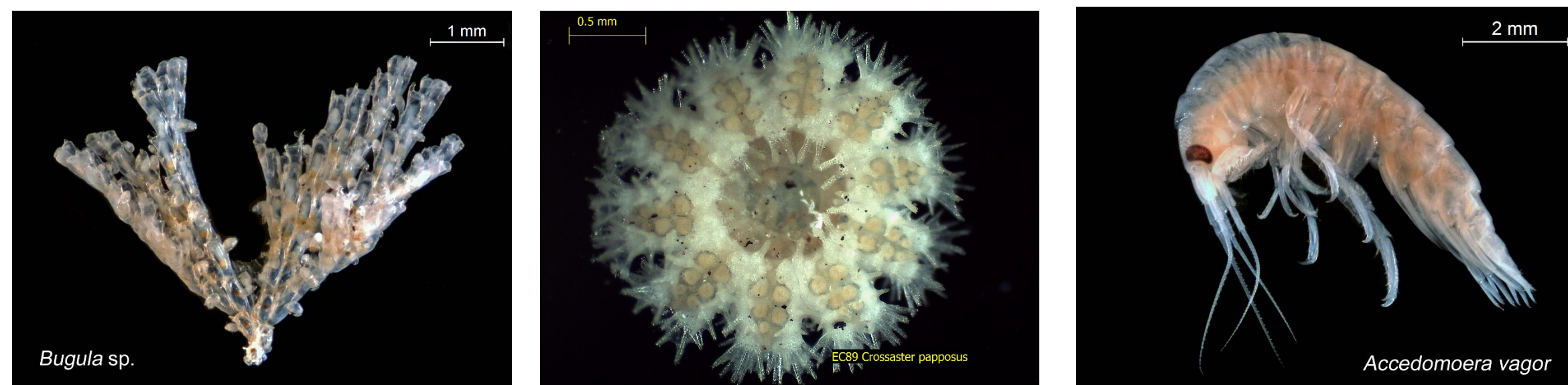


## Introduction

In 2016, a biomass and size classification component was added to the suite of benthic community indices analyzed by Ecology's Marine Sediment Monitoring Program. Biomass and size of benthic organisms can provide valuable information on:

- **Productivity** - nutrient cycling
- **Ecosystem function** - feeding, bioturbation
- **Stability** of benthic communities over time
- **Size structure** not captured by abundance data
- **Effects of stressors** on size and development of individual organisms



