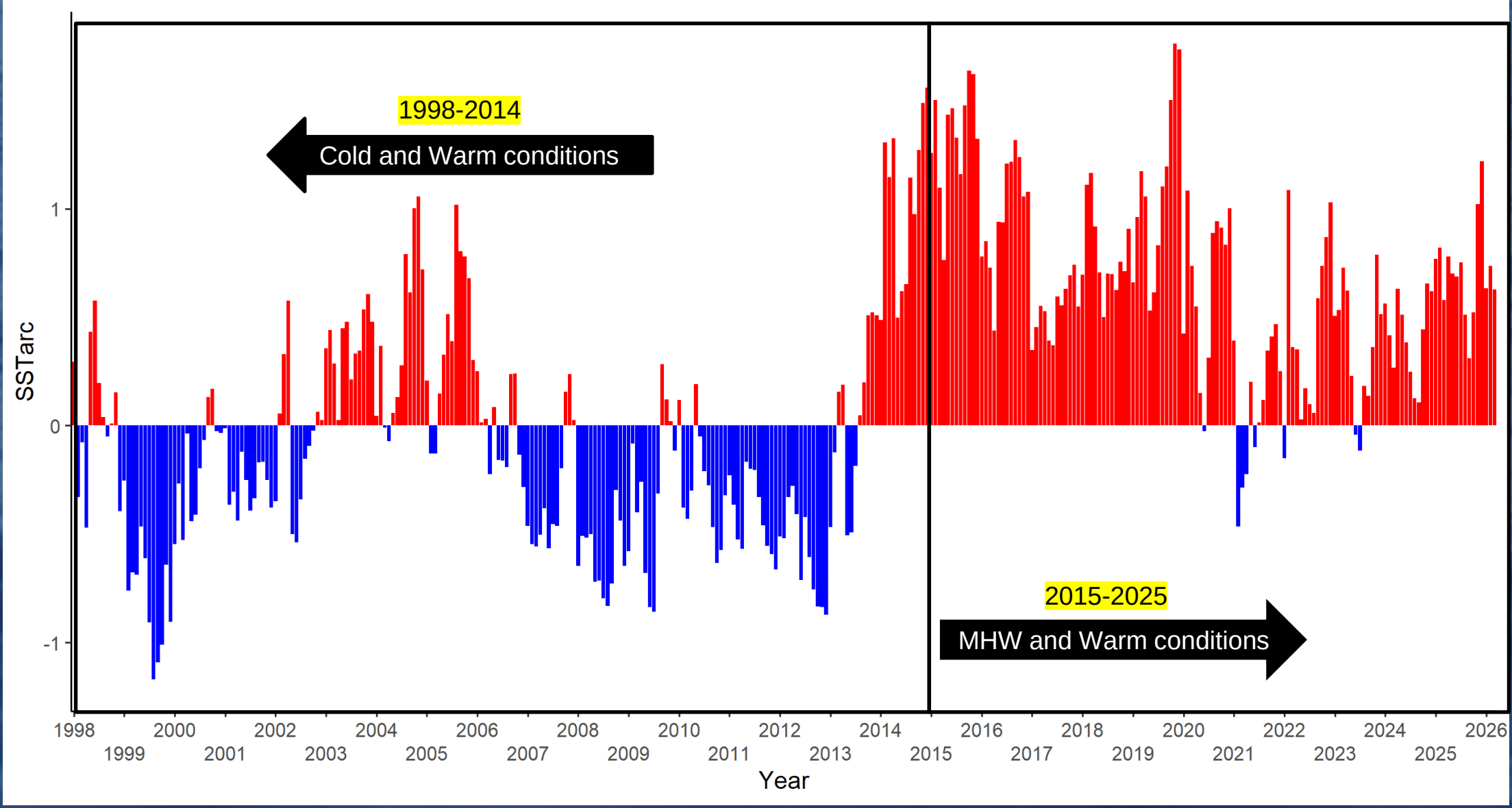
# Data on juvenile SPF and juvenile salmon were from:

Juvenile Salmon Ocean Ecosystem Survey (JSOES)

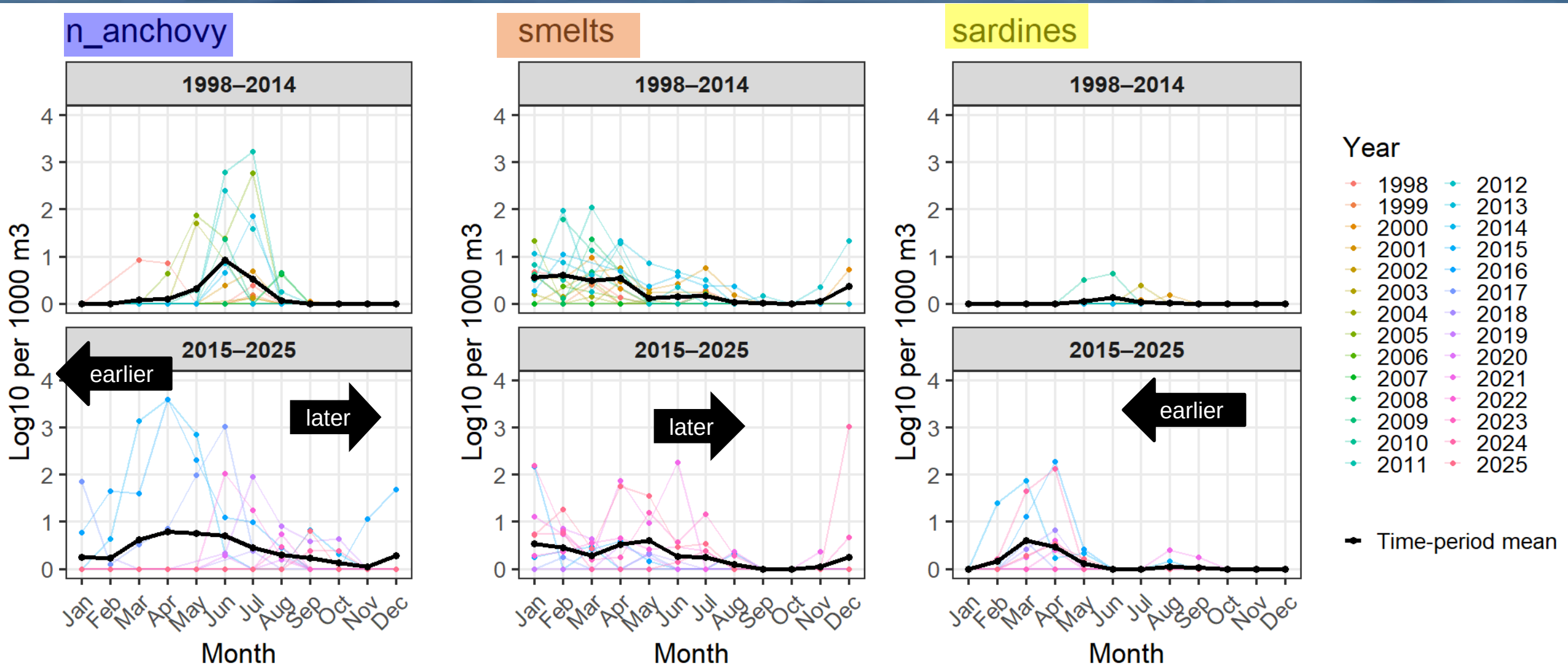
- 30-m wide trawl net with fine-mesh liner towed at surface to 20-m depth along Washington coast (46- 48°N) 2017-18; 2021-25 in May. Salmon were also sampled 1999-2012; 2015-2016



