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Regional and temporal variability in Puget Sound zooplankton: bottom-up links to juvenile salmon

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Keister, Julie; Bos, Julia; Herrmann, Bethellee; Keyers, Mya; Krembs, Christopher; Mickett, John; Newton, J. A. (Jan A.); Reuf, Wendi; and Winans, Amanda, "Regional and temporal variability in Puget Sound zooplankton: bottom-up links to juvenile salmon" (2018). *Salish Sea Ecosystem Conference*. 412. <https://cedar.wvu.edu/ssec/2018ssec/allsessions/412>

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Speaker

Julie Keister, Julia Bos, Bethellee Herrmann, Mya Keyers, Christopher Krembs, John Mickett, J. A. (Jan A.) Newton, Wendi Reuf, and Amanda Winans



Regional and temporal variability in Puget Sound zooplankton

Julie Keister, Julia Bos, BethElLee Herrmann, Christopher Krembs, Mya Keyzers, John Mickett, Jan Newton, Wendi Reuf, Amanda Winans, and *numerous* partners.



SALISH SEA
MARINE SURVIVAL PROJECT
www.marinesurvivalproject.com



DEPARTMENT OF
ECOLOGY
State of Washington

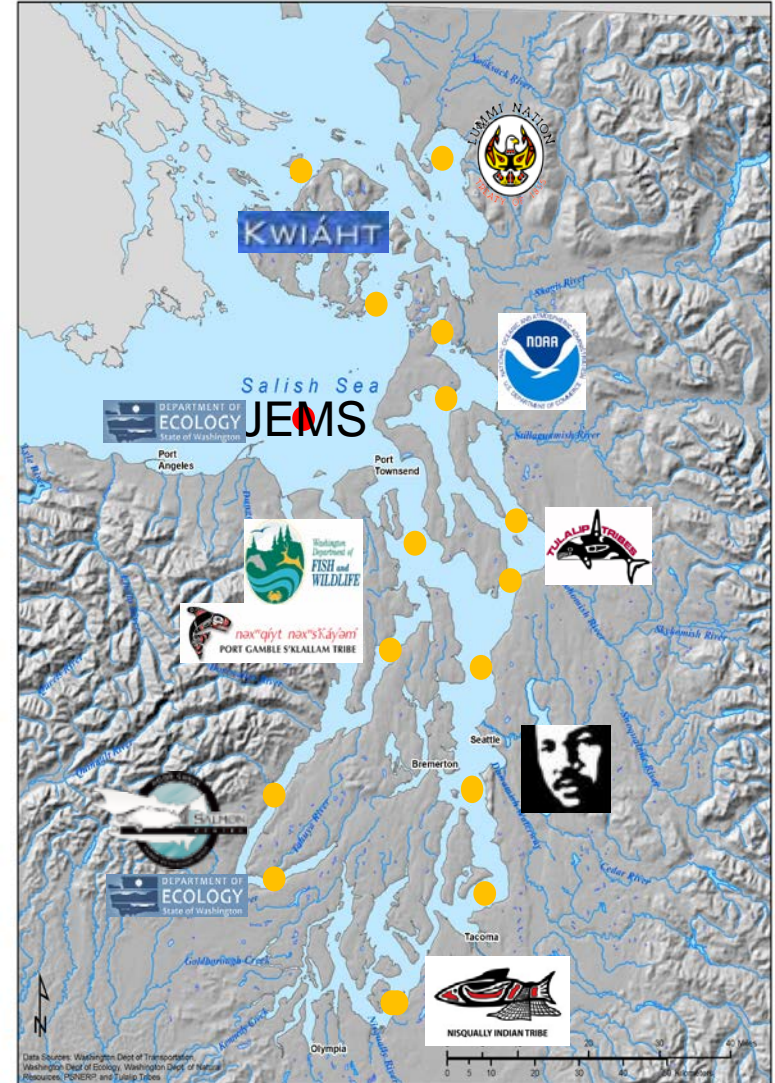
Puget Sound Zooplankton Monitoring Program

Initiated in 2014 to address hypotheses of bottom-up controls on salmon survival.

Provides data on:

- 1) Response of zooplankton community to environmental change.
- 2) Patterns in prey availability for salmon and other fish and seabirds.

Fills long-standing data gap for fishery and ecosystem modelers and managers.



Sampling Methods:

At most locations:

Bi-weekly sampling March-October, 2014-2017

+ Year-round sampling in Central Basin by King County

- **Vertical net tows**

Full water column tows
60-cm dia., 200- μ m mesh

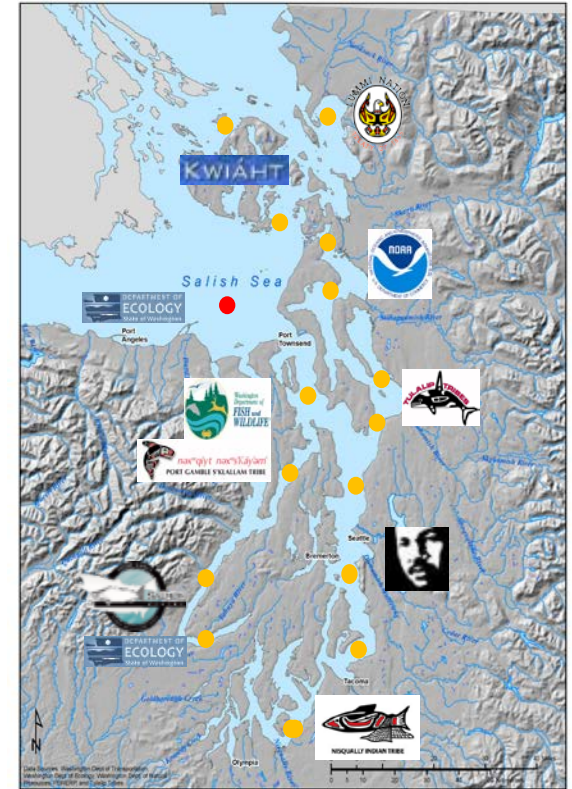
Targets smaller, diverse taxa
Used as indicators of environmental changes