**Objective:** Establish the first large-scale baseline of benthic macroinvertebrate biomass for Puget Sound.

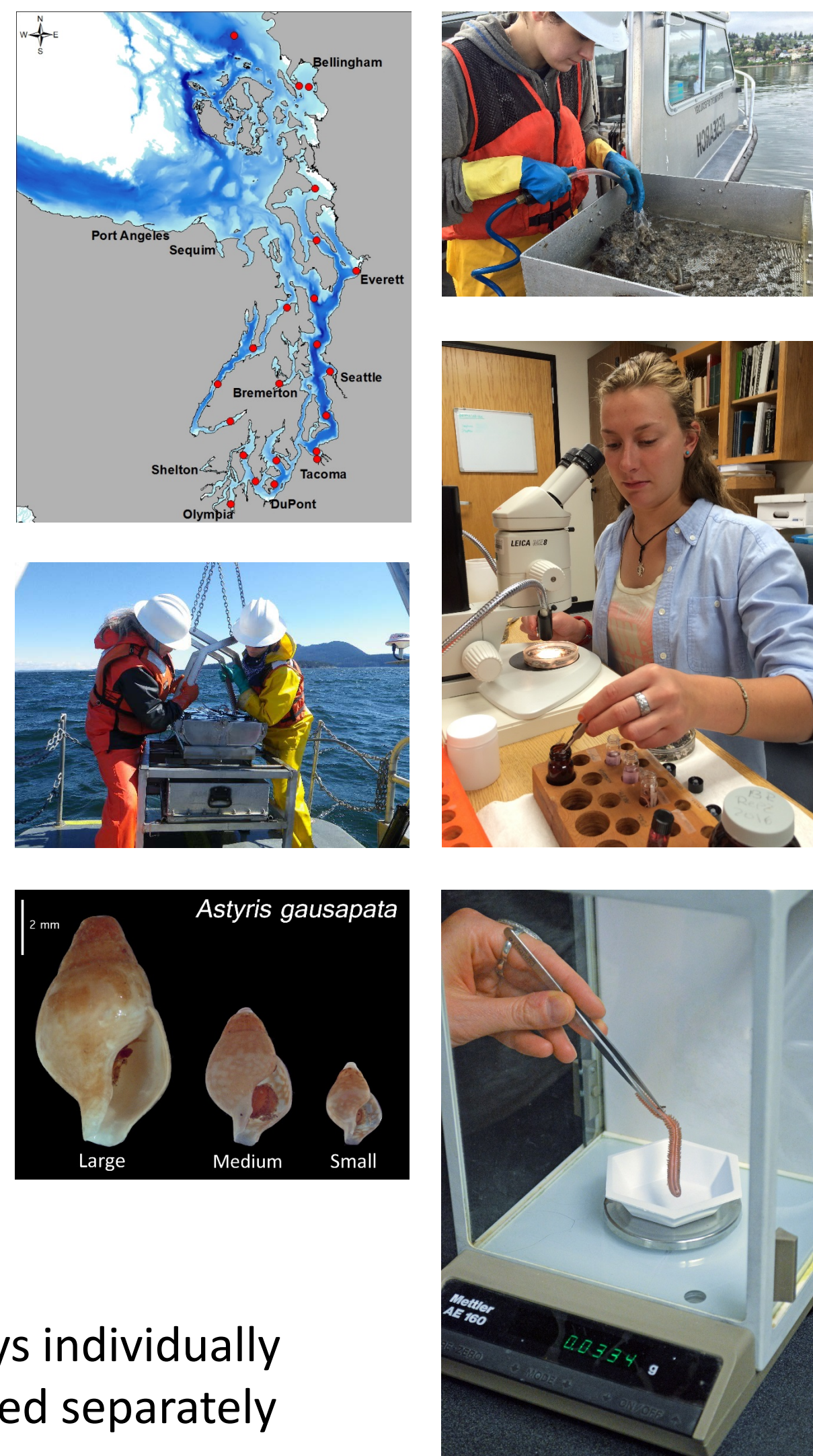
## Methods

### April 2016 - Long-term Monitoring

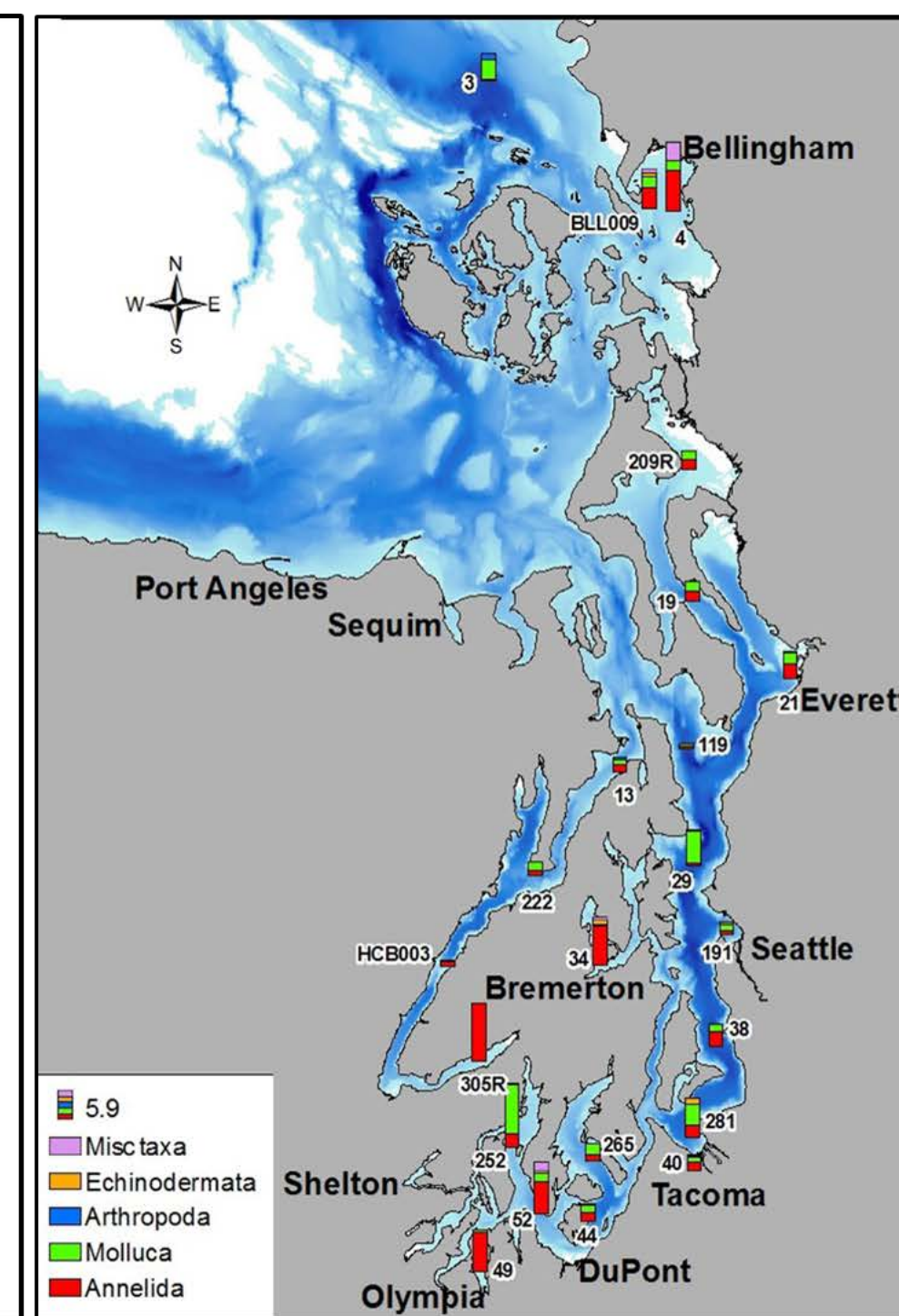
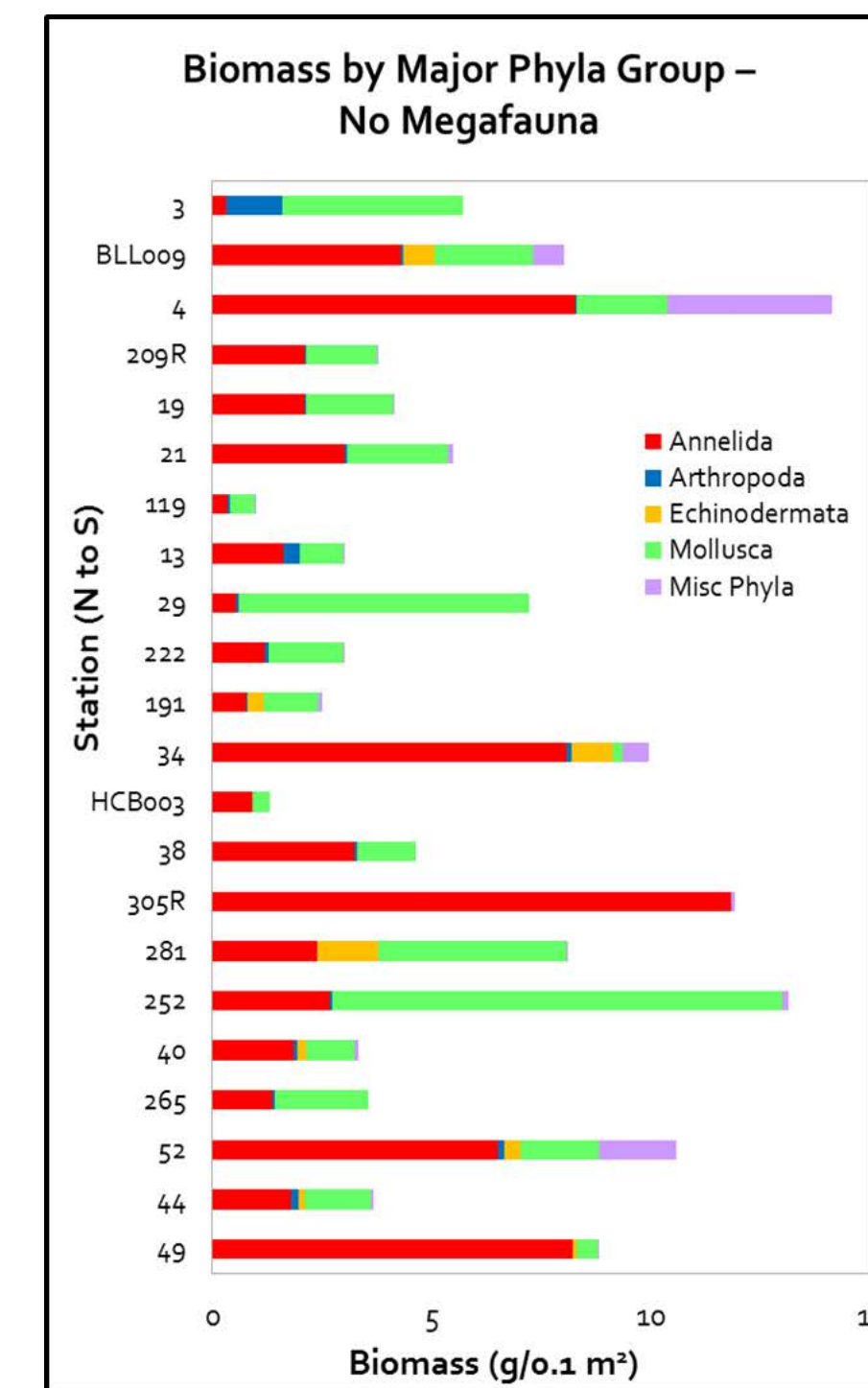
- 22 stations x 3 reps = 66 grabs
- Sieved on boat (1 mm mesh), sorted by phylum