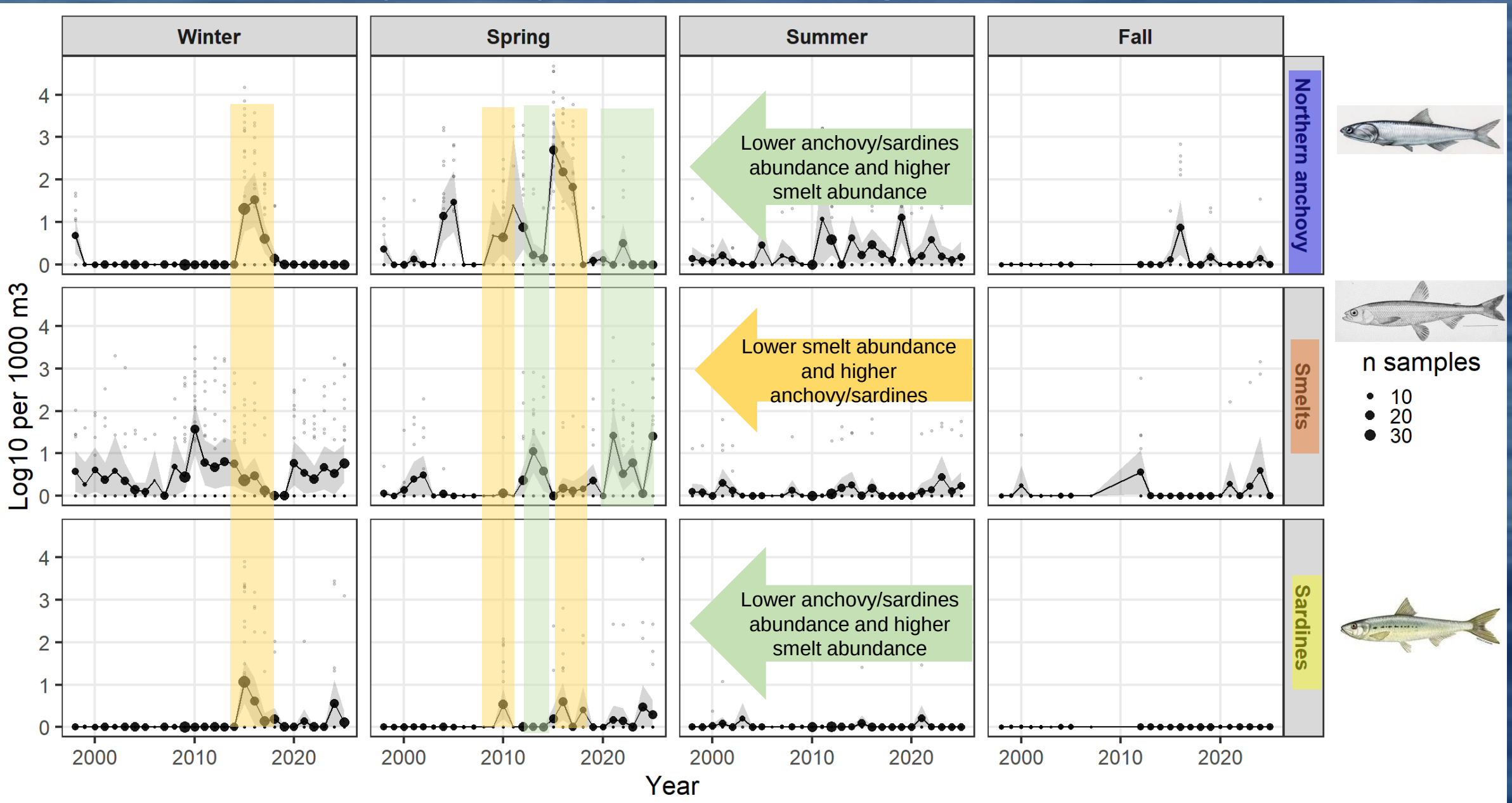
# Monthly sea surface temperatures have been anomalously warm in the NE Pacific ocean since 2015



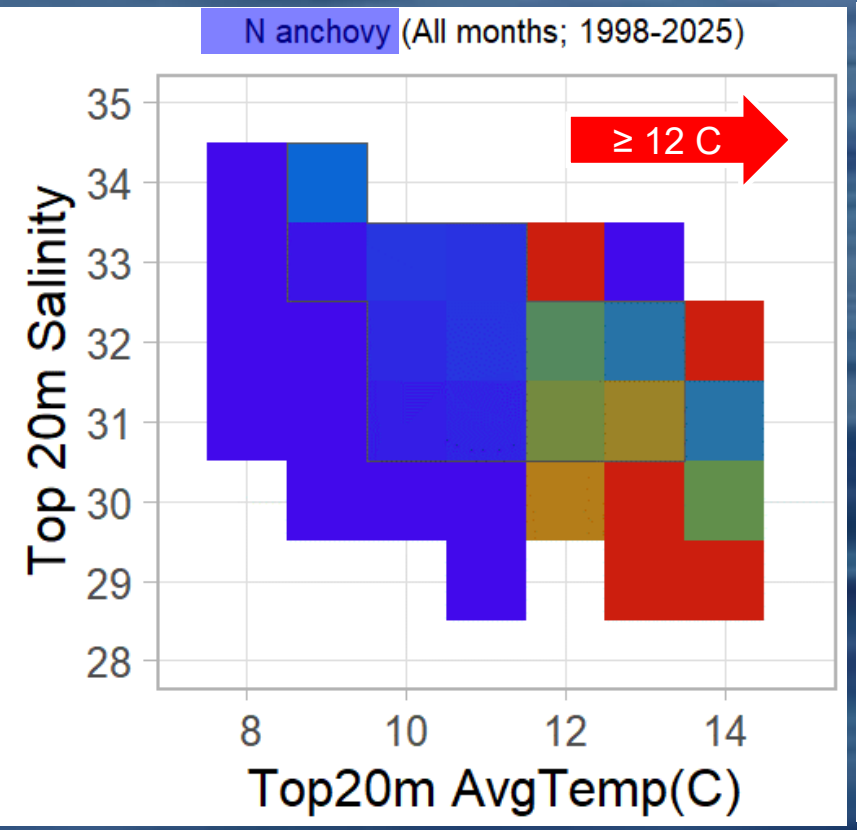
# Extended presence of larvae in the NCC between the two time-periods suggests spawning conditions/ larval success has been better since 2015

