Salmon Ocean Ecology:
Distribution, Growth, and Survival Trends

Washington Coastal Marine Advisory Council
September 20th, 2018

Brian Burke
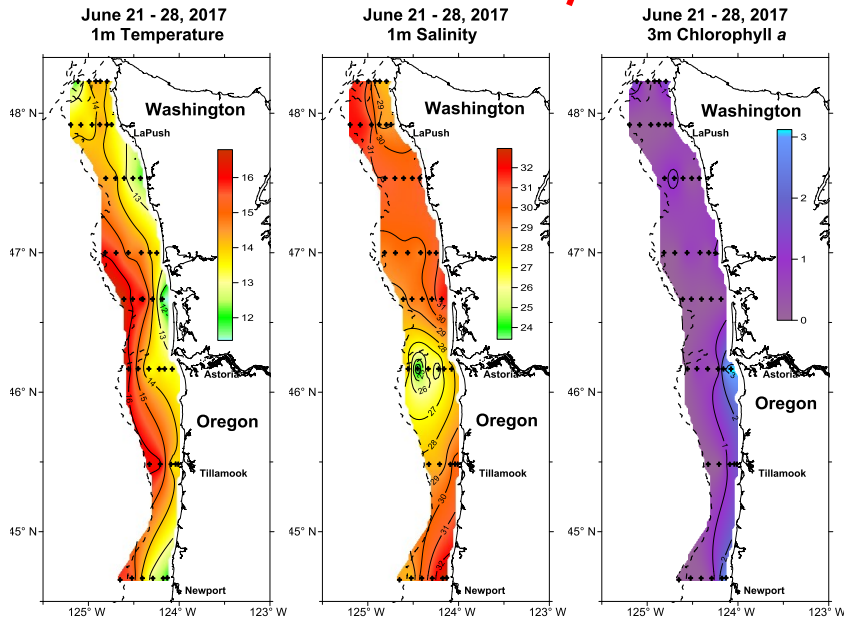NOAA Fisheries, NWFSC

Supported by:

Outline

- Summary of research projects

- Recent ocean conditions

- Salmon distribution and trophic interactions
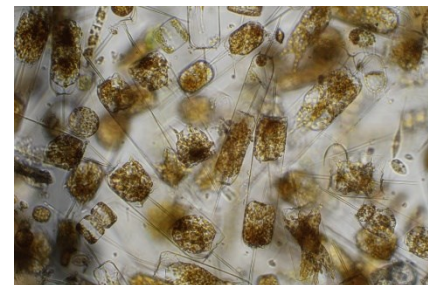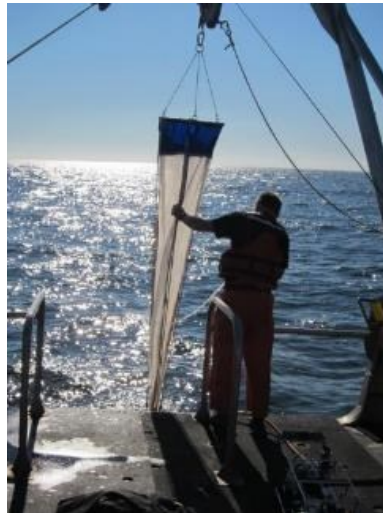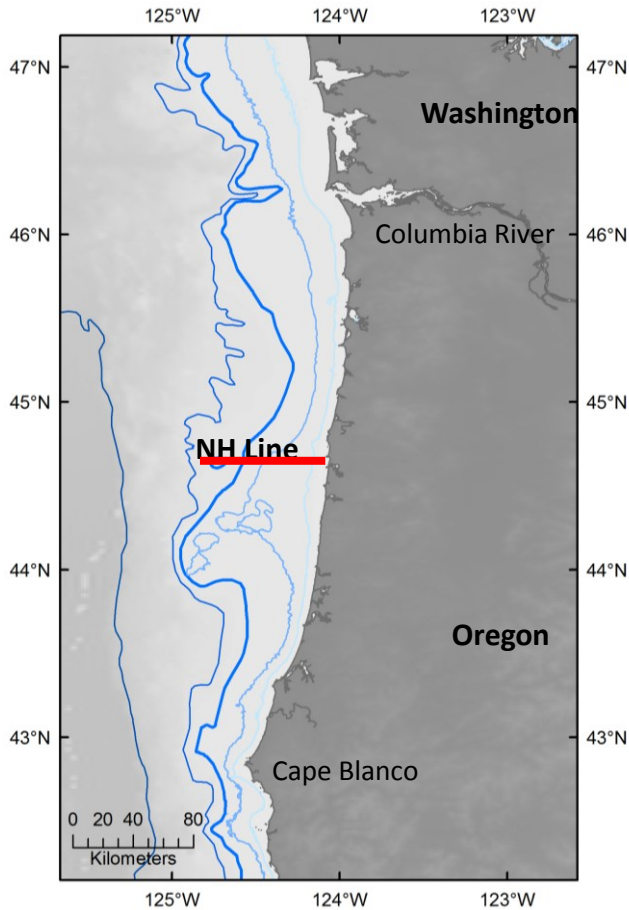
- Addressing survival (3 examples)

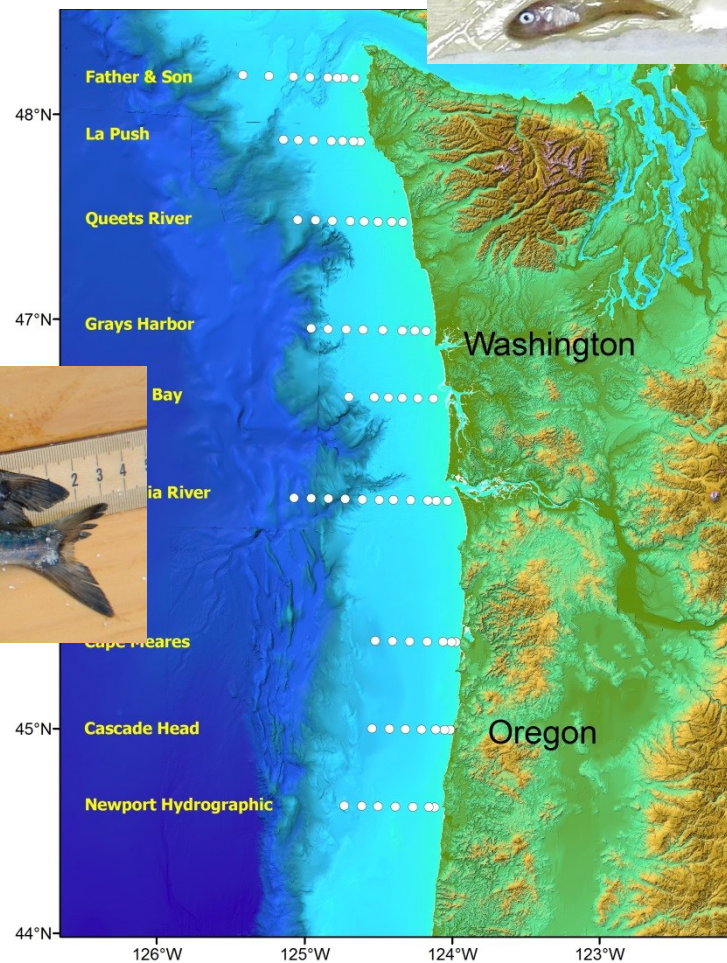# Understanding complex ecosystems requires Research and Monitoring

Newport Hydrographic Line

- Sampled biweekly for 20+ years (**1996 – present**)
  - 7 stations
  - 1 – 25 nm, seasonally out to 200 nm
- CTD, nutrients, chl-*a*, phytoplankton and HABs, zooplankton, ichthyoplankton

Juvenile Salmon and Ocean Ecosystem Survey (JSOES)
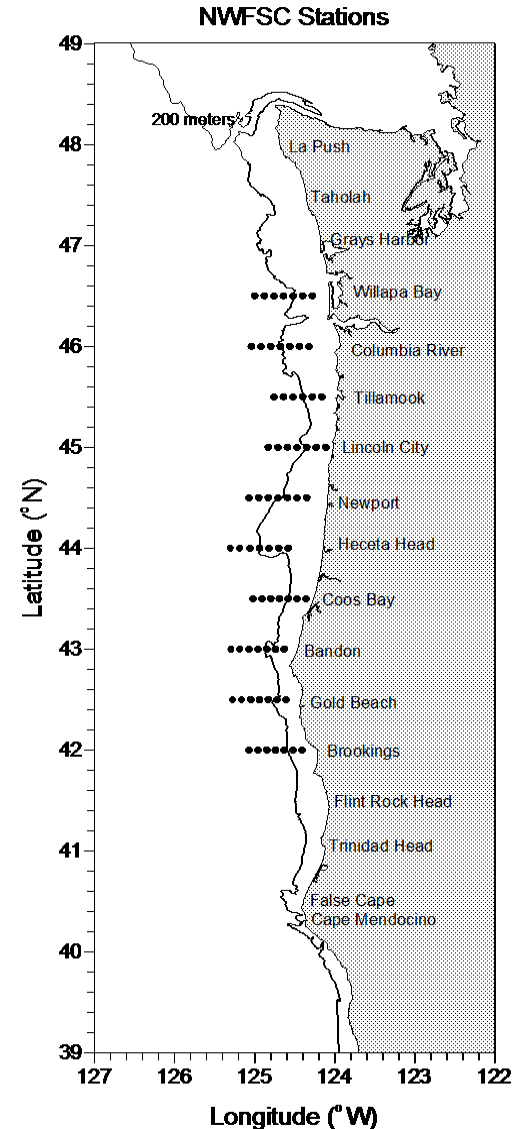