### Size Class Reference Collection

- Complete representative specimens of each taxon measured (length and width, nearest 0.25 mm) and weighed (blotted wet weight, g)
- Assigned to a size class:
  - ❖ **Small** - juveniles & small intermediates
  - ❖ **Medium** - intermediates & small adults
  - ❖ **Large** - adults
  - ❖ **X-Large** - largest adults <2 g
  - ❖ **Megafauna** - adults >2 g; always individually weighed/measured and analyzed separately from smaller classes
- Mean wet weight for each taxon/size class combination used to calculate total biomass estimates



## Results

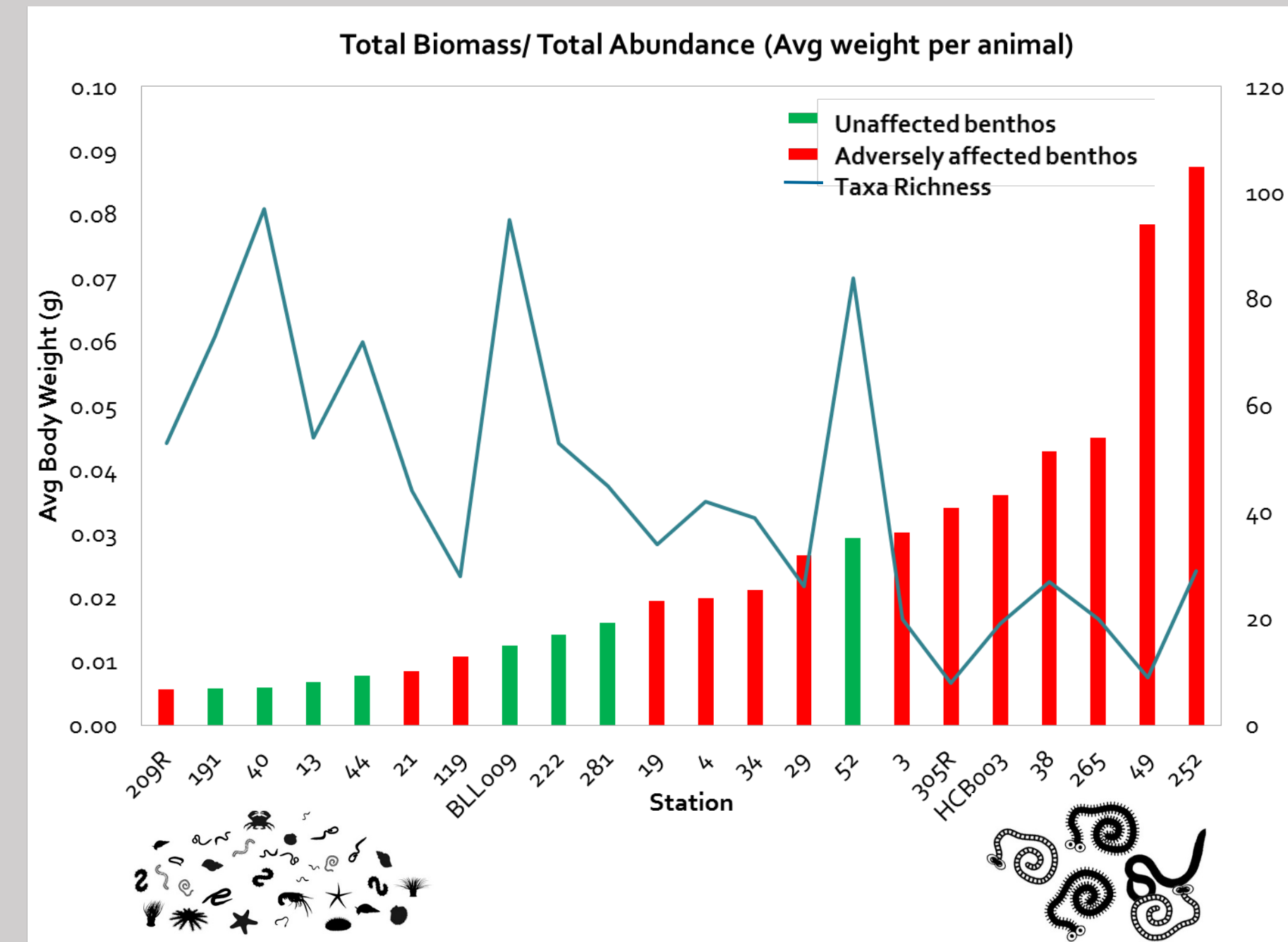


Biomass by major phyla group, Rep 1 only, megafauna excluded

- **Higher biomass** in shallow areas and generally **lower biomass** in deep basins
- **Top Contributors to Total Biomass** (all stress-tolerant taxa):
  1. *Paraprionospio alata* (annelid)
    - Dominates in shallow terminal inlets
    - ❖ 49 - Budd Inlet
    - ❖ 34 - Sinclair Inlet
    - ❖ 305R - Lynch Cove
  2. *Scalibregma californicum* (annelid; see feature, right)
  3. *Parvilucina tenuisculpta* (small bivalve)