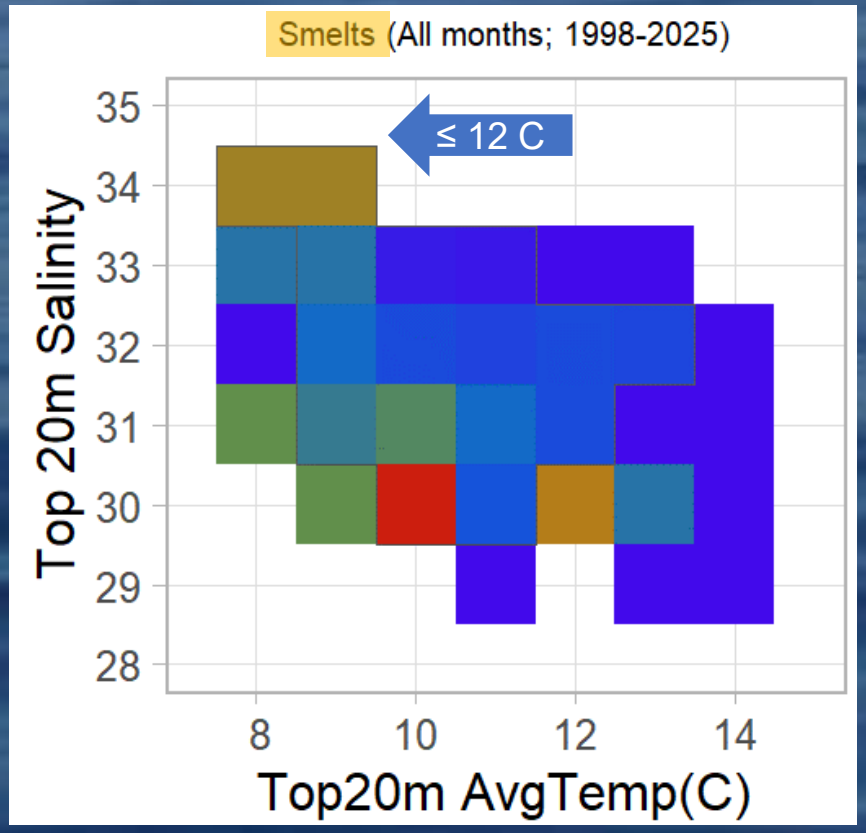


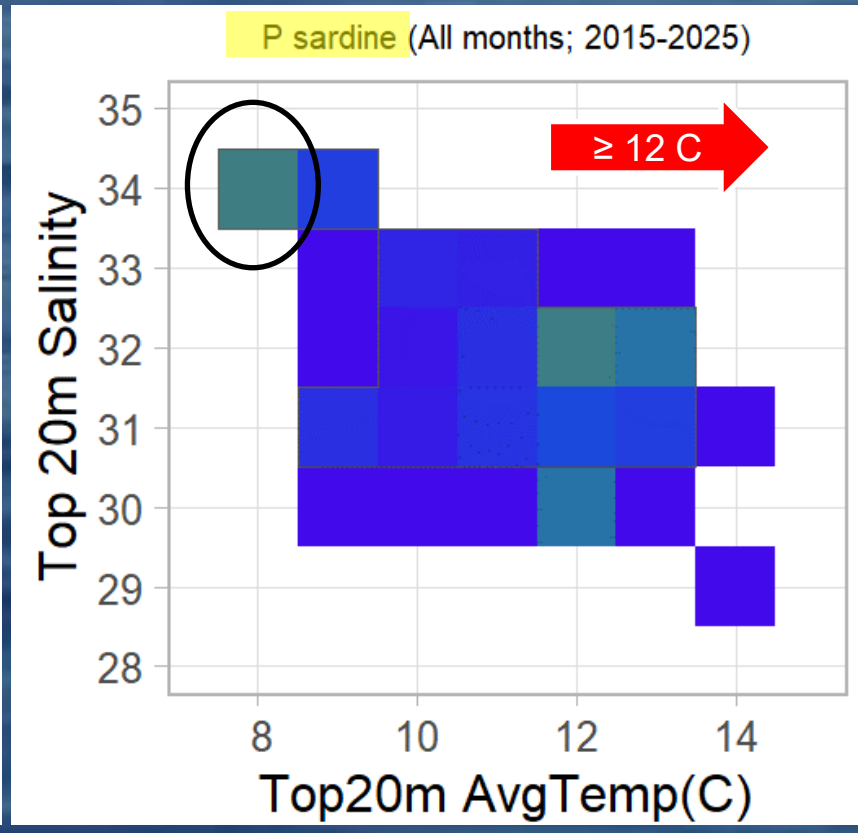
# Alternating changes in abundance between anchovies and smelt larvae early in the year: NH line bongo net 1998-2025

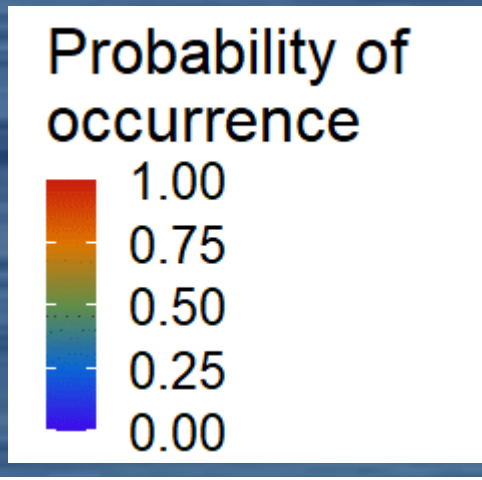


# Larval SPF occurrence in the environment is largely structured by station temperature and not salinity (or chlorophyll)