Photo credit: Pacific Drone

Pre-recruit survey and ecosystem assessment project

Objective: Examine abundance and distribution patterns of age-0 fish including rockfish, hake, and flatfishes in relation to ocean conditions

Sampling: May-June (2011, 2013-2018); night trawls at 30 m depth, plankton, CTD, acoustic, seabird and mammal surveys
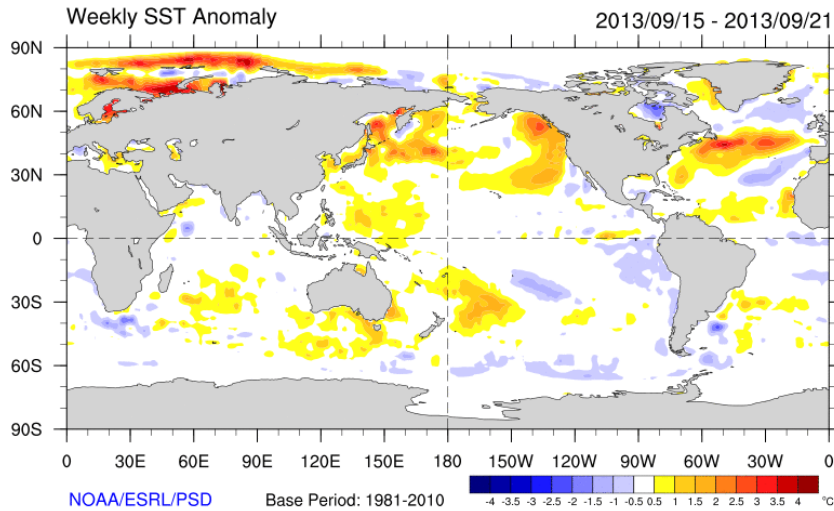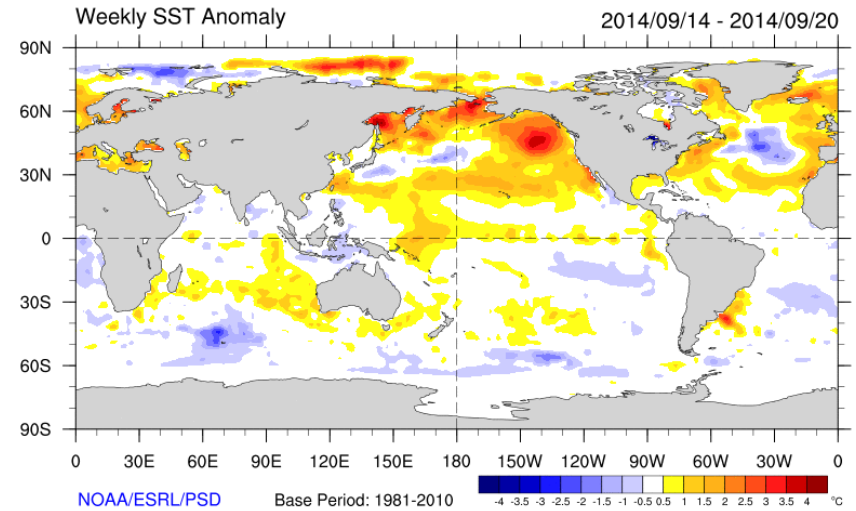

NWFSC Stations

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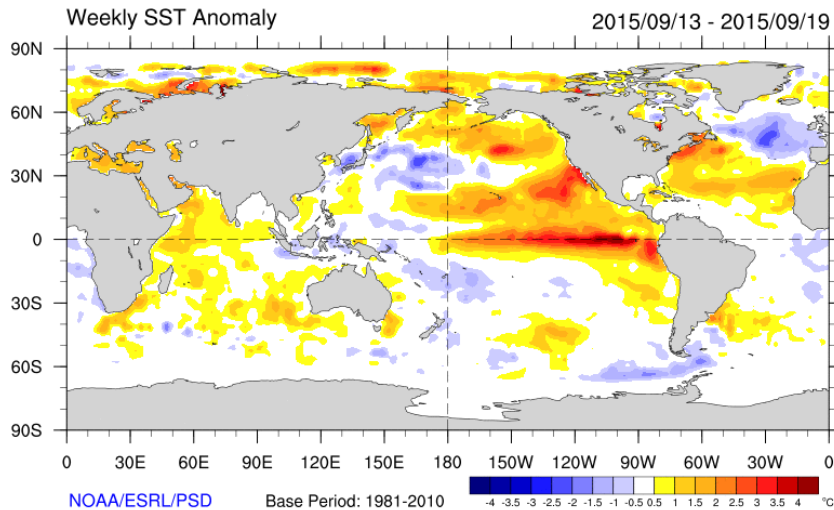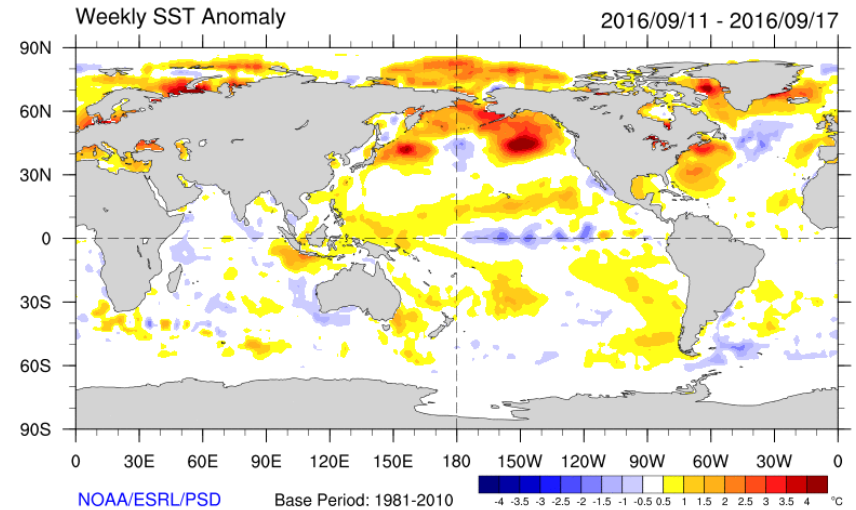# Pacific Basin-Scale Dynamics

September 2013

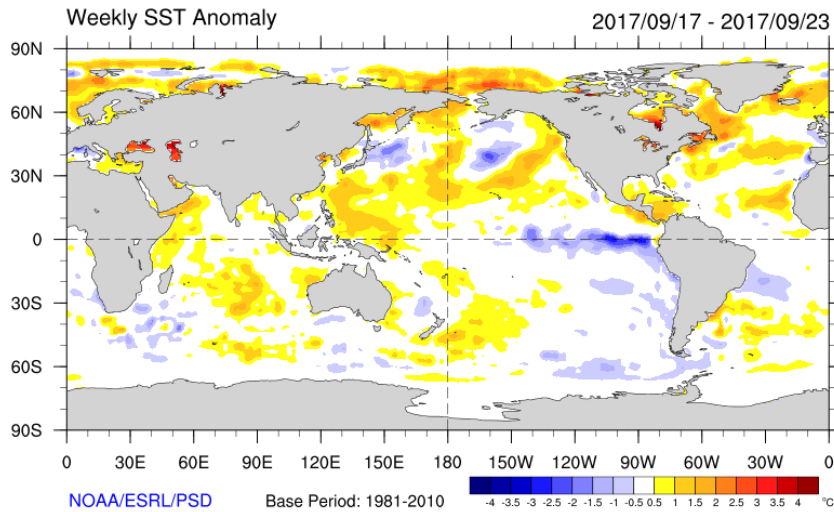Weekly SST Anomaly — 2013/09/15 - 2013/09/21
NOAA/ESRL/PSD — Base Period: 1981-2010

September 2014

Weekly SST Anomaly — 2014/09/14 - 2014/09/20
NOAA/ESRL/PSD — Base Period: 1981-2010

September 2015

Weekly SST Anomaly — 2015/09/13 - 2015/09/19
NOAA/ESRL/PSD — Base Period: 1981-2010

September 2016

Weekly SST Anomaly — 2016/09/11 - 2016/09/17
NOAA/ESRL/PSD — Base Period: 1981-2010

https://www.esrl.noaa.gov/psd/map/clim/sst.shtml

Pacific Basin-Scale Dynamics

September 2017

September 2018

https://www.esrl.noaa.gov/psd/map/clim/sst.shtml
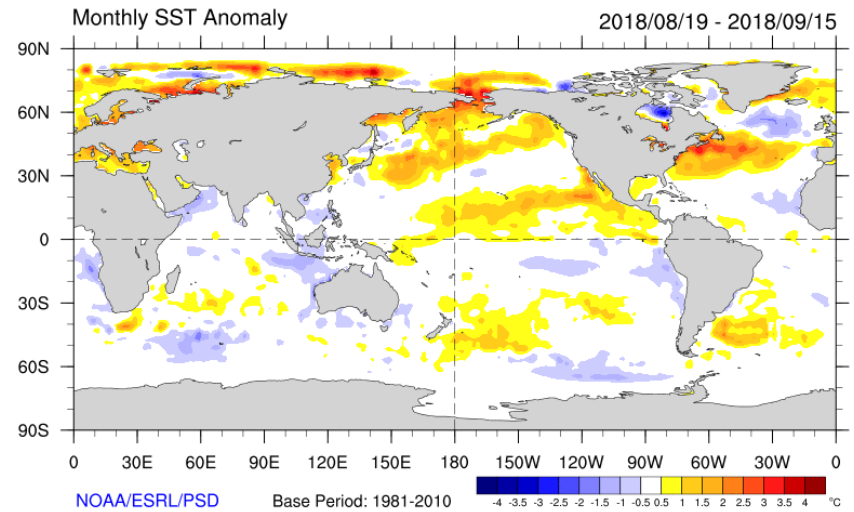
Zooplankton