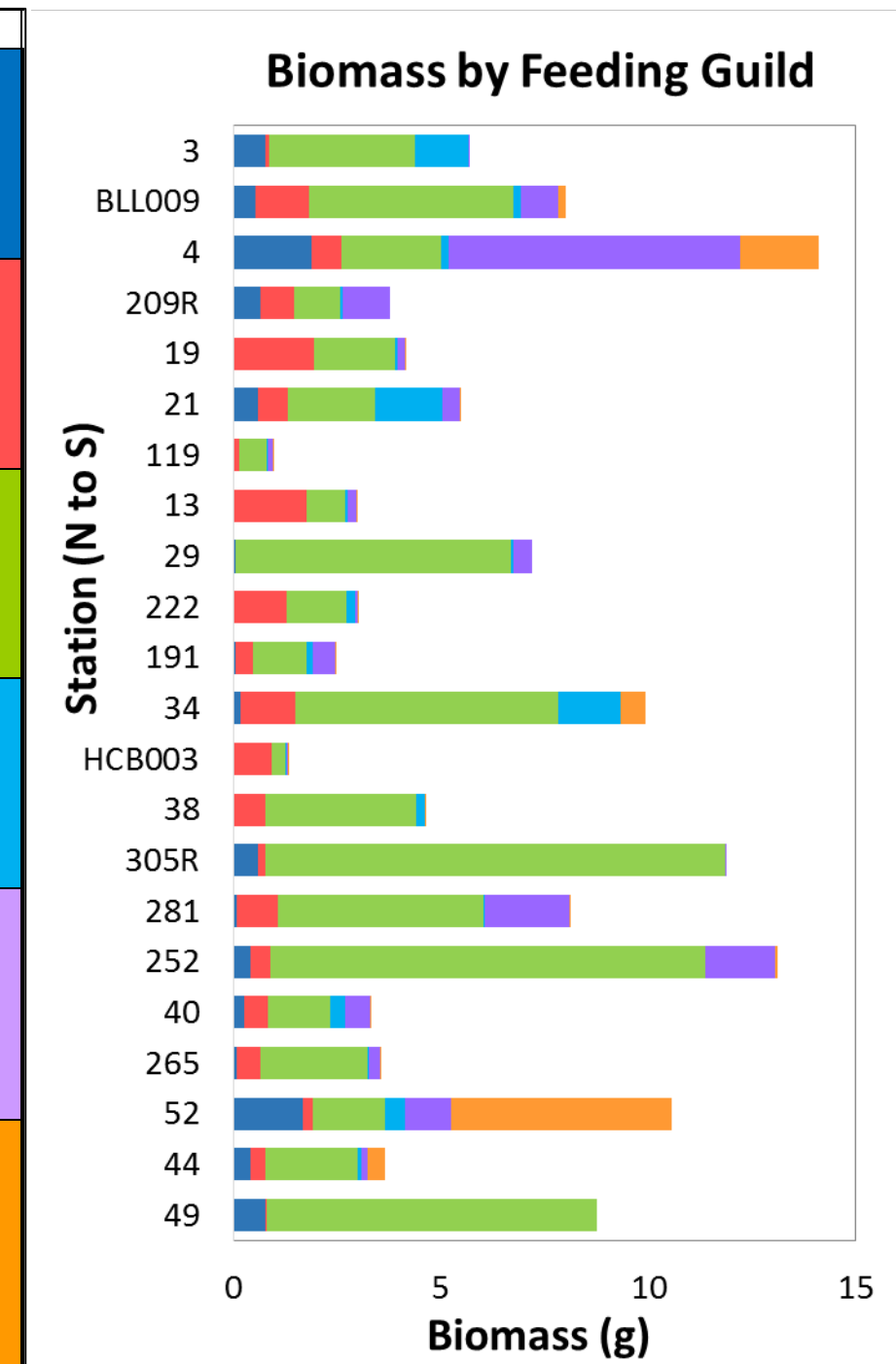


- Low biomass, high abundance = communities made up of many small animals
- High biomass, low abundance = communities made up of a few larger animals
- General trend of lower taxa richness with increasing body weight
- Not a perfect inverse relationship between biomass and abundance due to unique stations and confounding habitat variables



Benthos are designated as *unaffected* or *adversely affected* based on taxa richness, diversity, evenness, dominance, and presence of stress-tolerant or stress-sensitive taxa.

Examples	Feeding Guild Type
	<b>Benthic Carnivore</b>
	<b>Facultative Carnivore</b> • Can switch feeding modes
	<b>Facultative Detritivore</b> • Ingests detritus, but can switch feeding modes
	<b>Surface Deposit Feeder</b> • Ingests sediment at surface
	<b>Subsurface Deposit Feeder</b> • Ingests sediment below surface
	<b>Other:</b> • Suspensivore • Herbivore • Macro-omnivore • Planktivorous Carnivore