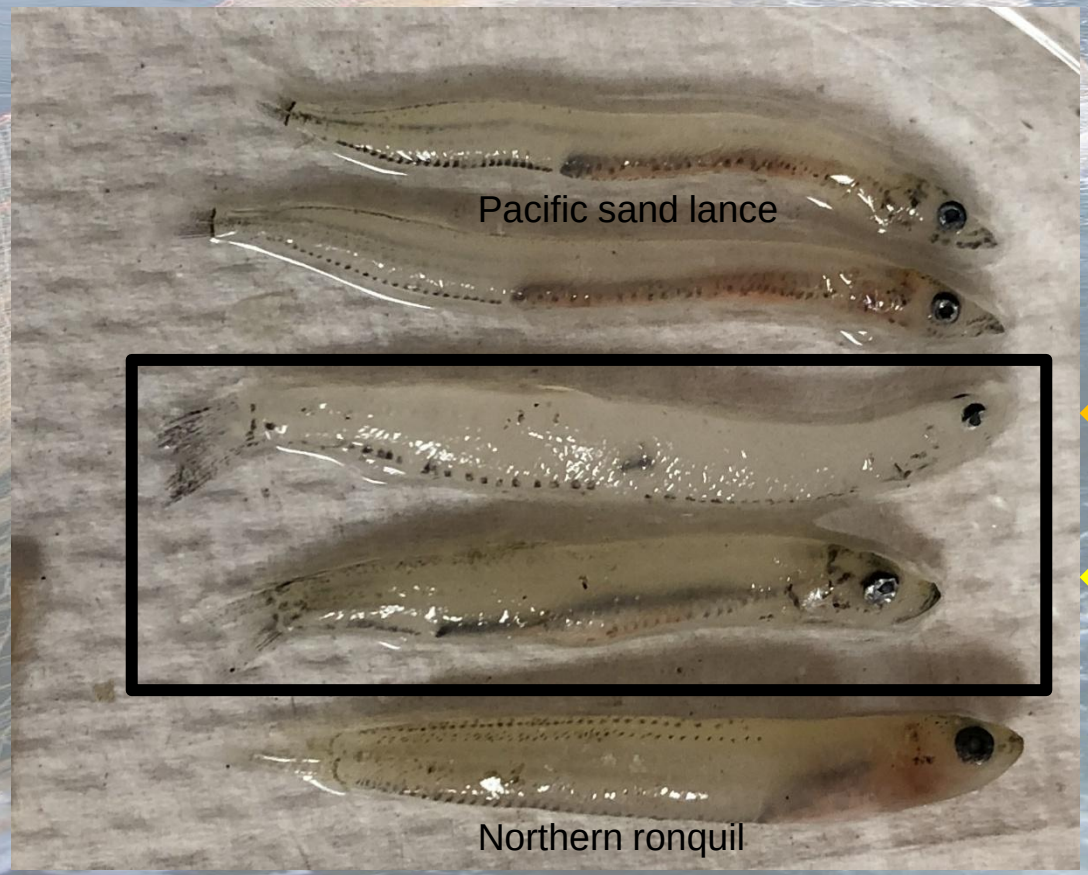


# Juvenile SPF and salmon diets:
# May trawl (30 m by 20 m) with a fine-mesh liner

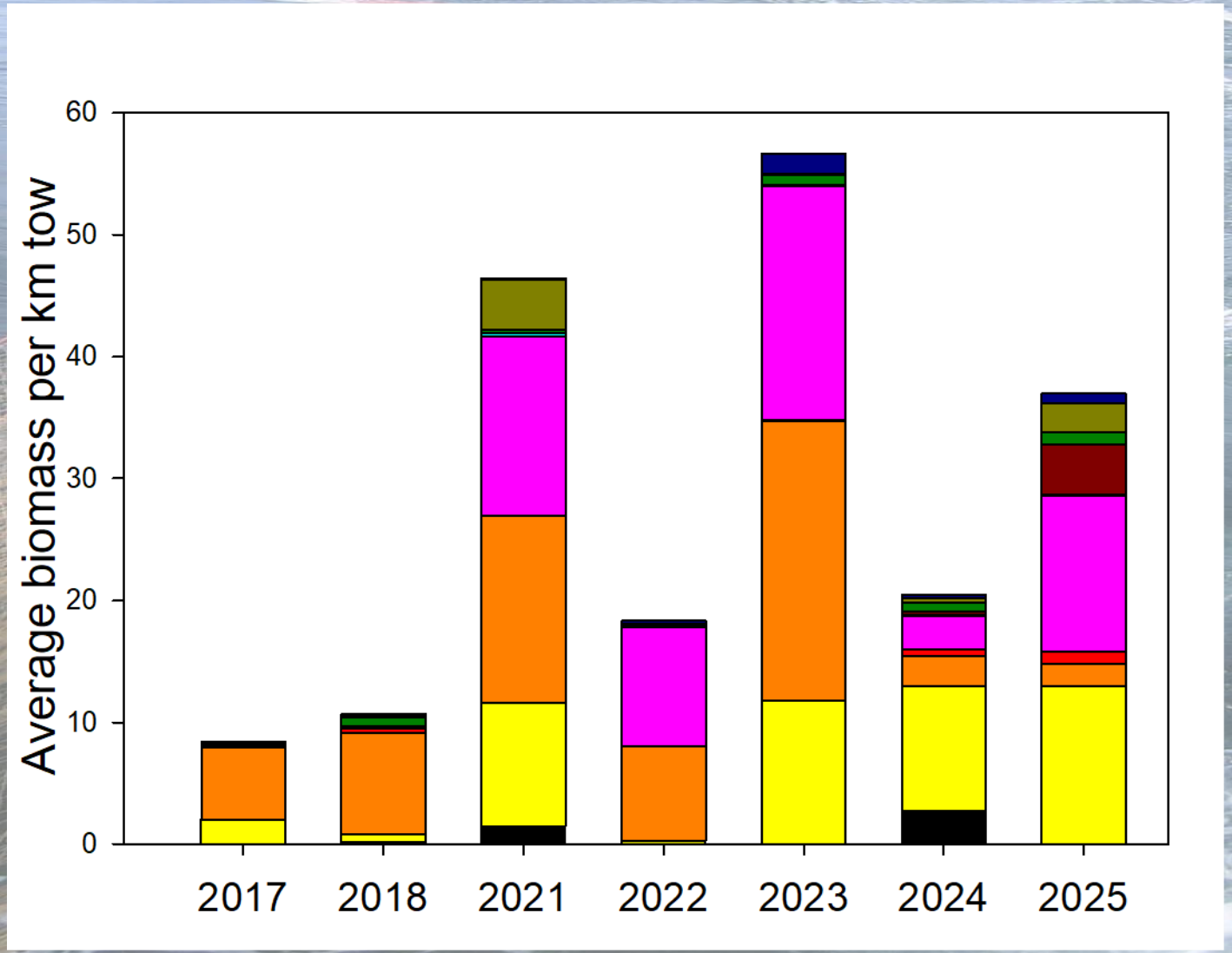



Smelt

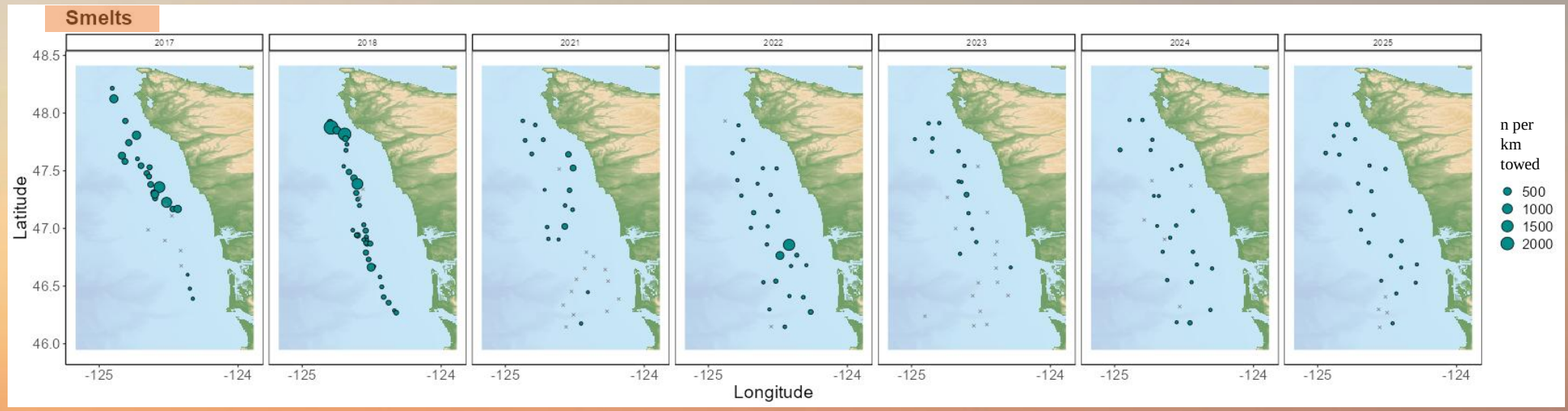
Sardine

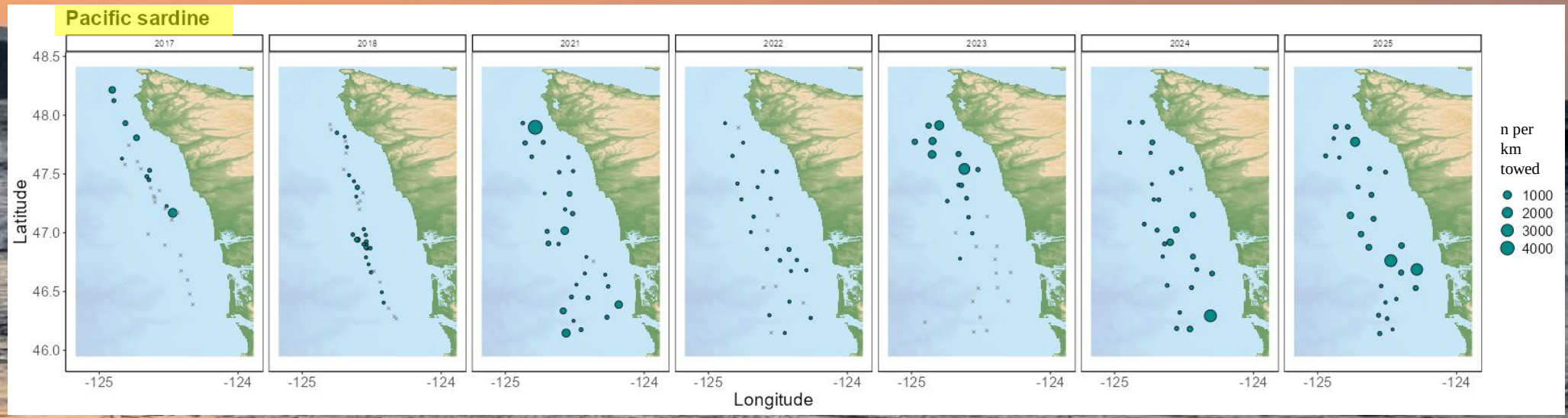