The blob came onshore

Pyrosome Catch in Trawls

Scale bar = log (abundance)
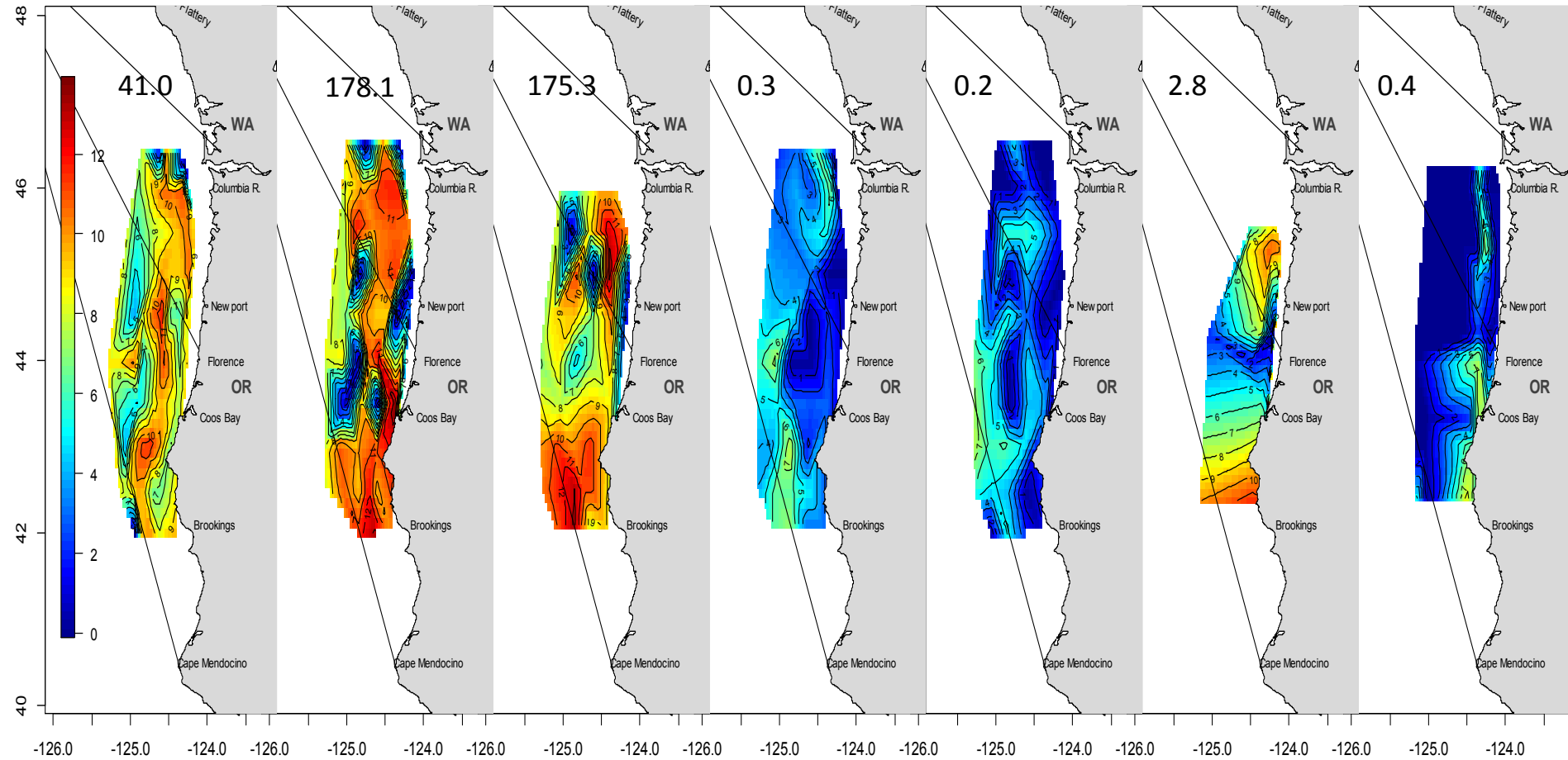Number = Geometric mean abundance
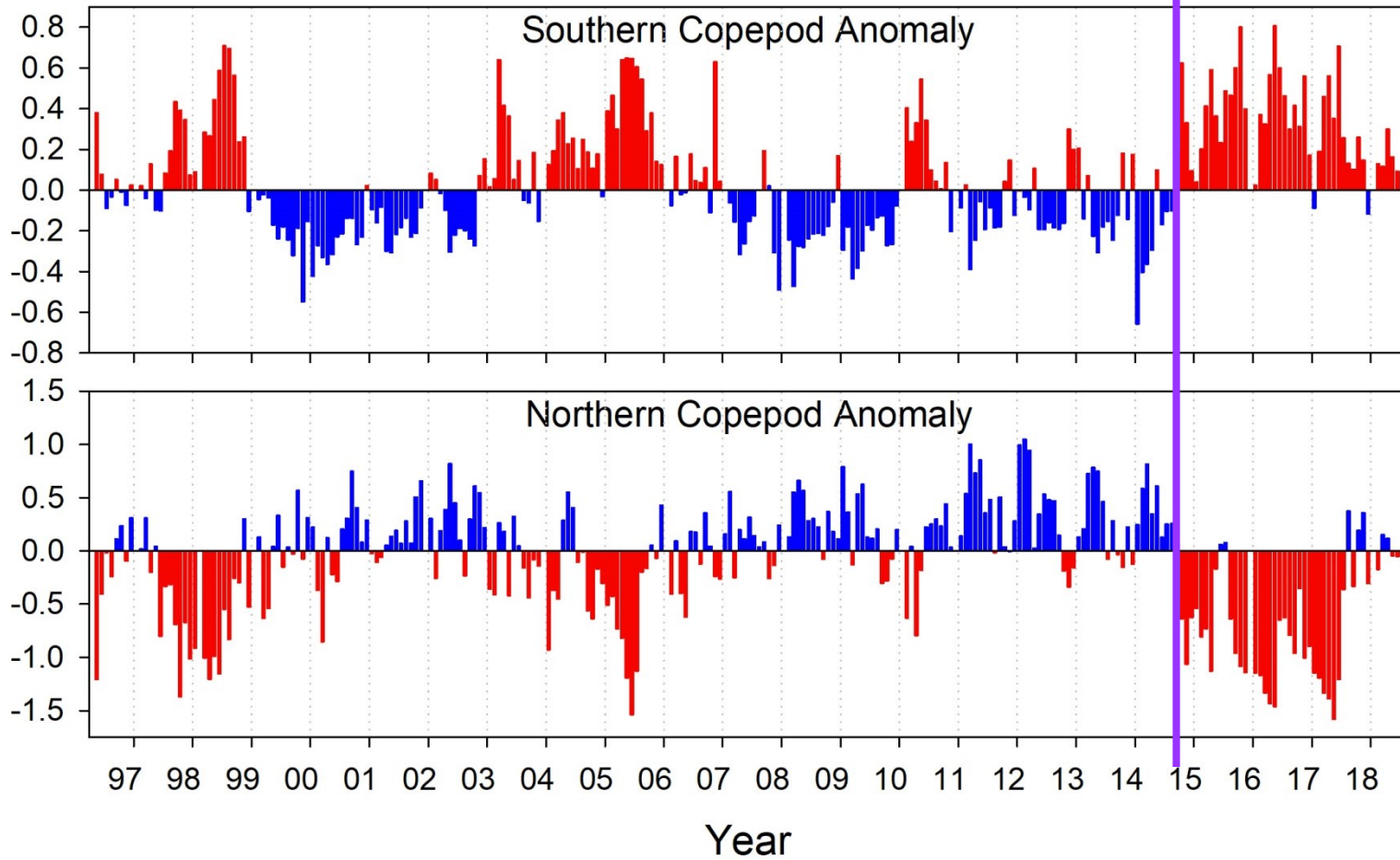
Brodeur et al. (MS)

Euphausiid Catch in Trawls

Scale bar = log (abundance)

Number = Geometric mean abundance x 10^{-4}

Brodeur et al. (MS)

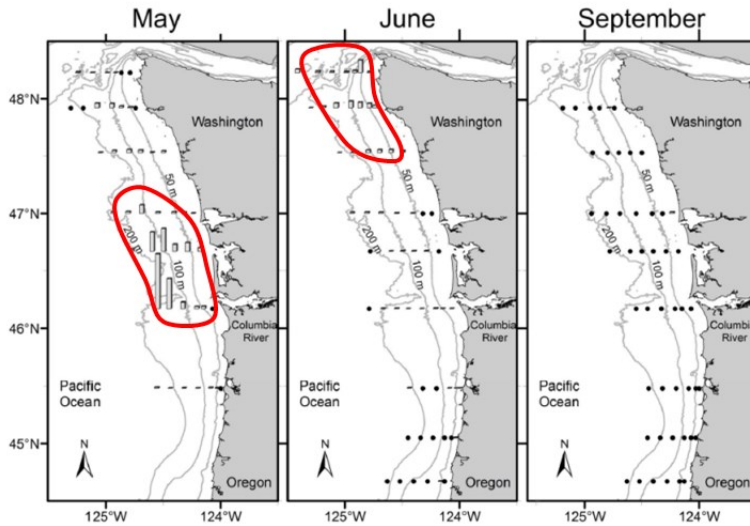# Systemic Biological Response to the Blob