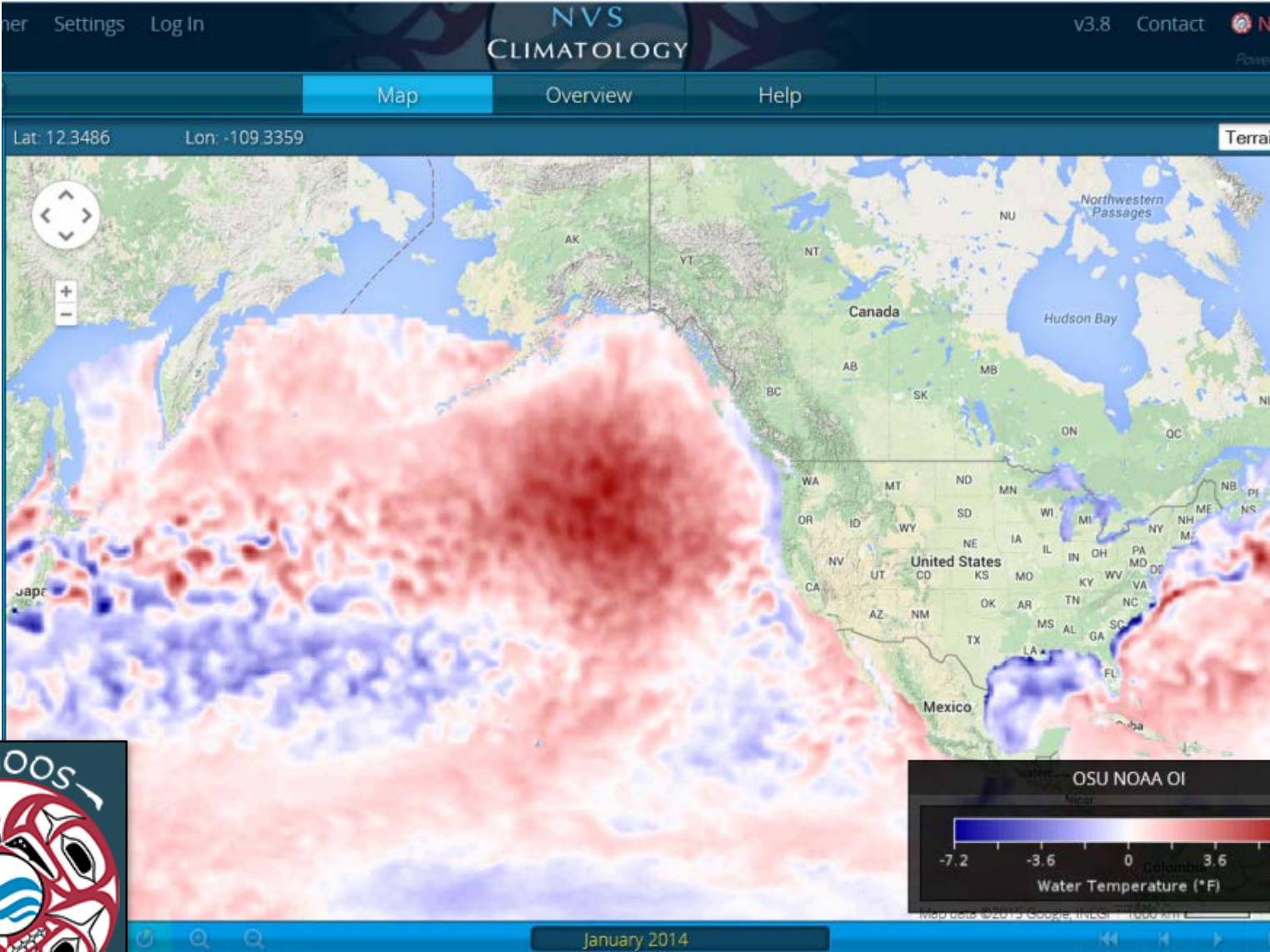
- **Oblique bongo net tows**

Upper 30 m
60-cm dia., 335- μ m mesh

Targets larger taxa
Used as indicators of salmon prey fields



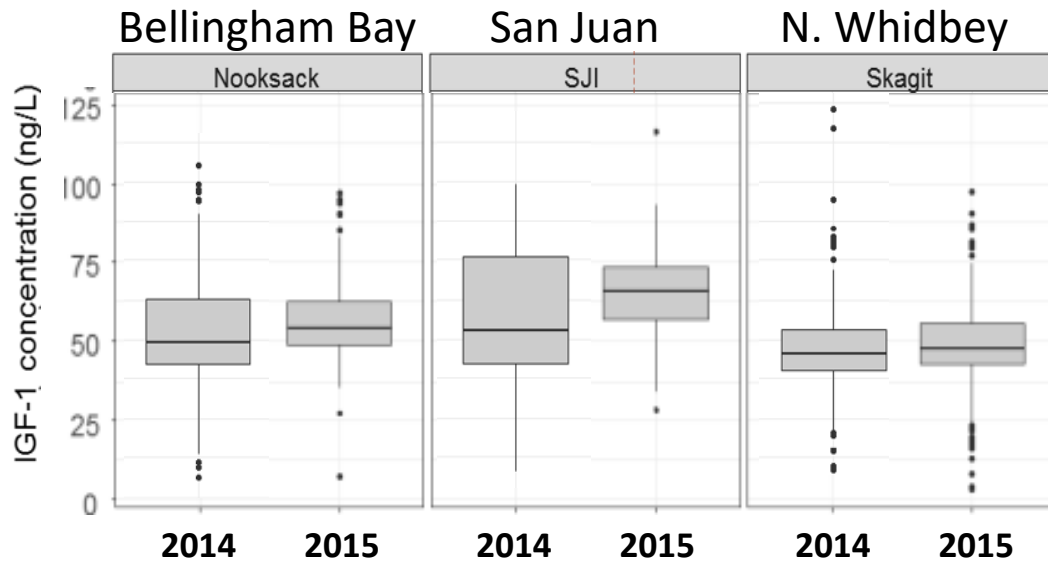
Late 2014 = Intrusion of “The Blob” into the Salish Sea



Juvenile Chinook salmon growth and size:

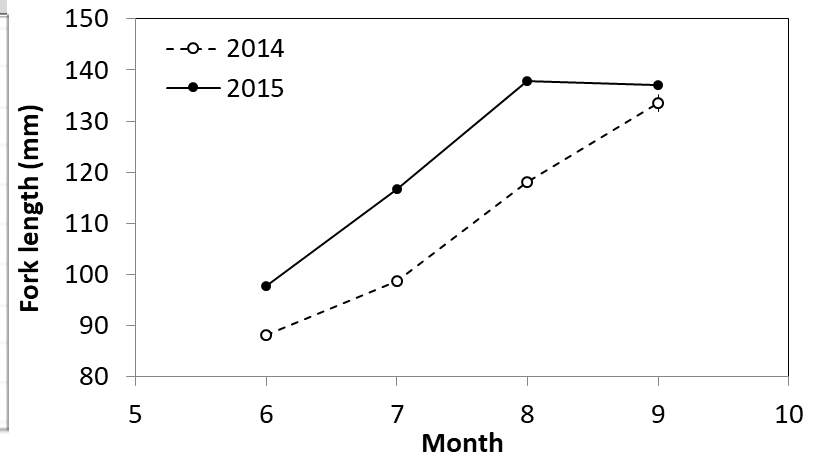
Tended to be lower and more variable in 2014 than 2015

IGF-1 index of growth by region




Chamberlain et al. 2017

N. Whidbey juvenile salmon size

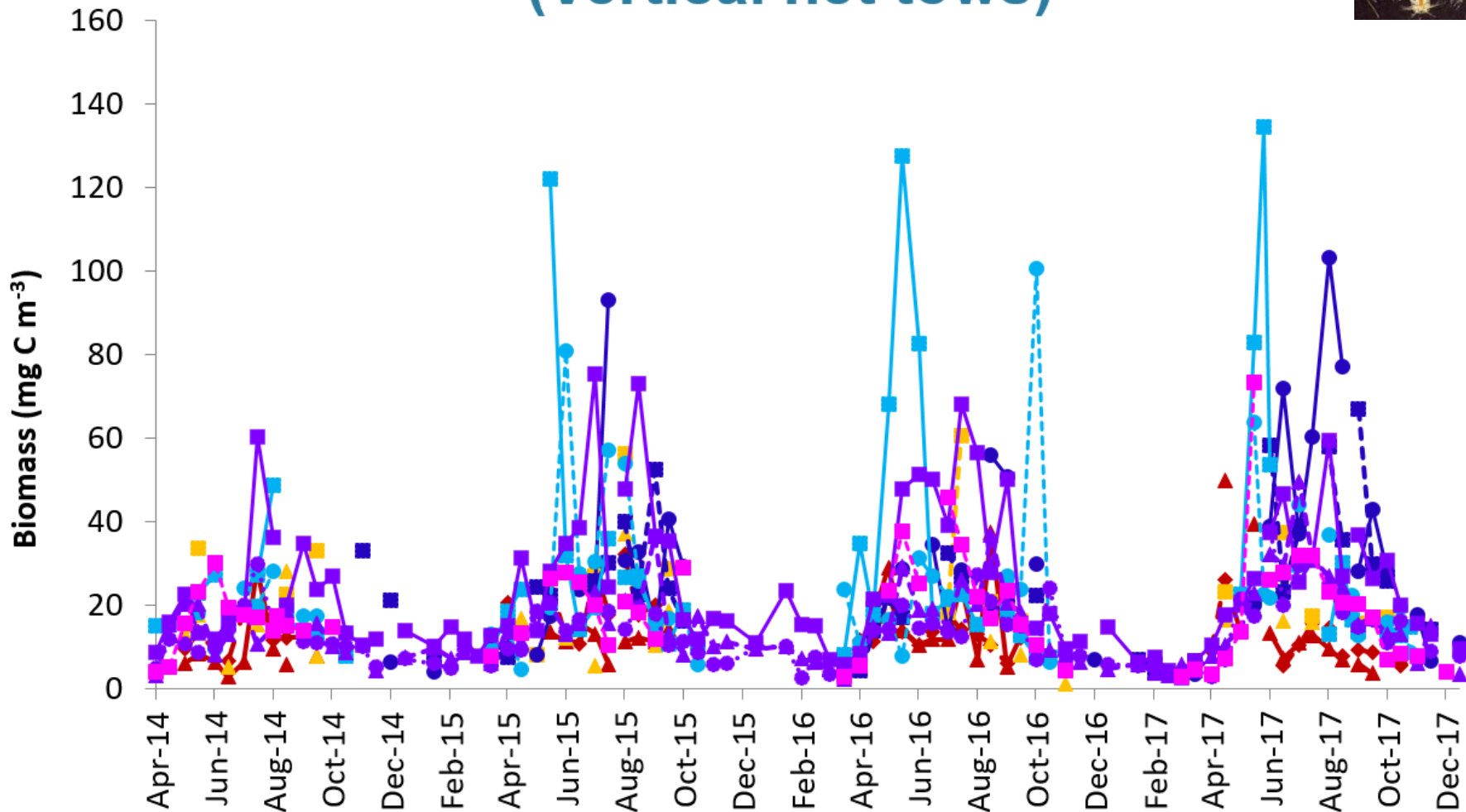


Courtesy of C. Greene et al., NOAA

A collection of various zooplankton specimens, including copepods, nauplii, and rotifers, displayed against a black background. The specimens are diverse in size and color, ranging from small, translucent organisms to larger, more complex forms with distinct internal structures and appendages. A white text box is overlaid on the image, containing the question: "How was this big variability in years reflected in the zooplankton?"

How was this big variability in years reflected in the zooplankton?