SPF (smelts and sardine) make up over half of the juvenile fish biomass in the upper 20 m in May, along with other juvenile groundfish

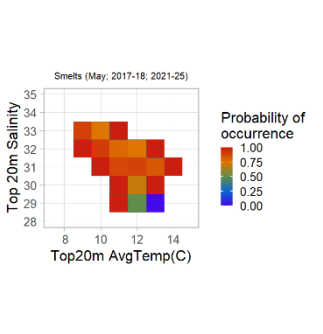
Where are the juvenile northern anchovies?



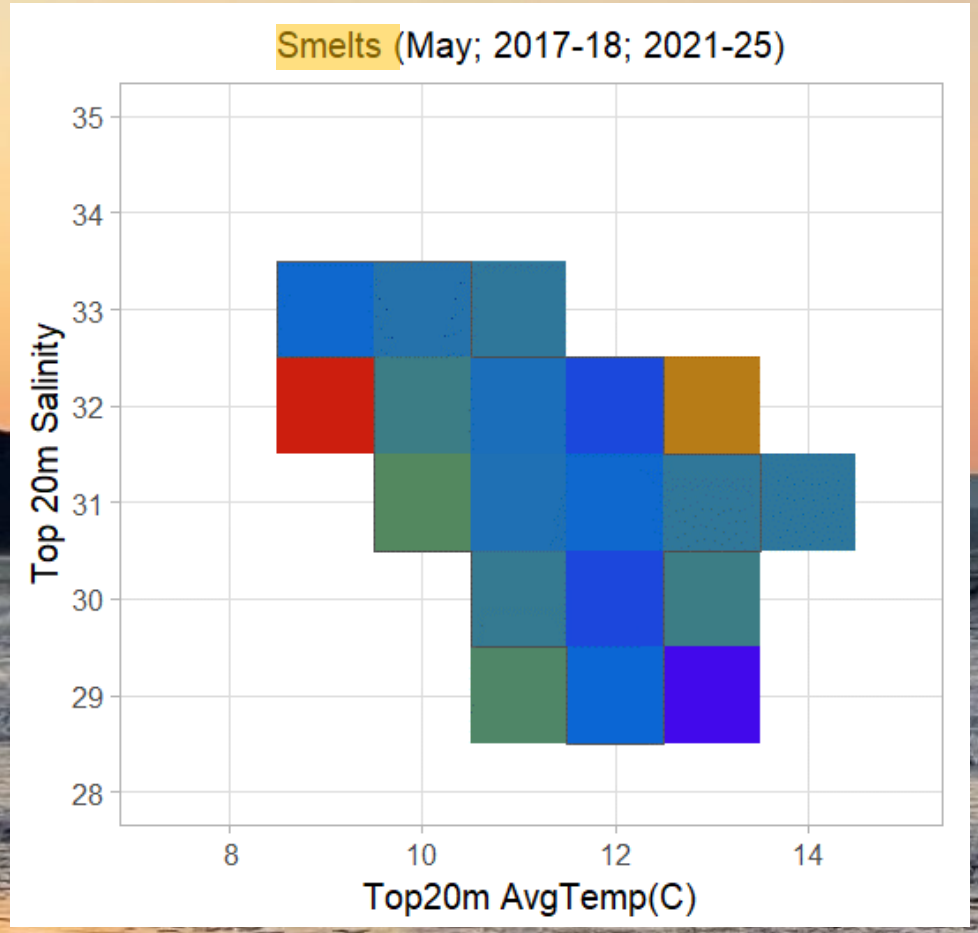
# Larval & juvenile smelts and sardines are caught in May along the coast of Washington