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- **Salmon distribution and trophic interactions**

- Addressing survival (3 examples)
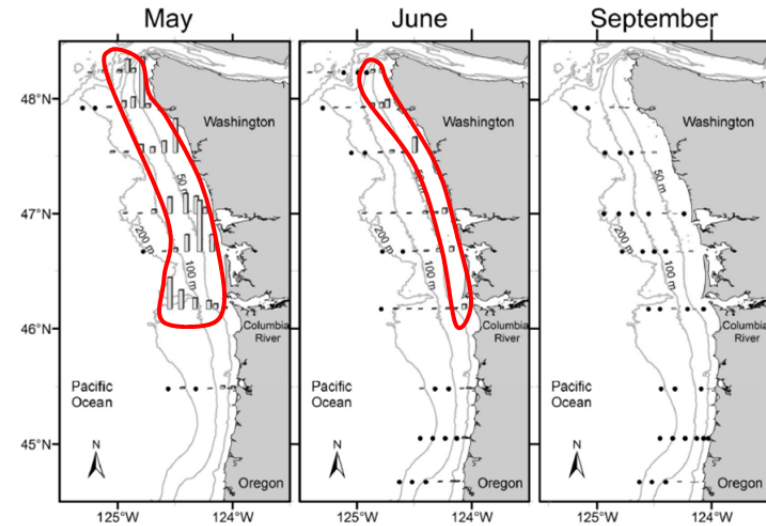
Yearling Chinook Stock Composition in June
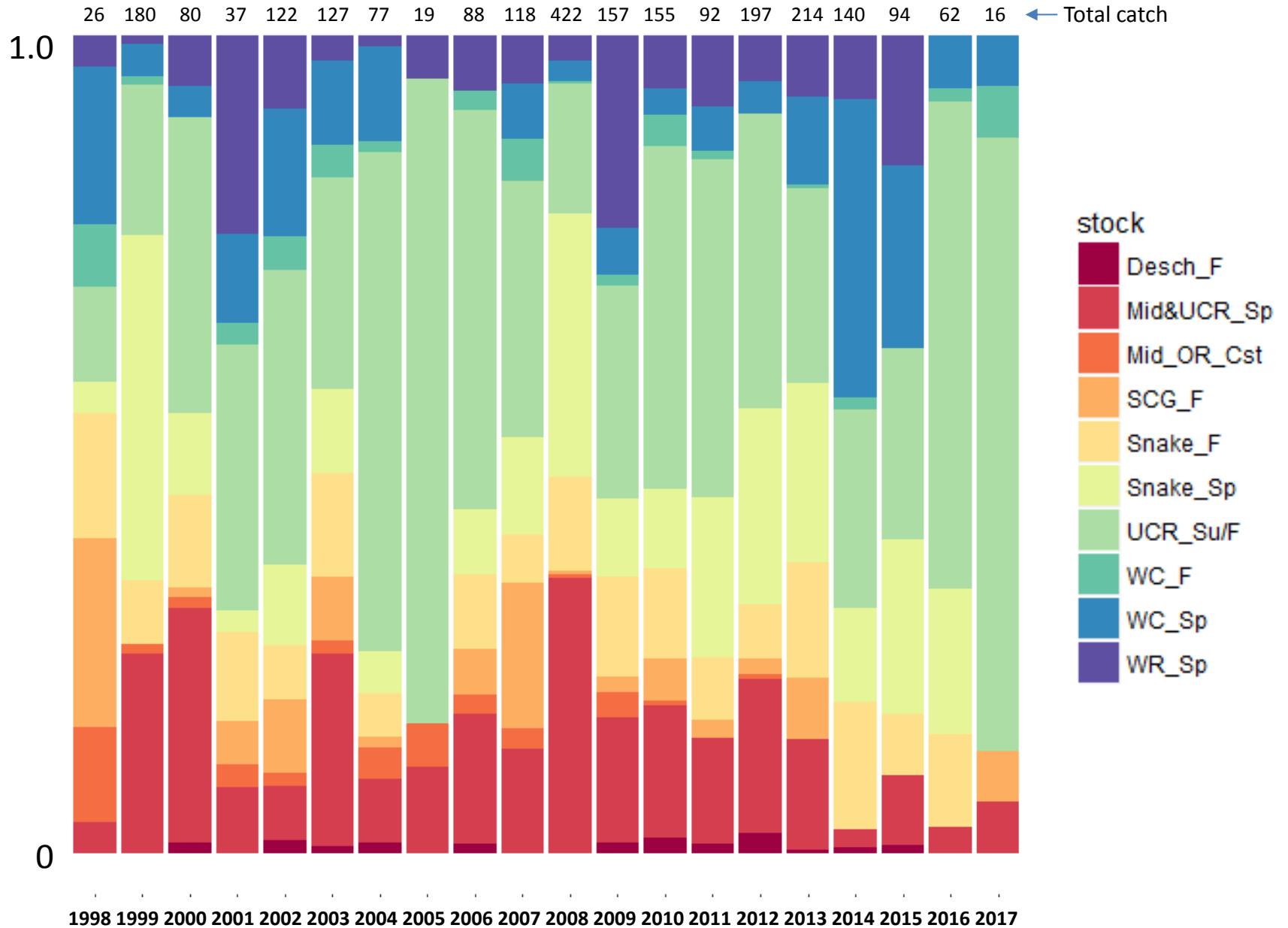
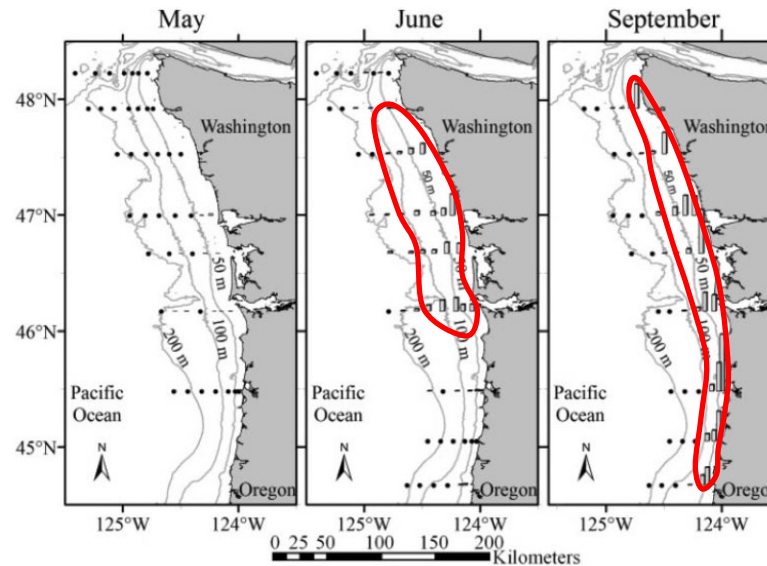# Spatial distribution is stock-specific