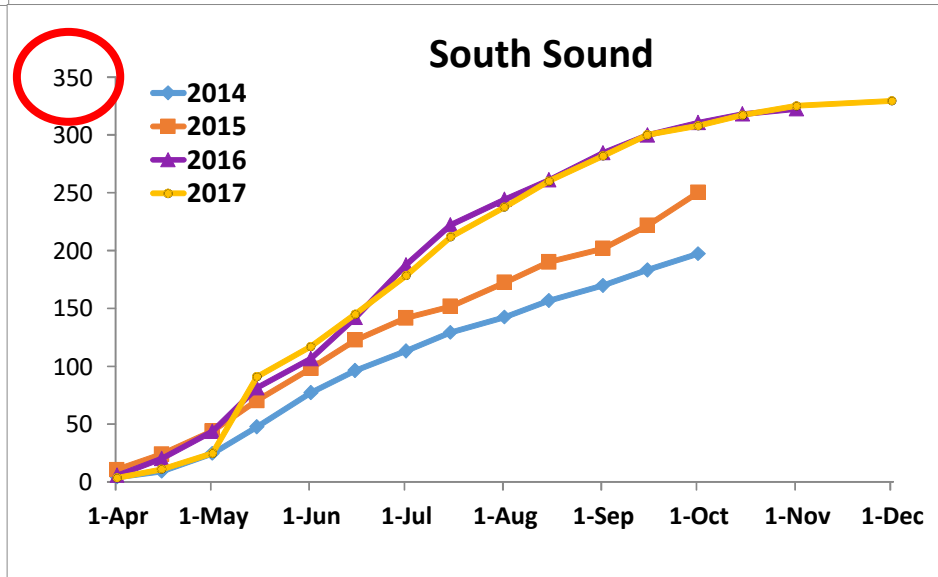
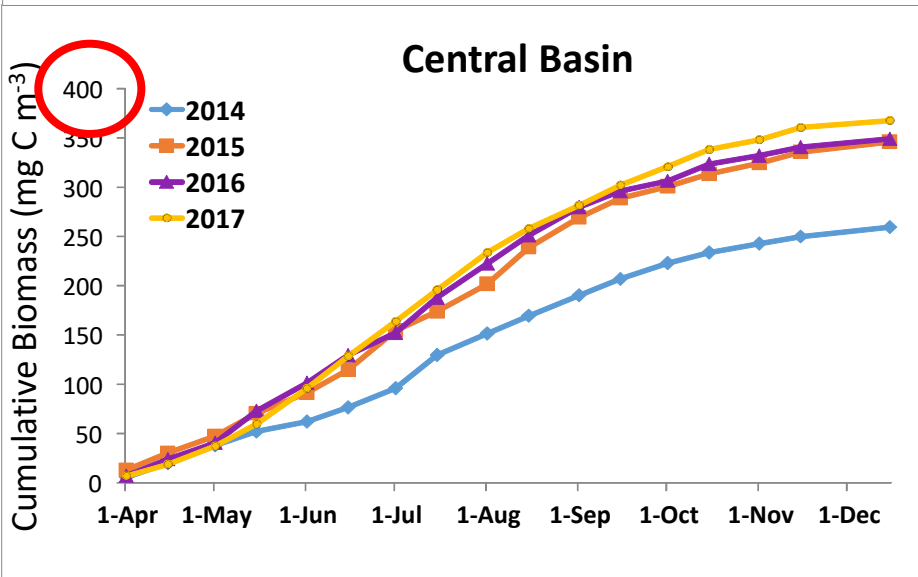
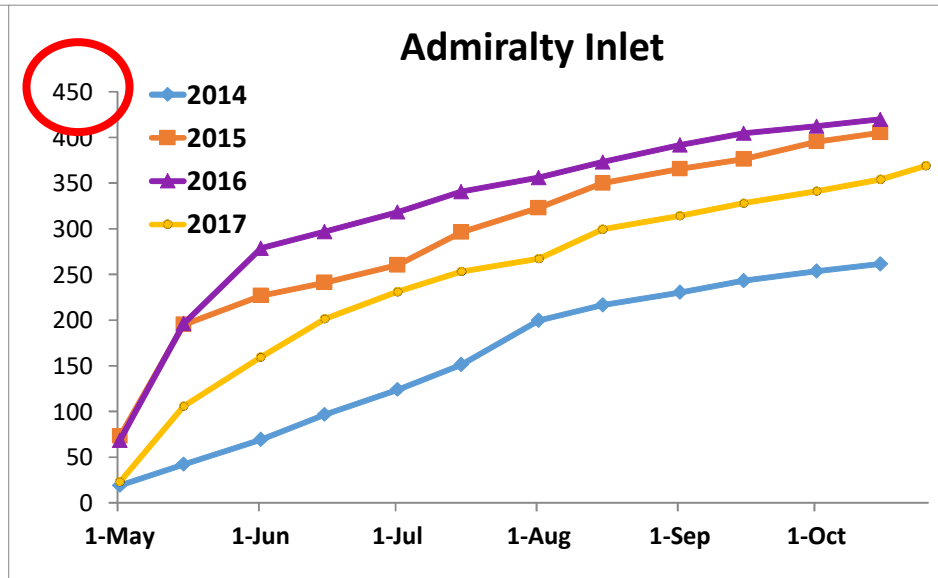
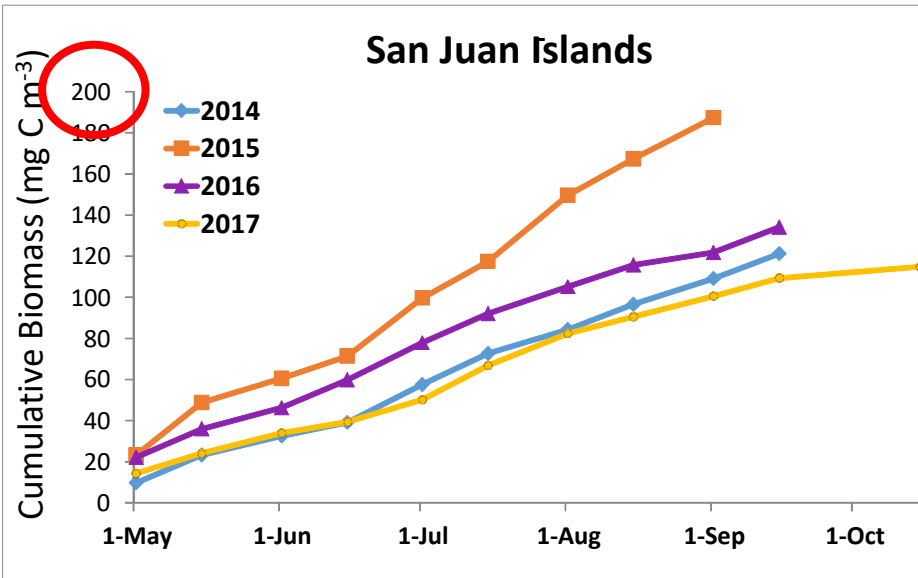
Total Zooplankton Biomass (Vertical net tows)