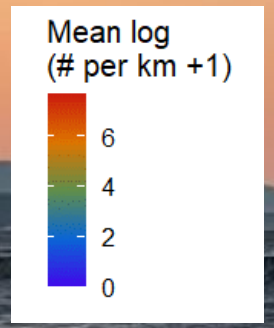


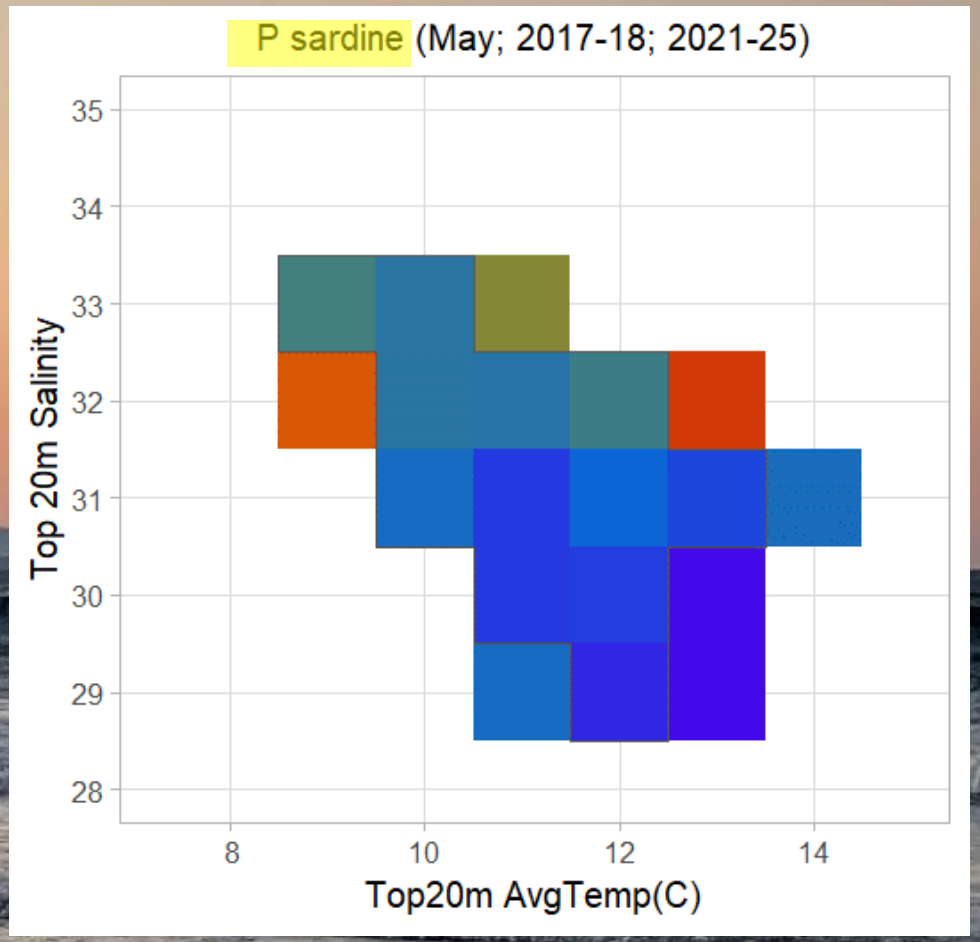





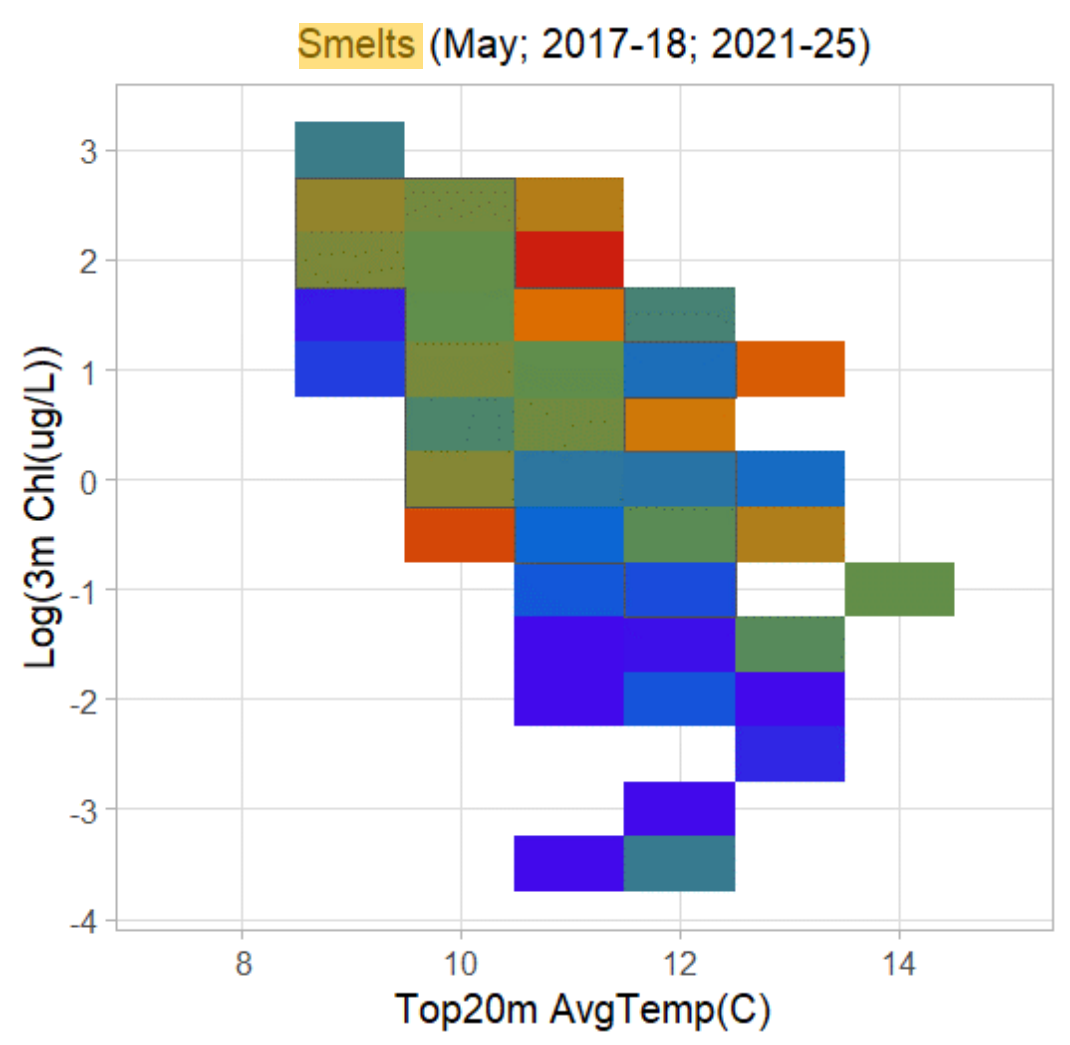

# In May, juvenile SPF CPUE did not show a relationship with temperature. There was a weak relationship between higher CPUE of juvenile sardines and salinity