Teel, et al. 2015. Marine and Coastal Fisheries 7:274-300.
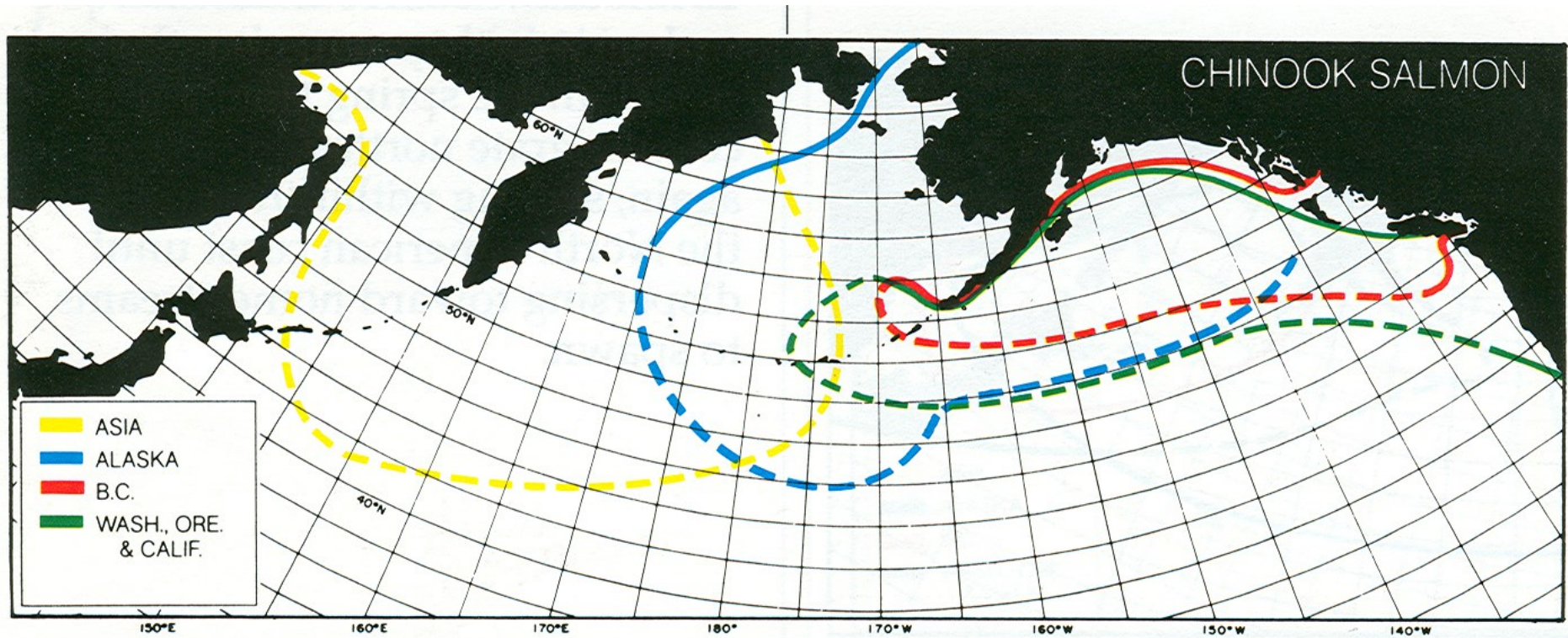
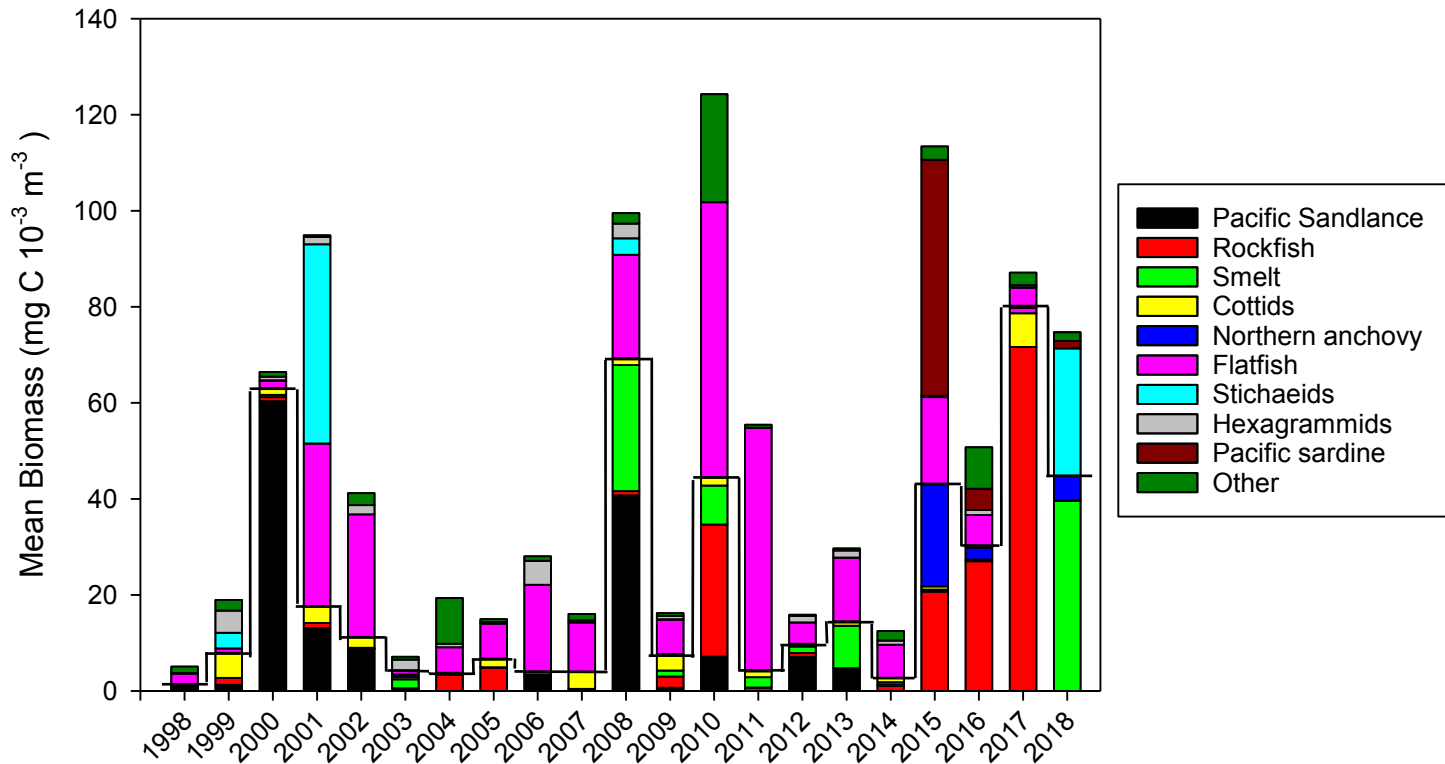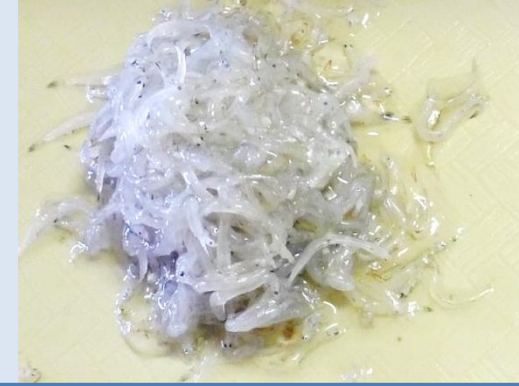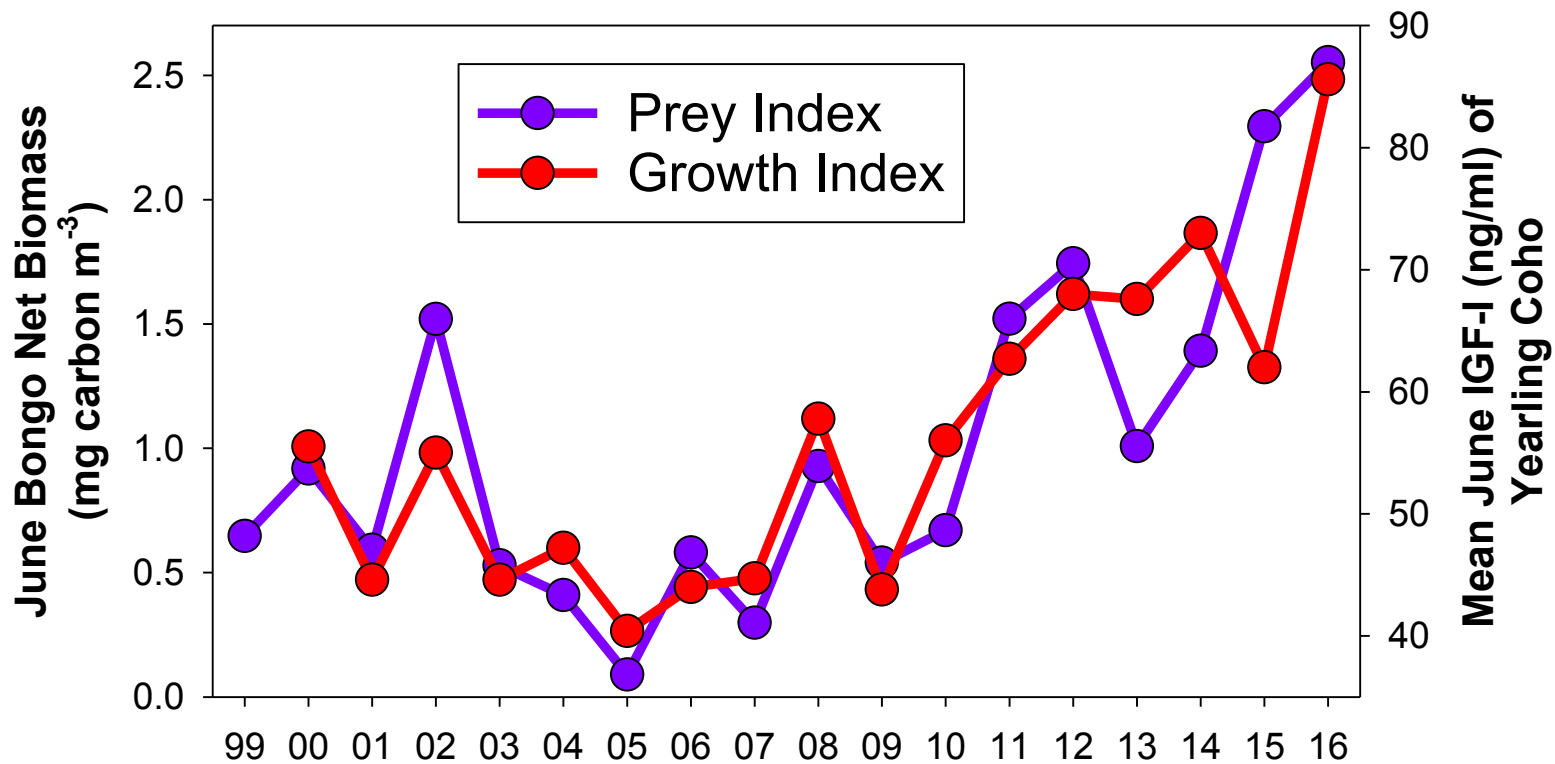# Subadult and Adult Distributions are Less Clear