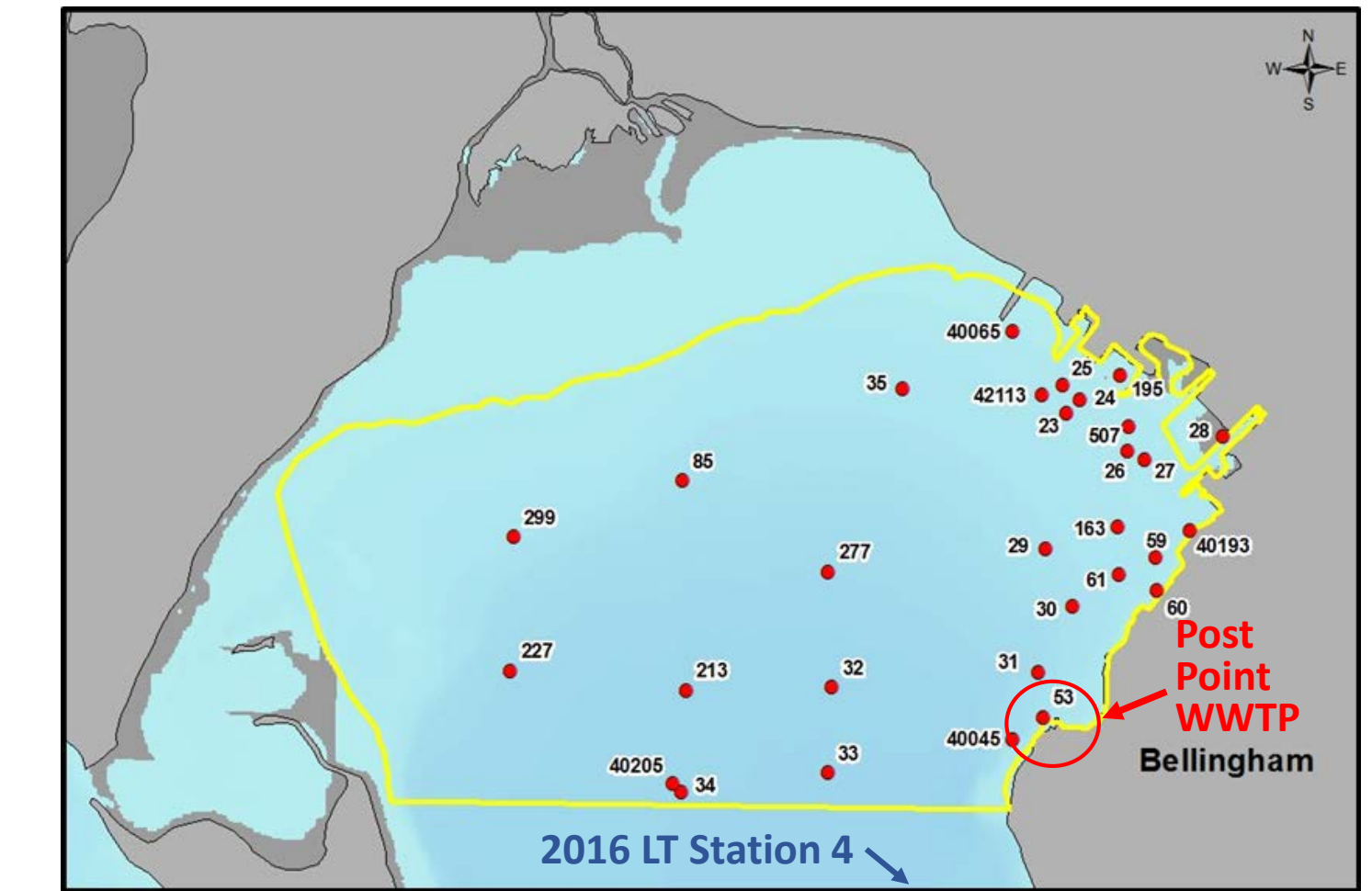


- Facultative feeders, especially **detritivores**, dominated at most stations, across most habitats
- Remaining categories contributed relatively little to total biomass, EXCEPT at:
  - ❖ Station 52 - high habitat complexity, many **suspensivores**
  - ❖ Station 4 (**subsurface deposit feeders** – *Scalibregma californicum*)

**Feeding Guild:** Trophic categories developed in BC, classify benthos based on feeding mode

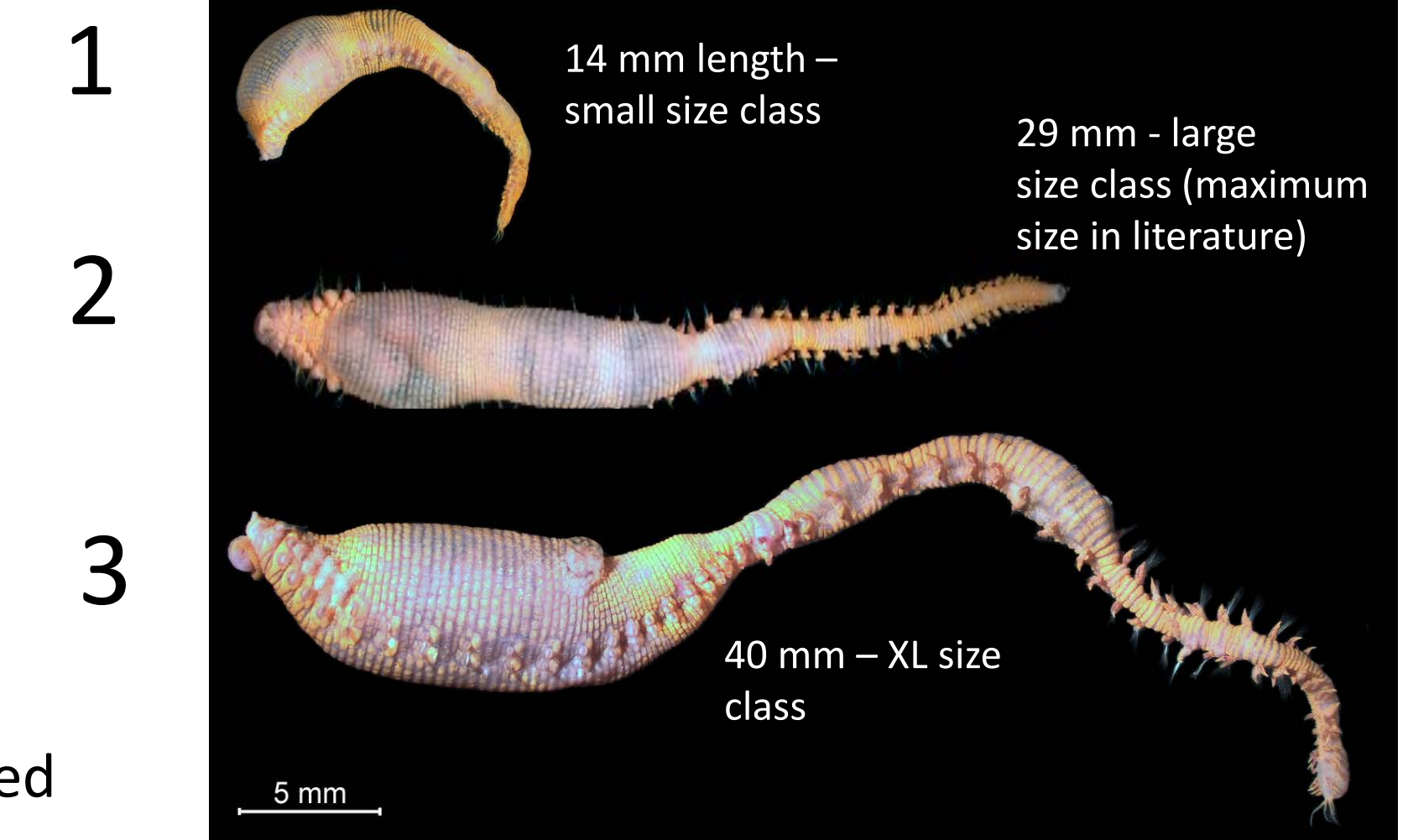
## The Case of *Scalibregma californicum*

Beginning in 2014, the polychaete *Scalibregma californicum* was collected from inner Bellingham Bay in record numbers. The addition of biomass to our program has revealed that the size of these animals varies dramatically as well. Could organic enrichment in some parts of the Bay be driving this response?