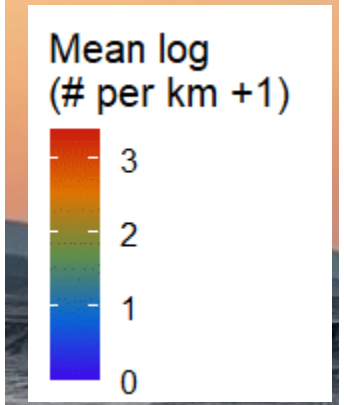


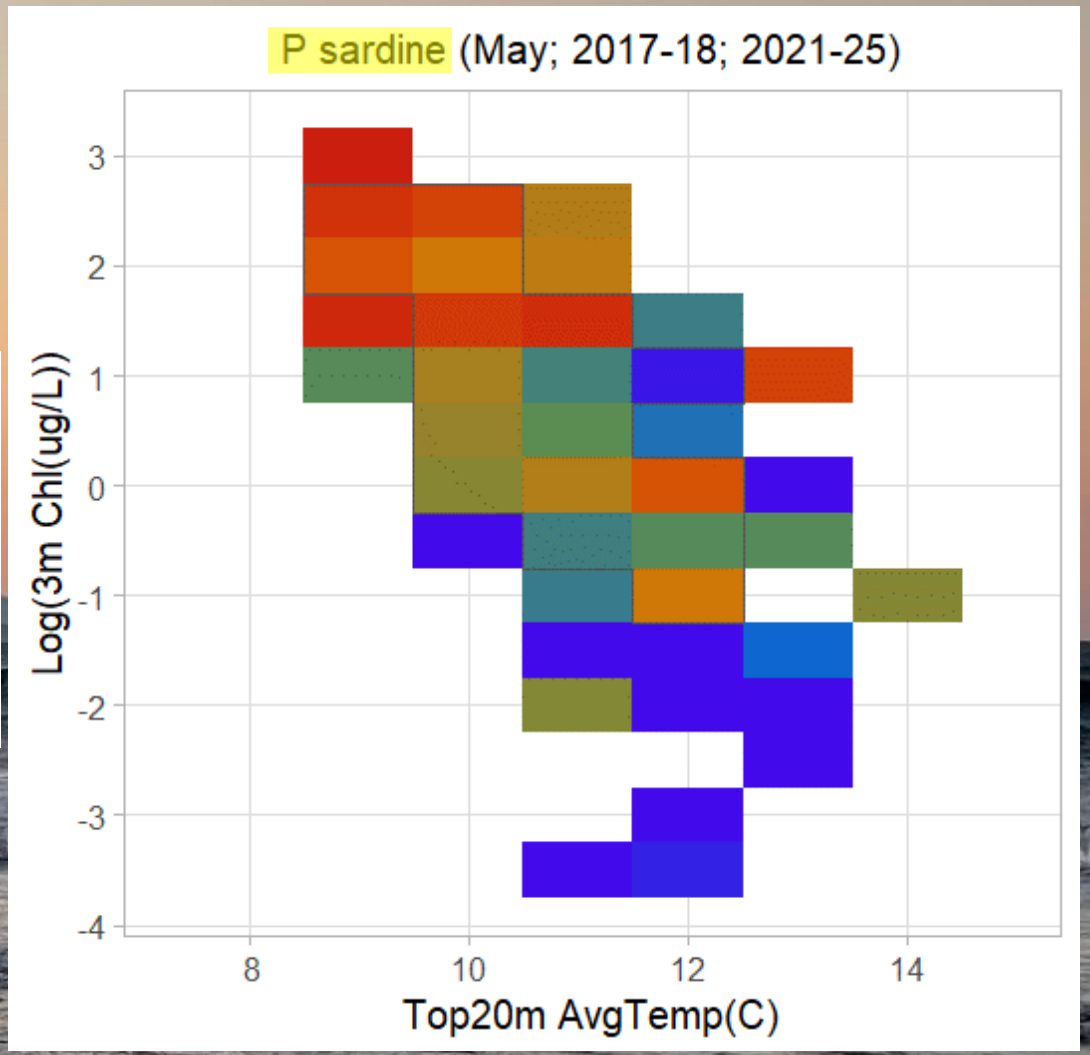



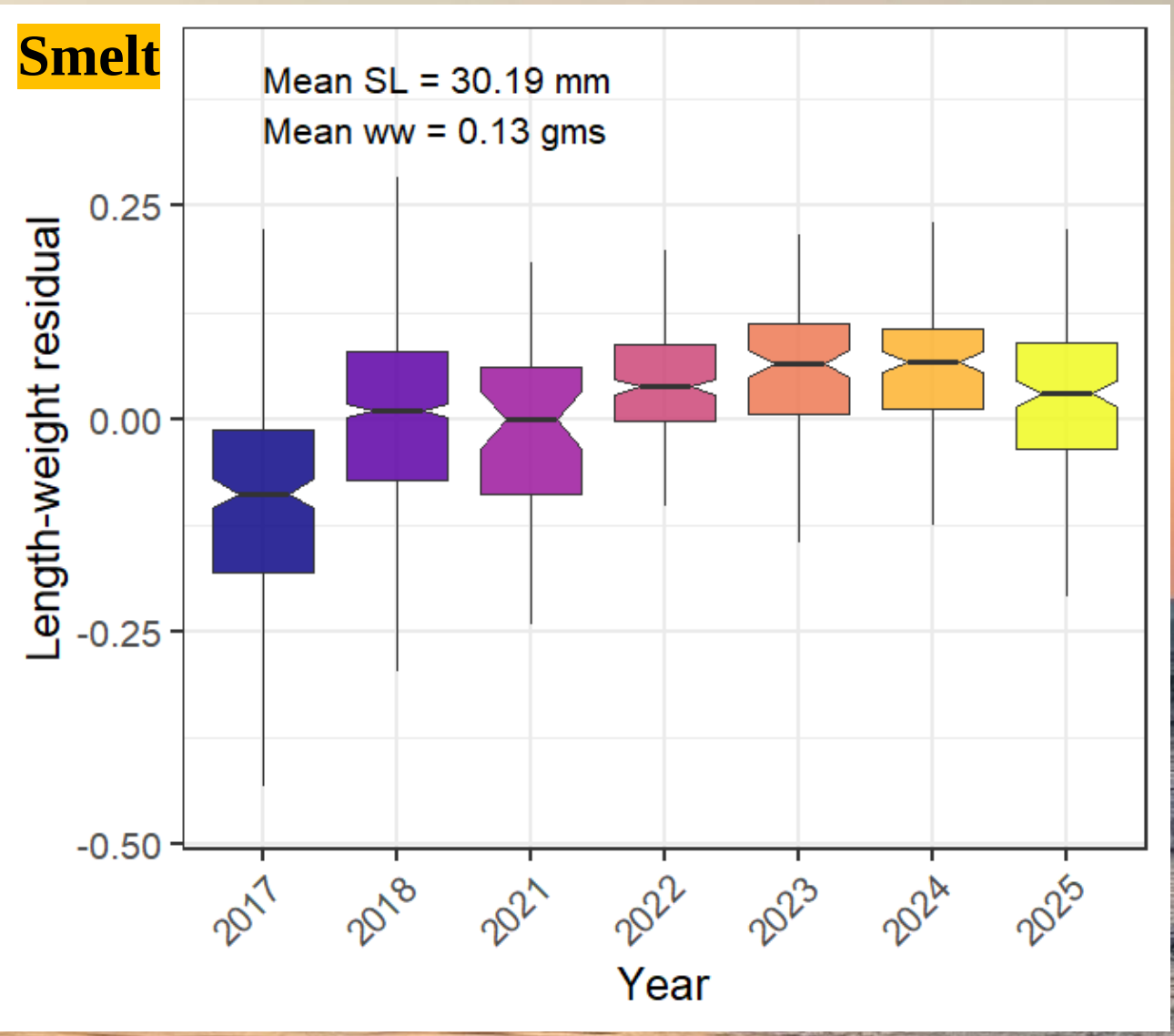
# Both juvenile smelt and sardines showed increased CPUE in association with higher 3-m chlorophyll