Image by DFO Canada

Potential Prey Resources

Annual mean biomass of larval fish taxa collected during winter (January-March in 1998-2018) along the Newport Hydrographic Line
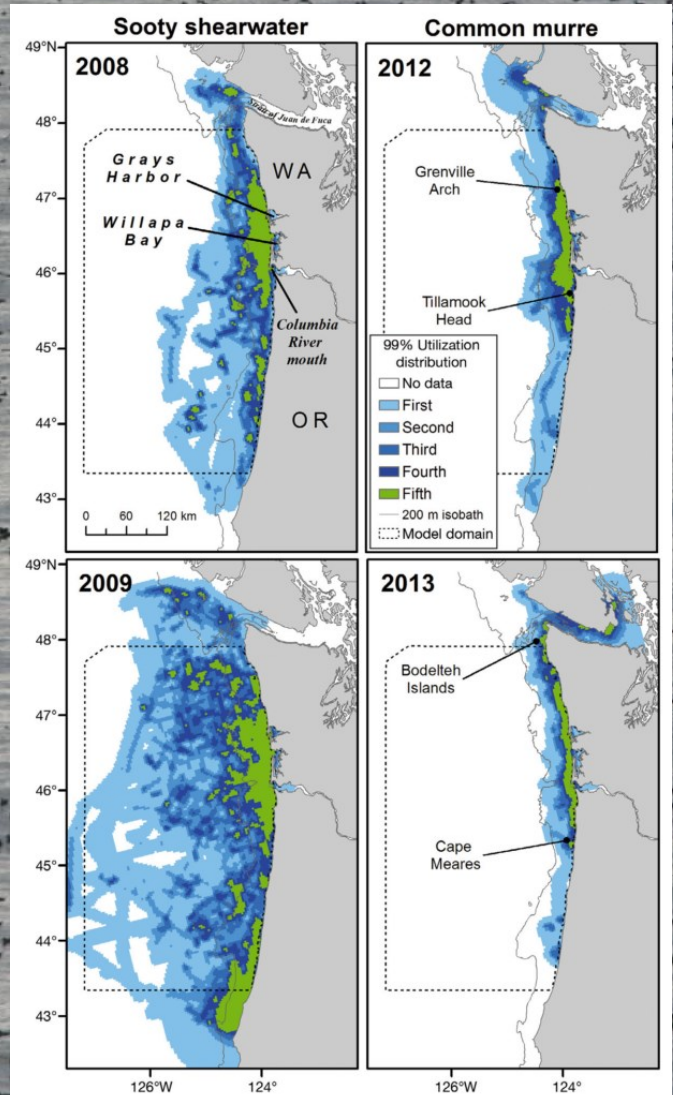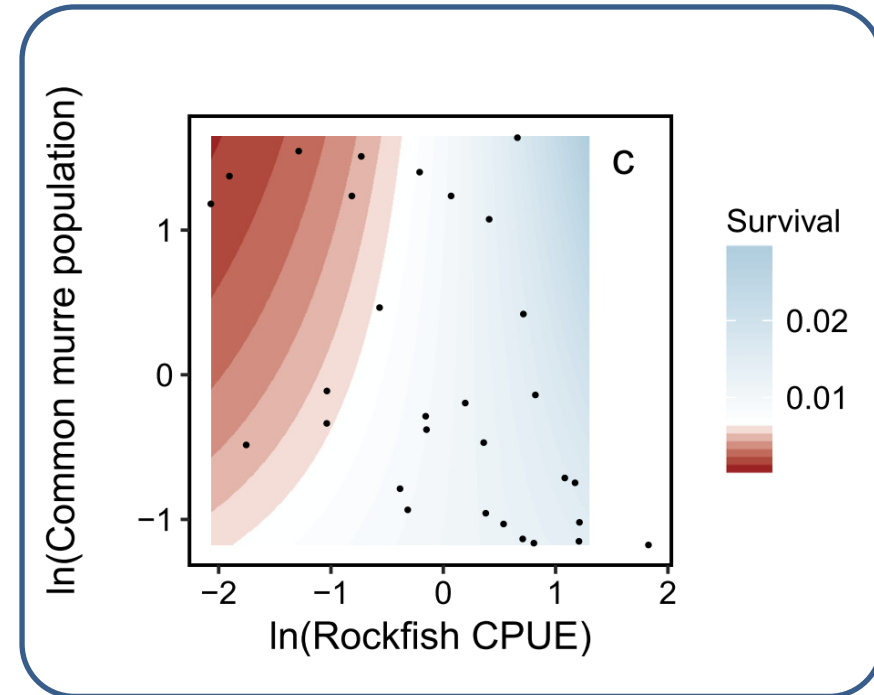
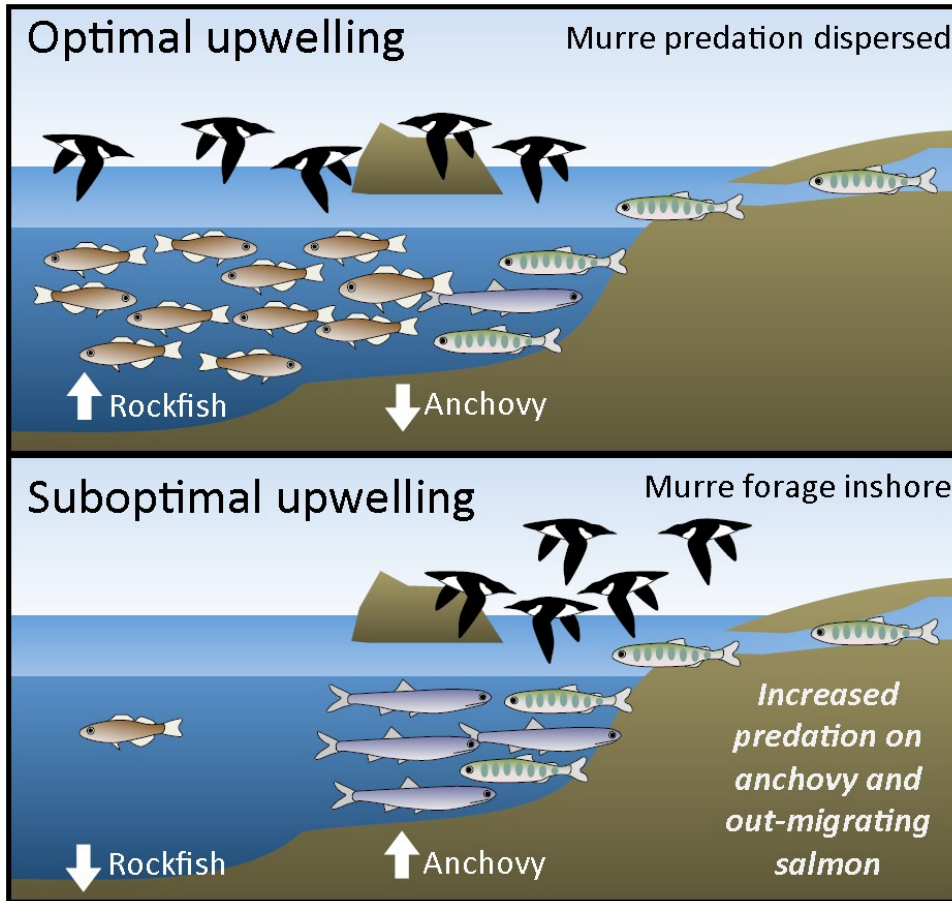# Prey abundance and estimated growth have been high

Predation impacts remain a data gap

Phillips et al. 2018

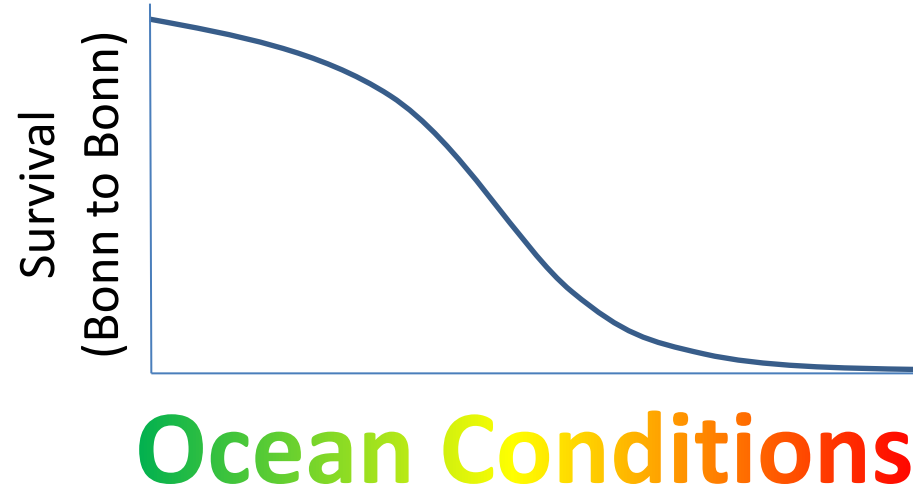# Predation impact depends on alternative prey