Study area for 2017 Urban Bays Program in Bellingham, WA.

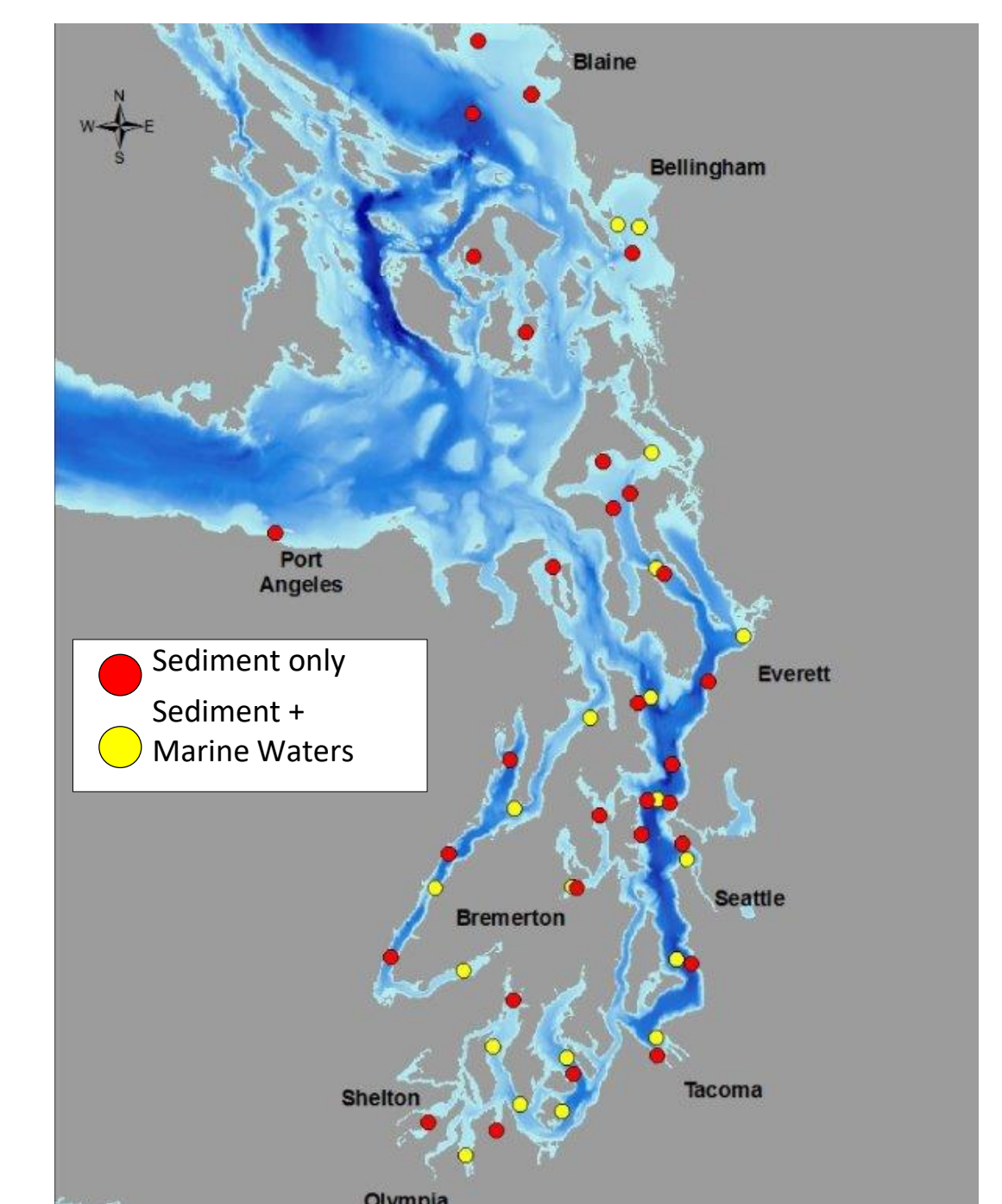
1. Average *S. californicum* from 2016 Long-term station 4 (west of Chuckanut Bay)
2. *S. californicum* collected in 2017 for Urban Bays Program – Bellingham Bay
3. A few 2017 stations had *S. californicum* that surpassed the maximum literature range, prompting the addition of an X-large size class. One station with XL animals was station 53, nearest to the Post Point Wastewater Treatment Plant.