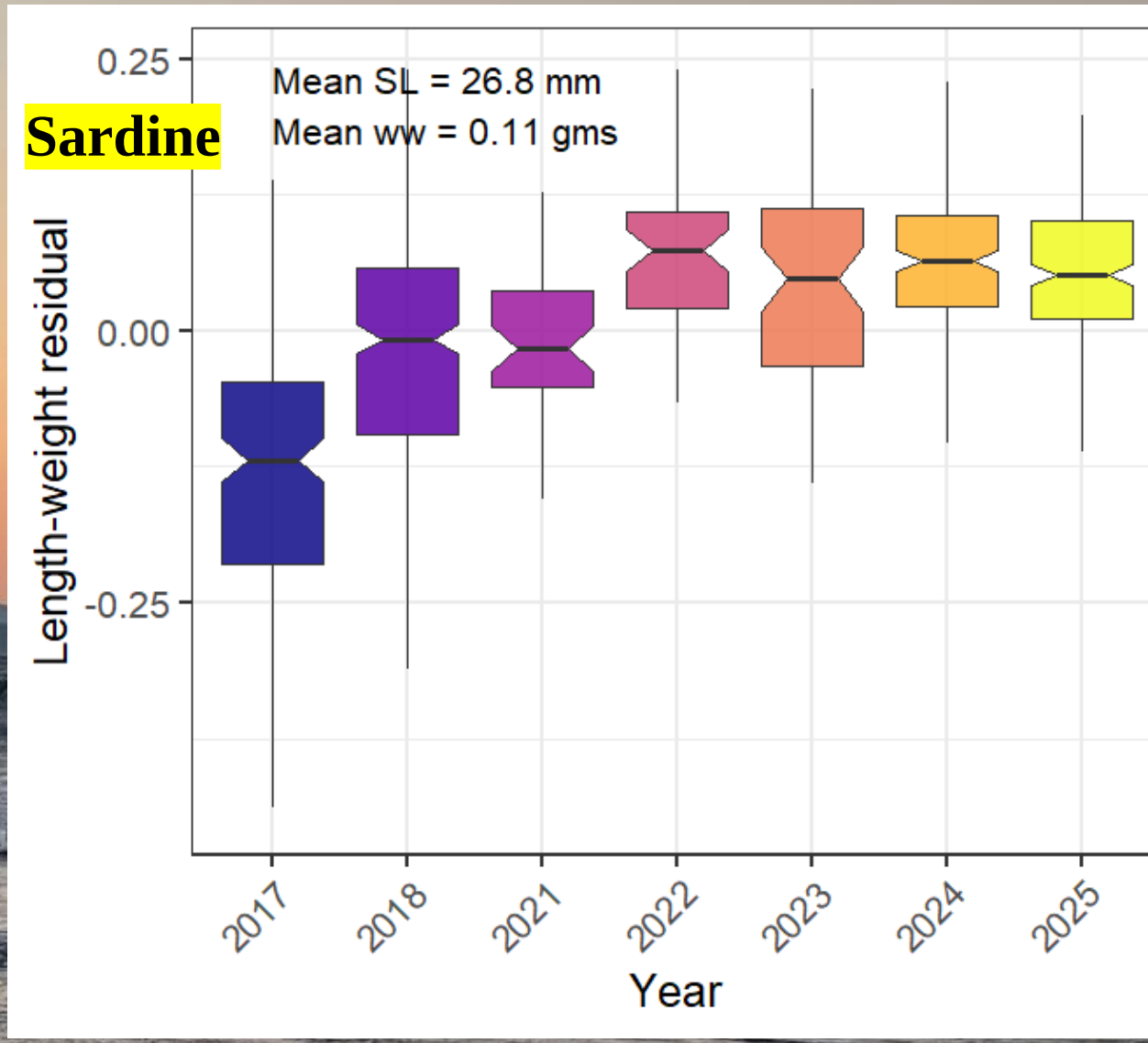


# The condition of juvenile smelt and sardine followed a similar interannual pattern: thin in 2017 and better condition 2022-2024/5



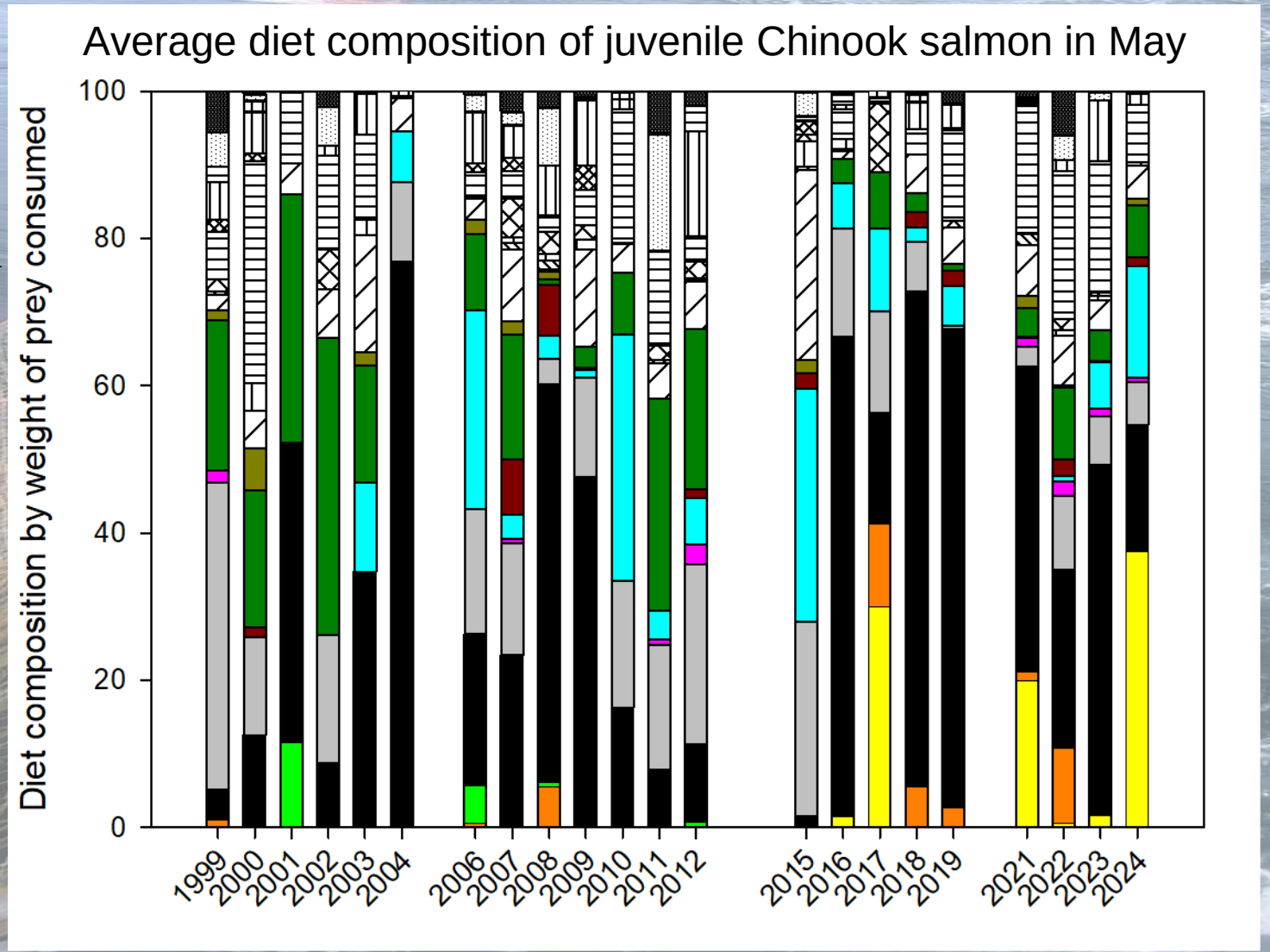



# Juvenile Chinook salmon are highly piscivorous when they enter the ocean

Sardines were not observed in the diets in 1999-2015, but in 2017, 2021 & 2024 sardines were an important prey item for Chinook salmon

Smelts are not generally an important prey

Anchovies have not been consumed in May



# In summary:

- Recent warm ocean conditions is correlated with extended SPF larval presence in the NCC
- Smelts and sardines have increased in size/condition; anchovy did not
- Temperature and chlorophyll influenced SPF occurrence and CPUE
- Sardines emerged as an important salmon prey in recent years

Thanks to all the research scientists within Oregon State University and NOAA fisheries, the captains and crew of the many research and fishing vessels.
Funding was provided by Bonneville Power Administration and NOAA fisheries.

**Any Questions?**