Wells et al. 2017

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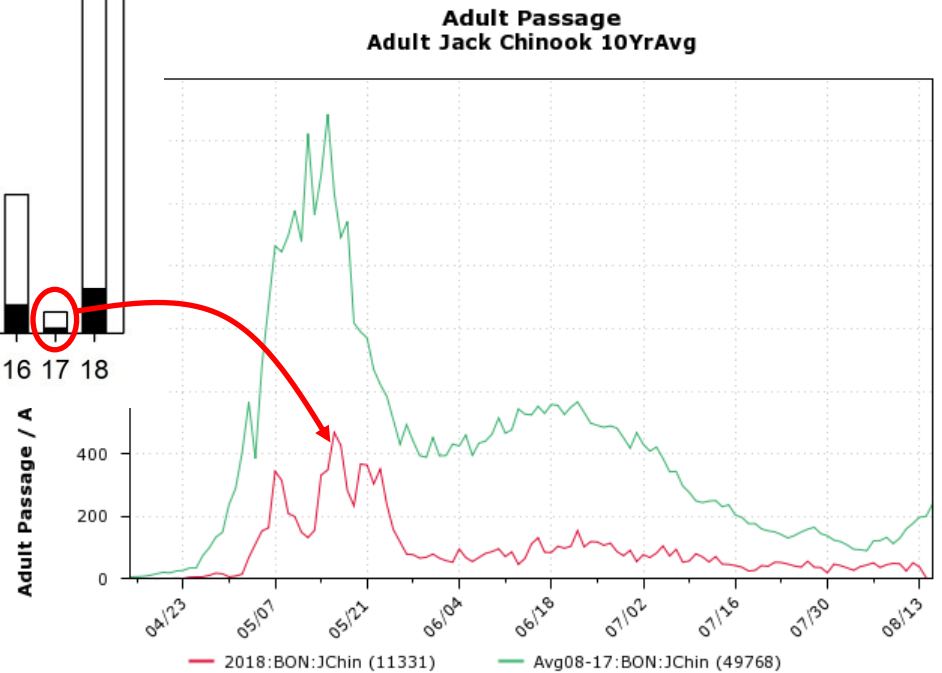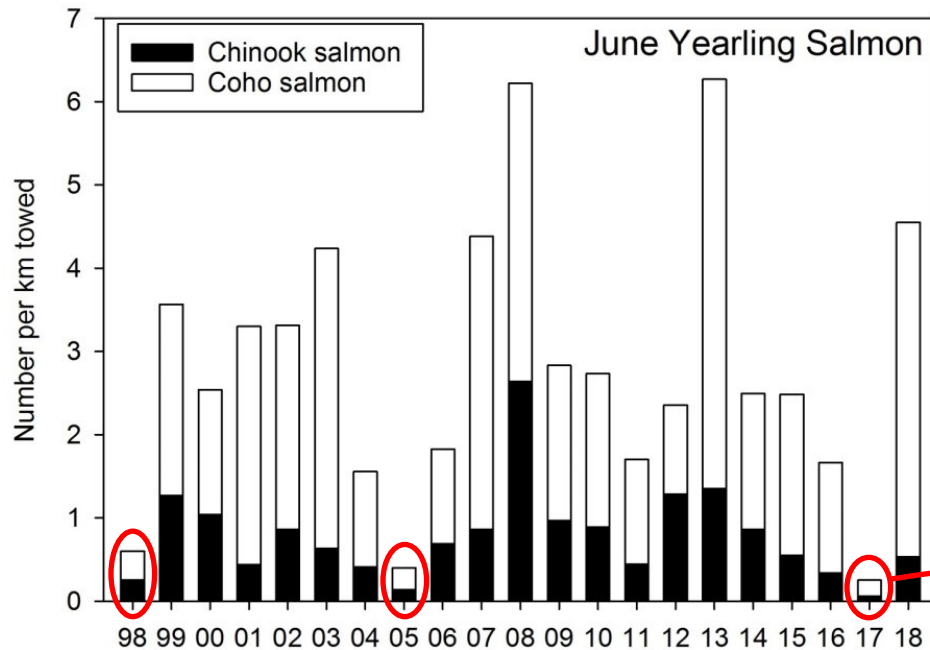- Salmon distribution and trophic interactions

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Early Warning:
Stoplight Chart

https://www.nwfsc.noaa.gov/oceanconditions

Survival (Bonn to Bonn)

Ocean Conditions

Early Warning:
Extremely Low Salmon Abundance in 2017

14 Aug 2018 13:04:05 PDT

Chinook at Bonneville Dam

Dynamic Linear Models

Sibling Regression and the first Principal Component of the stoplight chart
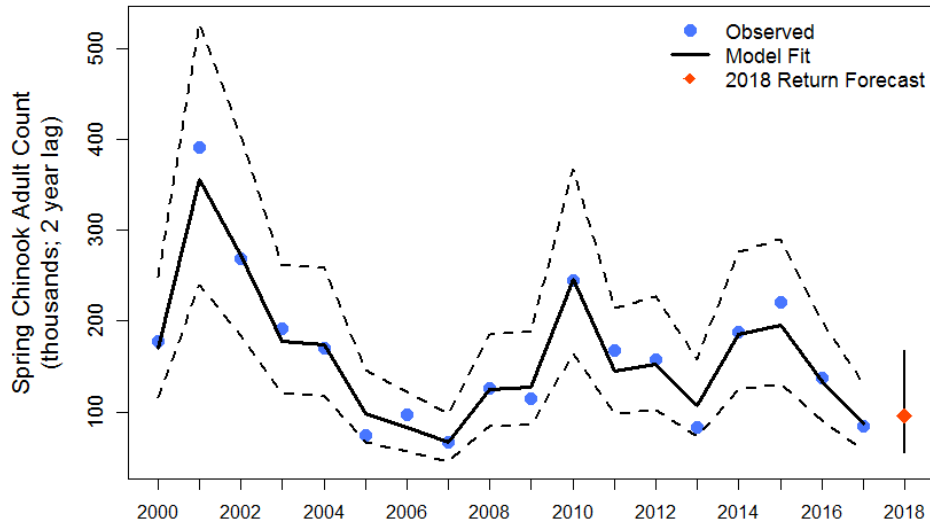
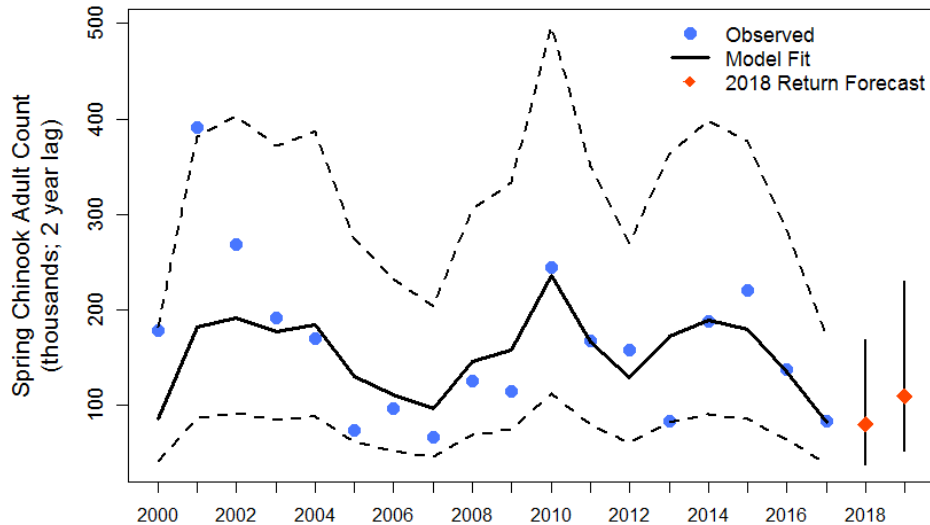**Spring Chinook**

March 15 – May 31
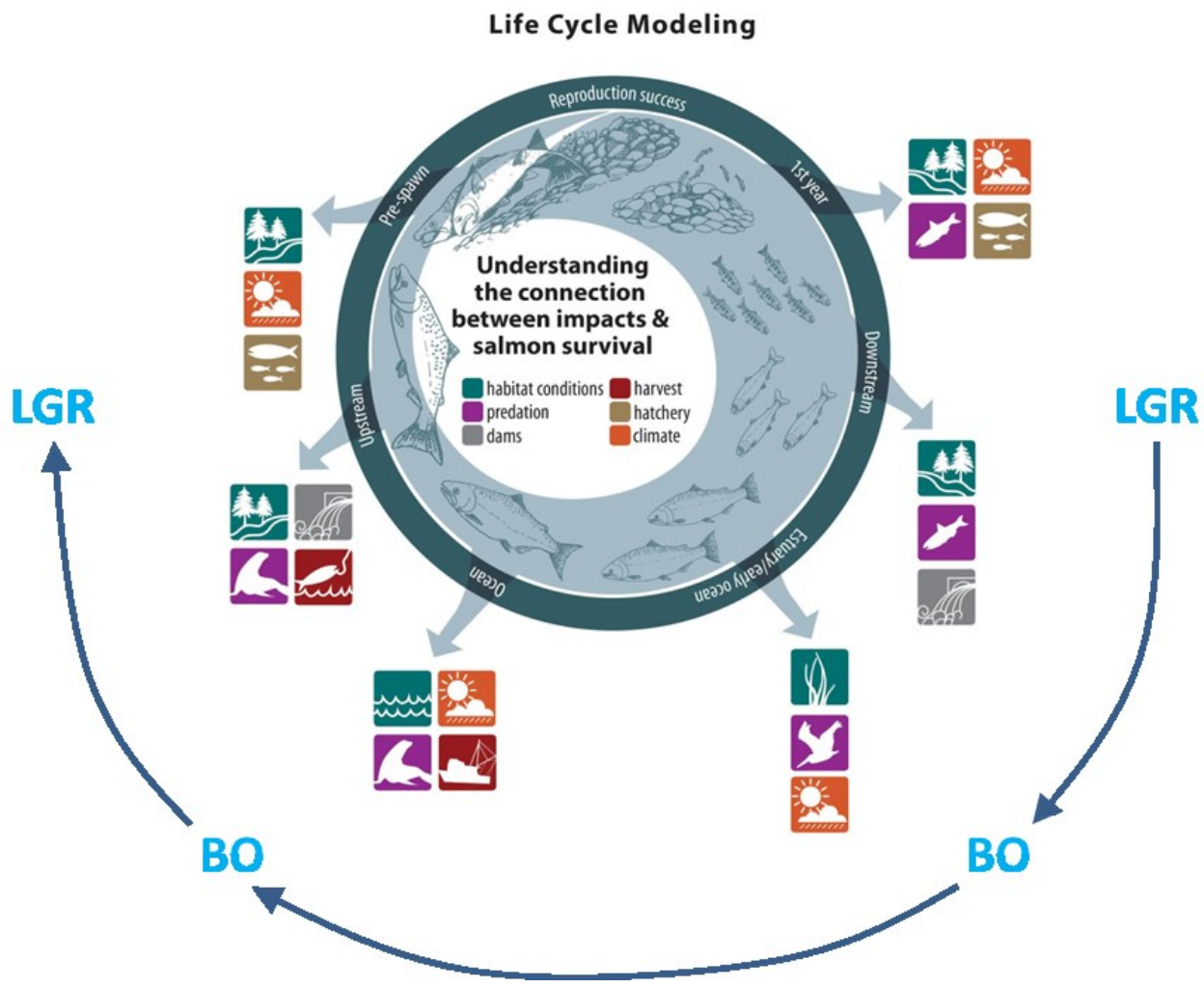
Outlook for 2018: 96K (55-168)