- | | | |
|------------------|------------------|---------------|
| San Juan Islands | San Juan Islands | Whidbey Basin |
| Whidbey Basin | Whidbey Basin | Whidbey Basin |
| Admiralty Inlet | N Hood Canal | Central Basin |
| Central Basin | Central Basin | South Sound |

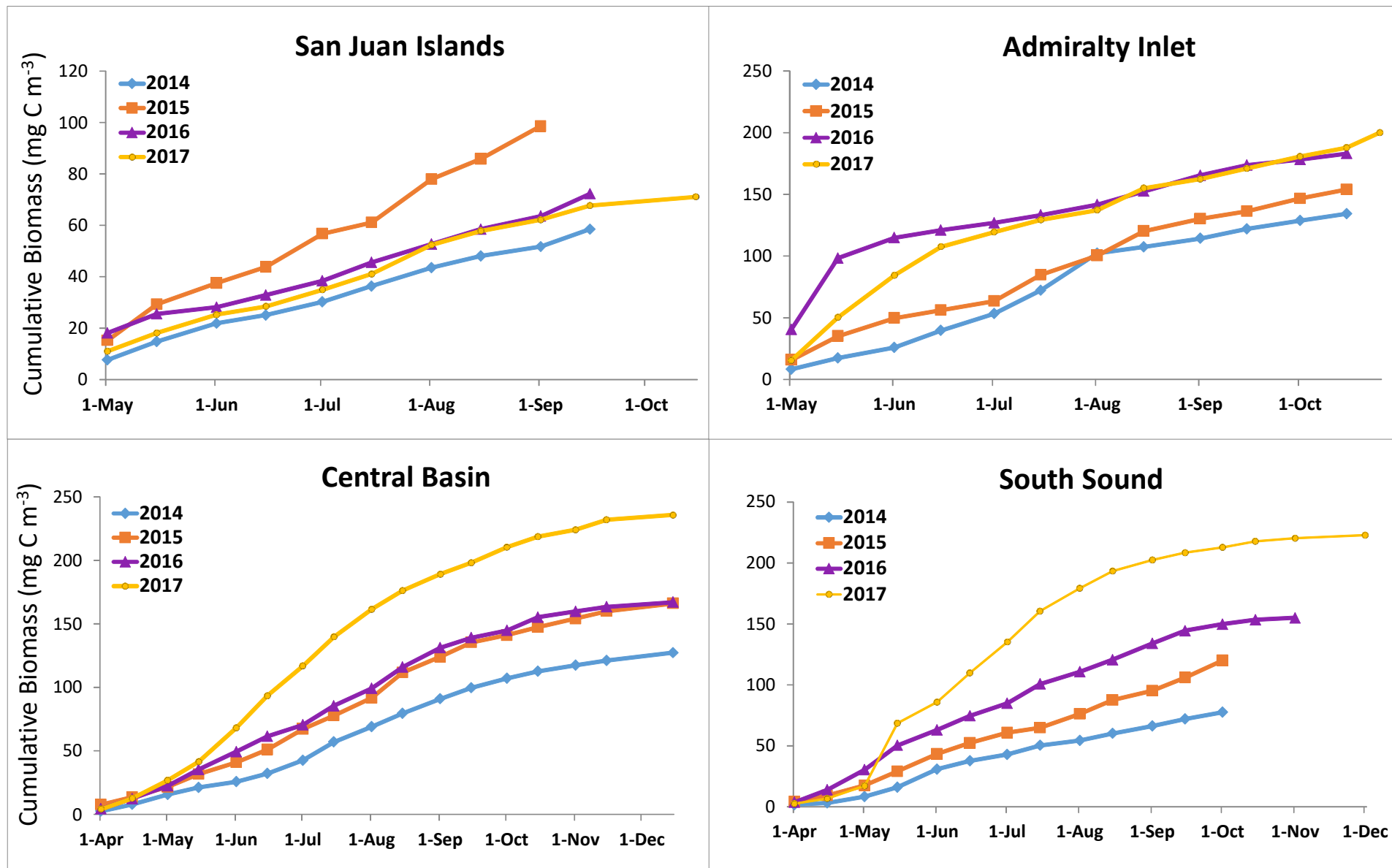
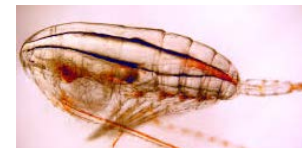
Total zooplankton biomass (vertical net tows):

2015-16 biomass was high. Big differences among regions.



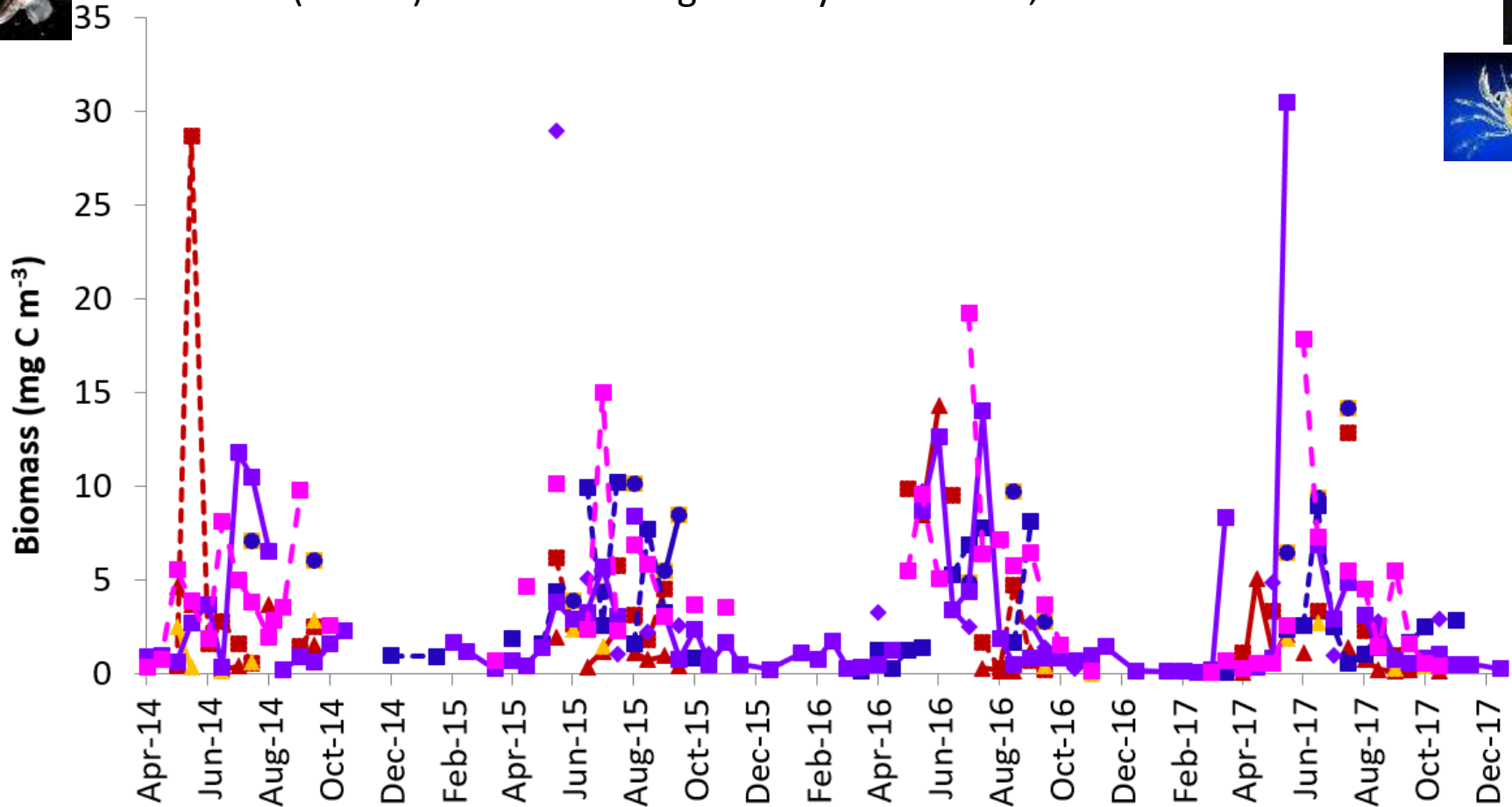
Copepod biomass:

Comprises most of the total biomass.



Juvenile Salmon Prey Field Index

(Subtle) increase during warm years overall, but mixed.



San Juan Islands

San Juan Islands

Whidbey Basin

Whidbey Basin

Whidbey Basin

Whidbey Basin

Central Basin

Central Basin

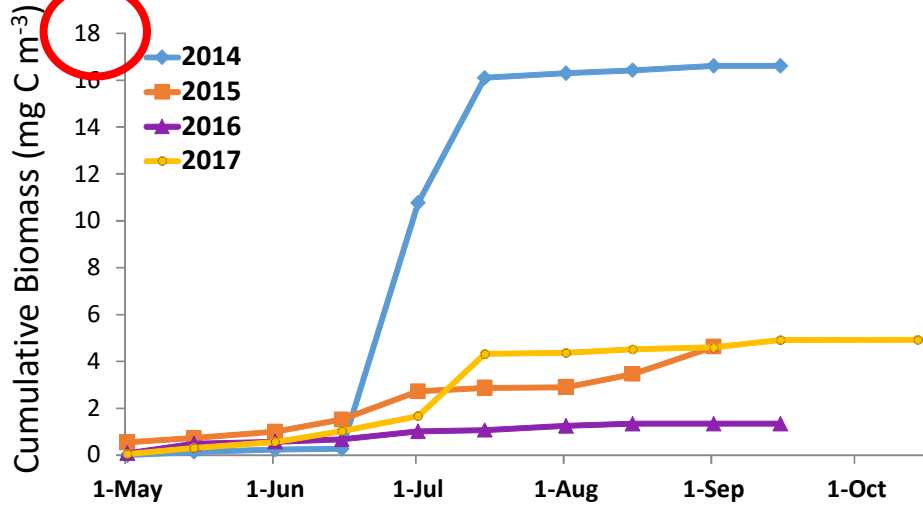
South Sound



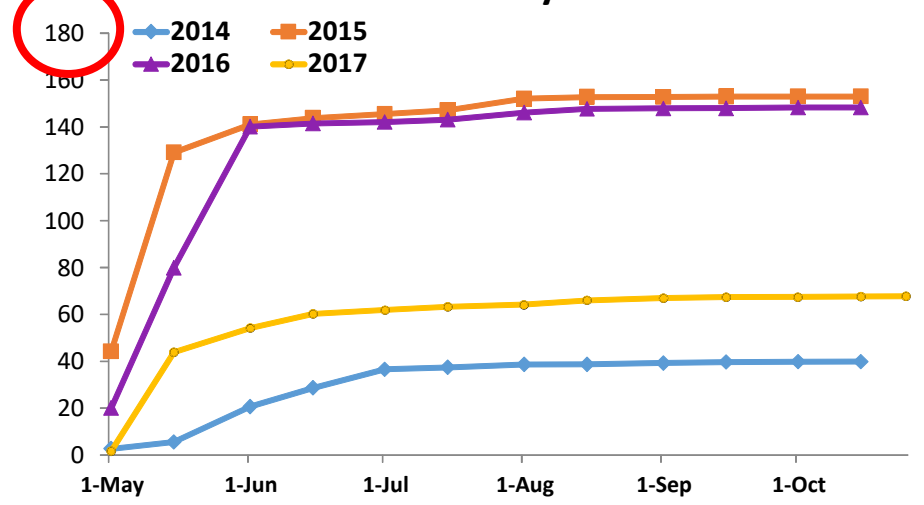
Crab larvae biomass (vertical net tows):