## Future Directions

### How can we use this baseline dataset?

- **Annual Sound-wide Biomass Estimates** – biomass and size classification at 50 Puget Sound stations annually, allowing us to monitor changes over time
- **Convert** wet weight biomass (g/0.1 m<sup>2</sup>) to organic biomass (kj/m<sup>2</sup>) – allow for calculations of productivity and comparisons with British Columbia biomass studies in Strait of Georgia
- **Which taxa drive biomass** at stations with unaffected vs adversely affected benthos?
- **Correlate biomass with:**
  - ❖ **Station habitat types** - defined based on environmental variables (e.g. depth, grain size, TOC)
  - ❖ **New program parameters**, including nutrient flux and stable isotopes



### Literature Cited

Burd, B. 2014. Distribution, inventory and turnover of benthic organic biomass in the Strait of Georgia, Canada, in relation to natural and anthropogenic inputs. *Marine Pollution Bulletin* (online).  
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 Macdonald T., Burd, B., van Roodselaar, A. 2012(a). Size structure of marine soft-bottom macrobenthic communities across natural habitat gradients: implications for productivity and ecosystem function. *PLoS ONE* 7(7).  
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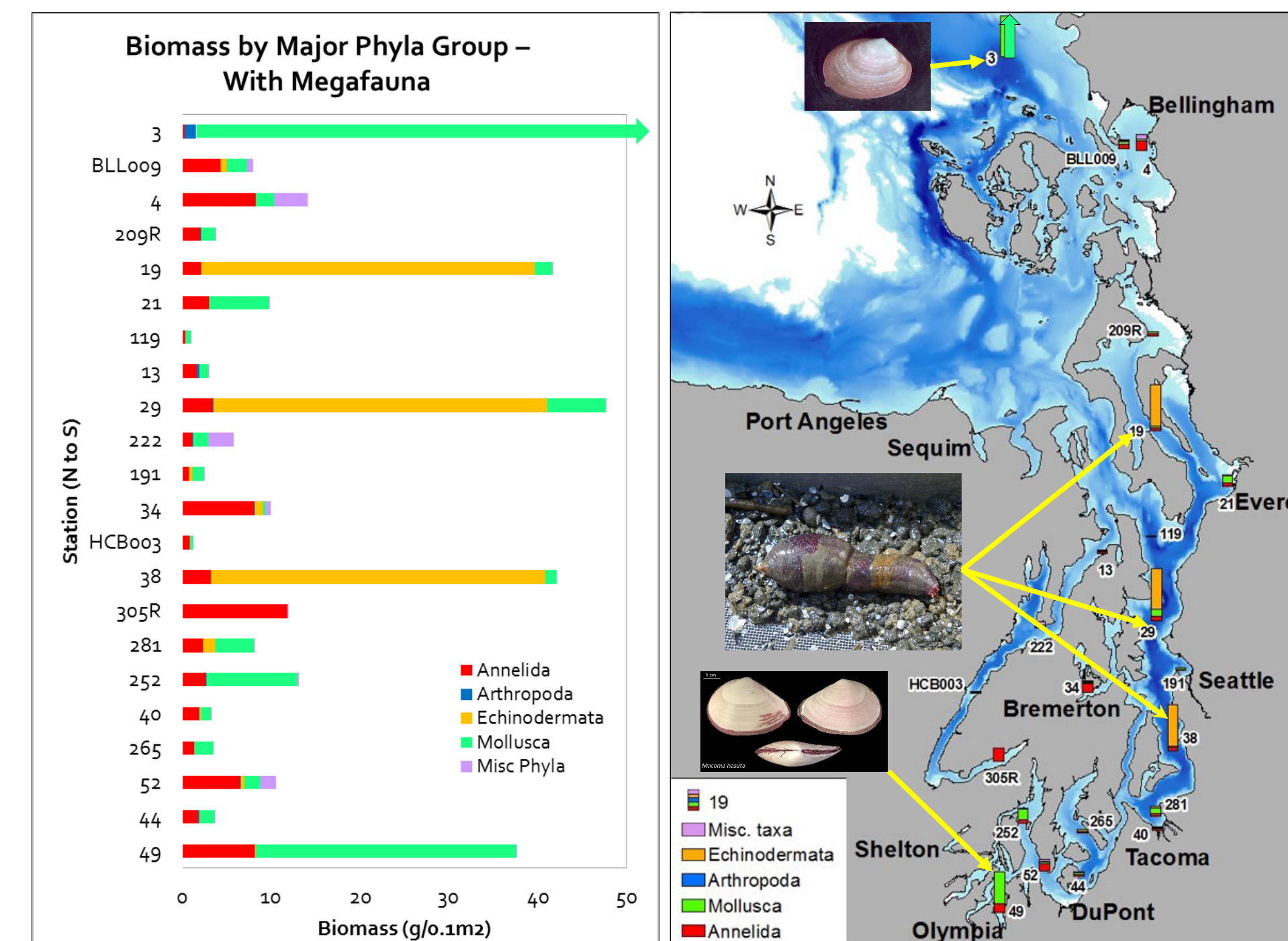
For more information:

<https://ecology.wa.gov/Research-Data/Monitoring-assessment/Puget-Sound-and-marine-monitoring>

Presented at the 2018 Salish Sea Ecosystem Conference – Seattle, WA

Original poster included a 3-dimensional overlay showing these additional results with megafauna included:

### Results (Megafauna Included)



Biomass by major phyla group, Rep 1 only, megafauna included

- **Station 3 - Strait of Georgia**  
*Macoma calcaria* (bivalve) biomass is too large to fit on the graph or map.
- **Stations 19 - Saratoga Passage**  
**29 - Shilshole**  
**34 - Point Pully**  
Large echinoderm biomass due to *Molpadia intermedia*, the Sweet Potato Sea Cucumber.
- **Station 49 - Budd Inlet**  
Majority of mollusk biomass from *Macoma nasuta*, the Bent-nosed Clam.