(Observed for 2018: 88K)

Outlook for 2019: 109K (52 – 230)

(no jack data used)
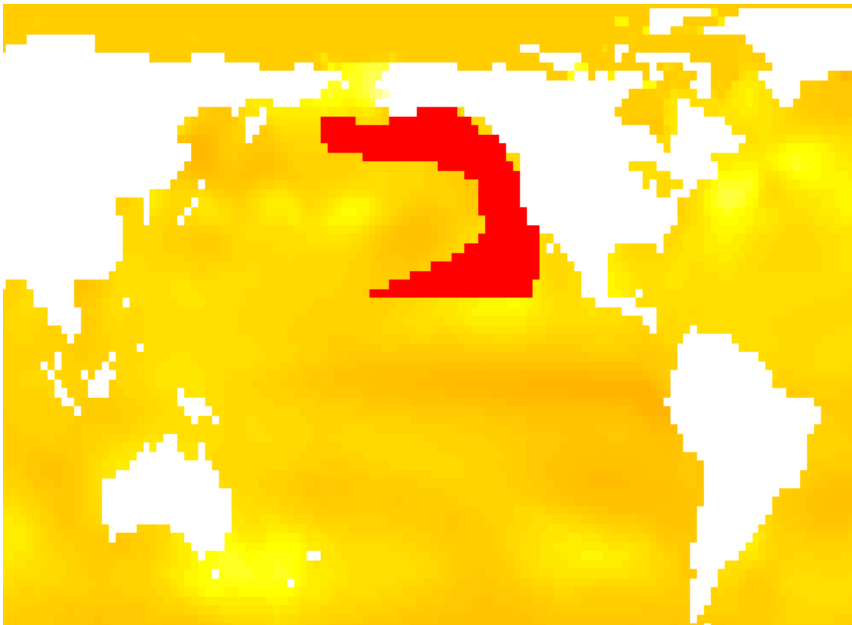
Return data from Columbia Basin Research, DART

Life Cycle Modeling

Best Set of Covariates*

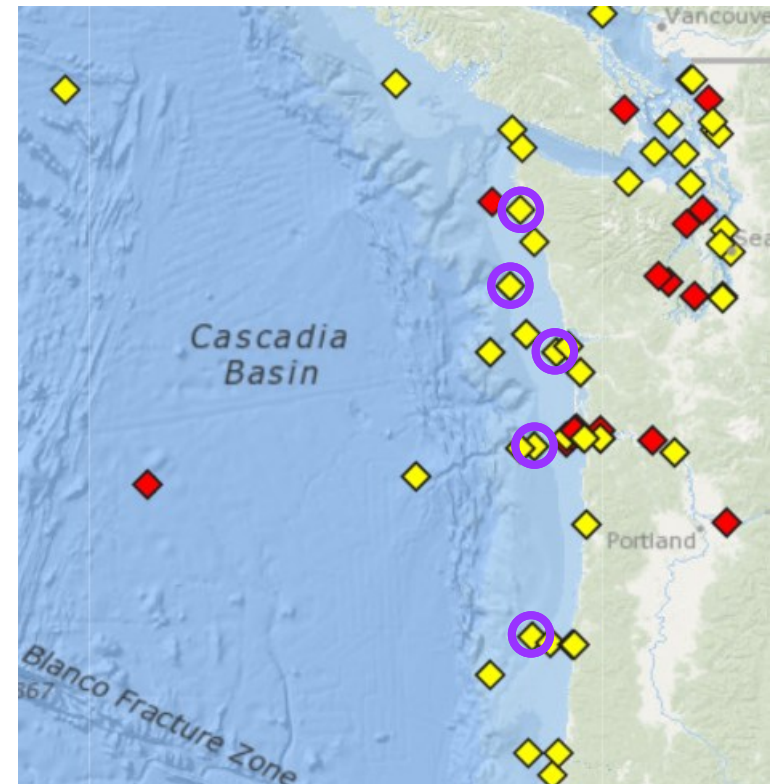## Large-scale winter SST

Recreated using ERSST v5 data

Johnstone and Mantua. 2014

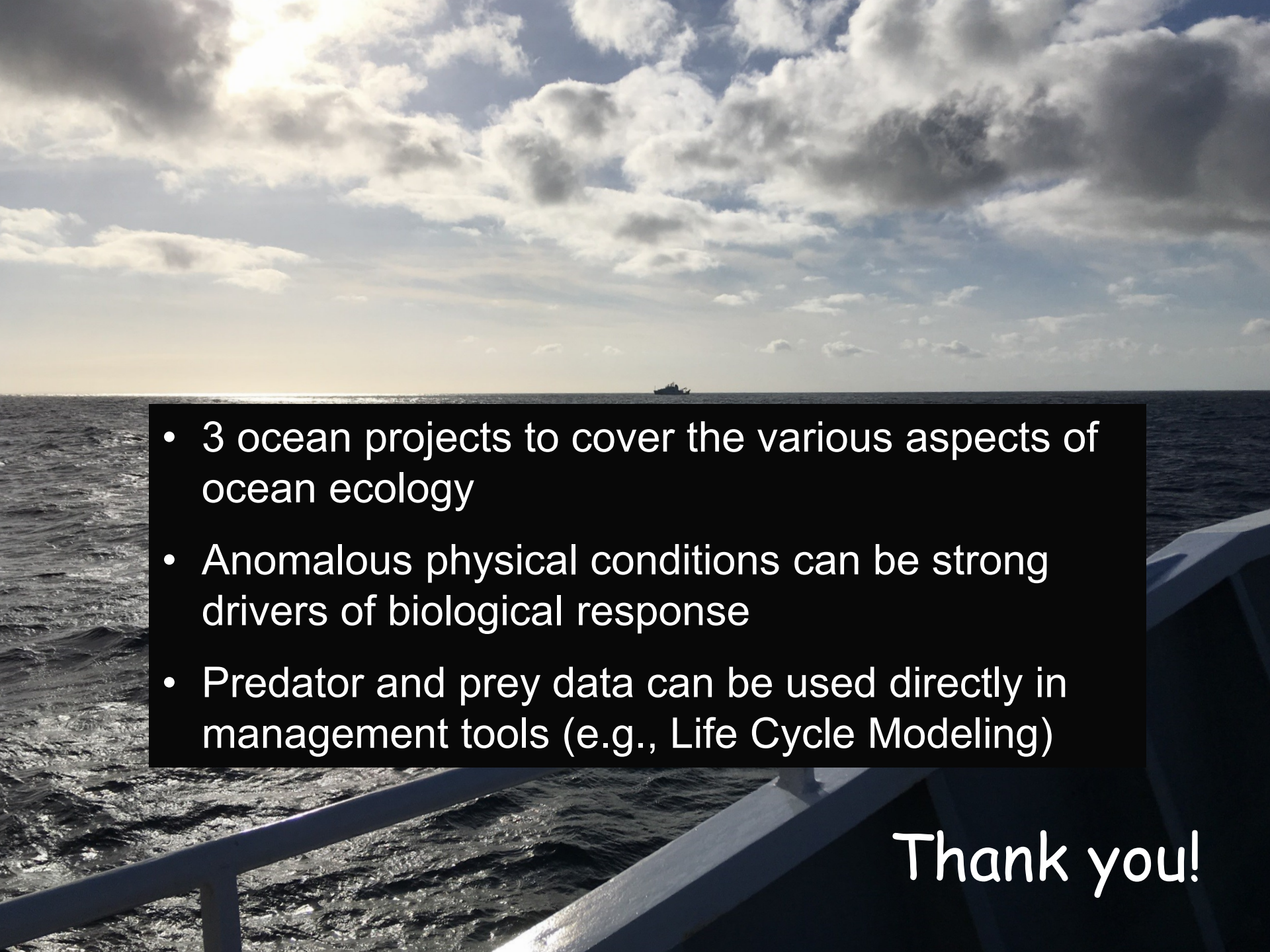https://www.ncdc.noaa.gov/data-access/marineocean-data/extended-reconstructed-sea-surface-temperature-ersst-v5

Local summer SST
From Buoys

http://www.ndbc.noaa.gov/

* These should be thought of as indices of the (unmeasured) ecological processes

- 3 ocean projects to cover the various aspects of ocean ecology

- Anomalous physical conditions can be strong drivers of biological response

- Predator and prey data can be used directly in management tools (e.g., Life Cycle Modeling)

Thank you!