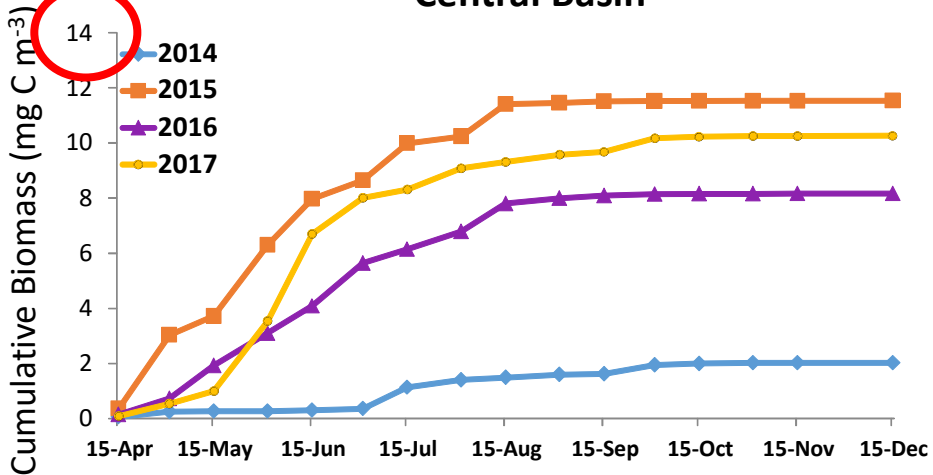
San Juan Islands



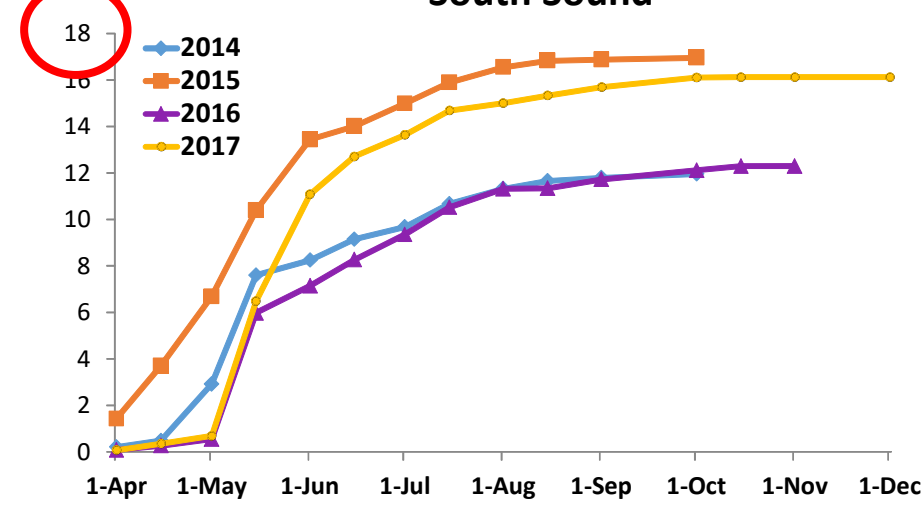
Admiralty Inlet



Central Basin

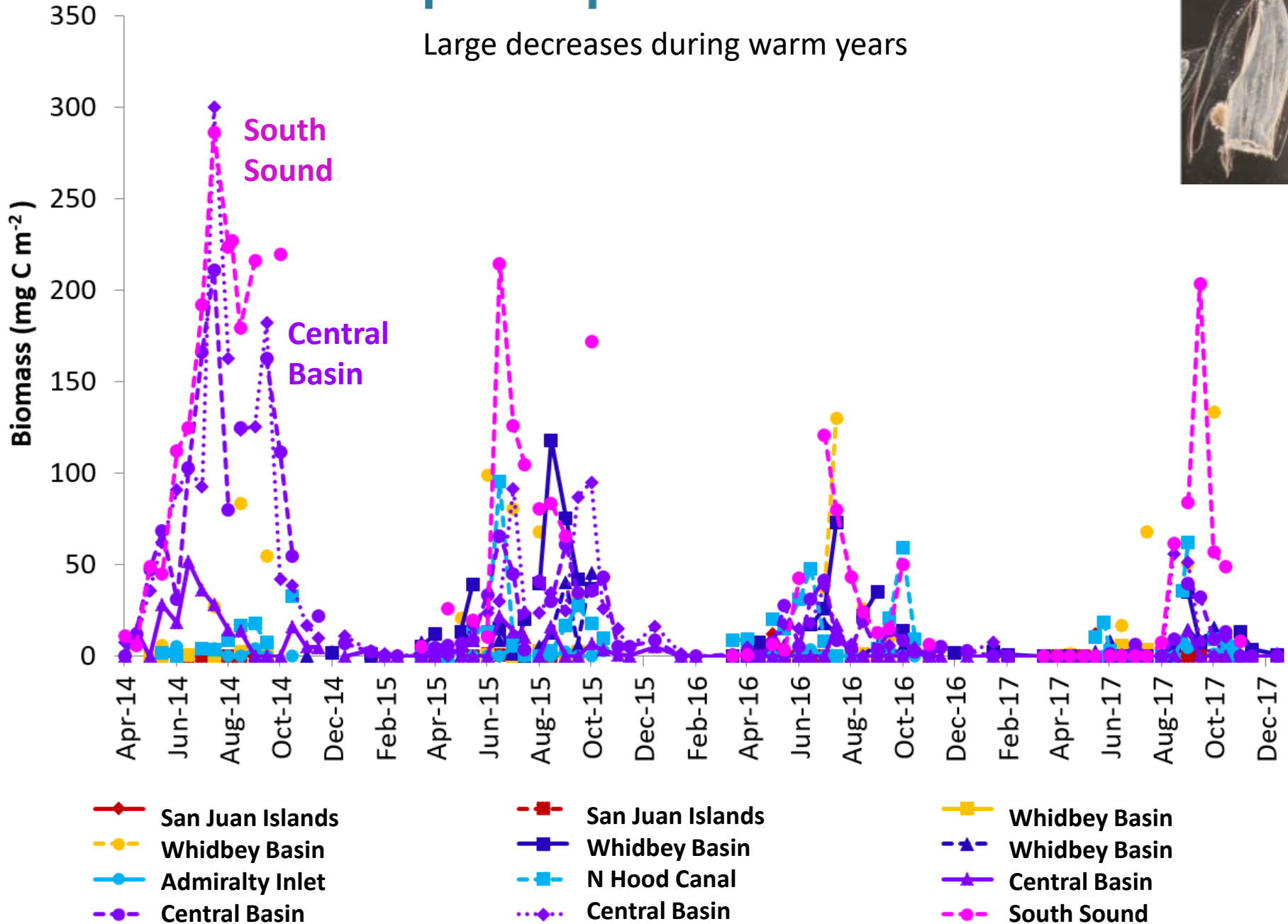


South Sound



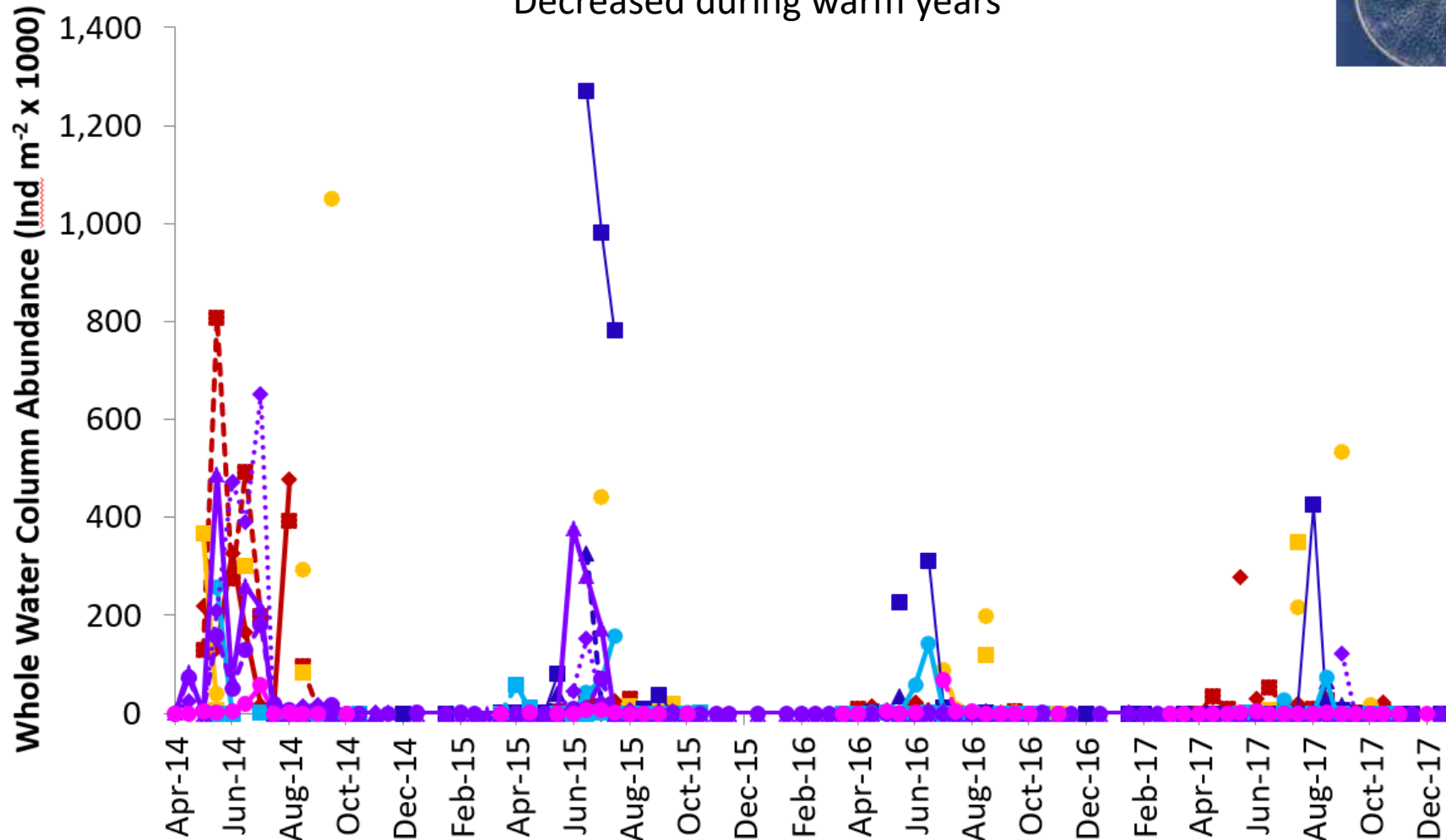
Siphonophore Biomass

Large decreases during warm years



Noctiluca Abundances

Decreased during warm years



- San Juan Islands (red diamond)
- Whidbey Basin (yellow circle)
- Admiralty Inlet (cyan circle)
- Central Basin (purple circle)
- San Juan Islands (red square)
- Whidbey Basin (blue square)
- N Hood Canal (cyan square)
- Central Basin (purple square)
- Whidbey Basin (yellow square)
- Whidbey Basin (blue triangle)
- Central Basin (purple triangle)
- South Sound (magenta circle)

Conclusions

- Puget Sound zooplankton monitoring began just prior to the warmest years on record.
- Total zooplankton and biomass of important fish prey were higher in 2015-16 than 2014.
- Biomass of some “unfavorable” taxa declined during the warm years.
- Large regional variability observed.
- Funding beyond 2019 has not been secured!

Partnerships & Funding



WASHINGTON STATE DEPARTMENT OF
Natural Resources



NISQUALLY INDIAN TRIBE



nəxʷqíyt nəxʷsʰkáyám
PORT GAMBLE S'KLALLAM TRIBE

PugetSoundPartnership

LEADING PUGET SOUND RECOVERY

Many rare taxa observed in 2015-2017

Genus Species		2014	2015	2016	2017	Location
Copepod	<i>Candacia bipinnata</i>	x			x	Bellingham, Central Basin, South Sound
	<i>Clausocalanus</i>*	x		x	x	Bellingham
	<i>Clytemnestra rostrata</i>*	x		x	x	Bellingham
	<i>Eucalanus californicus</i>	x	x			Bellingham, San Juan
	<i>Euchirella pulchra</i>	x				Bellingham, San Juan, Whidbey, Central Basin
	<i>Mesocalanus tenuicornis</i> *	x	x	x		Bellingham, San Juan
	<i>Pleuromamma abdominalis</i>	x	x		x	South PS
	<i>Scaphocalanus brevicornis</i>	x	x		x	Central Basin, South Sound
	<i>Scolecithricella ovata</i>*	x	x	x		N Hood Canal
	<i>Tharybis fultoni</i>	x				Bellingham, Whidbey, Central Basin, N&S Hood Canal
	<i>Triconia conifera</i>	x				Throughout
Crabs	<i>Emerita analoga</i>	x			x	Main PS
Krill	<i>Nematoscelis difficilis</i>	x	x			San Juan, Central Basin
Shrimp	<i>Sergestes similis</i>	x	x	x		San Juan, Admiralty
Tunicate	Thaliacean	x			x	Bellingham, Central Basin, South Sound

* = species seen only once; x= not present; **Bold** = species observed off Oregon during the warming years of 2014-2016.

