Lower Columbia River Estuary Ecosystem Monitoring

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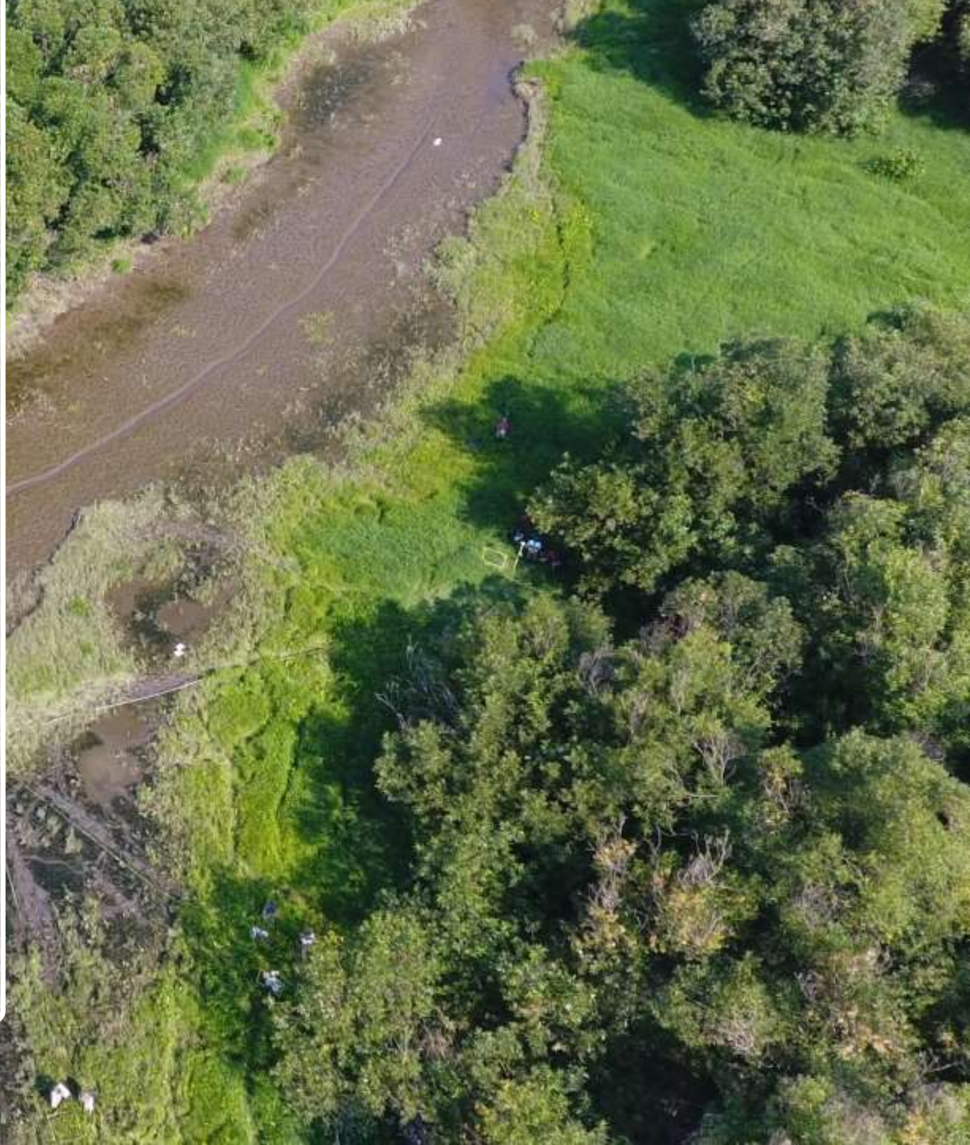
Lower Columbia Estuary Partnership

Program Overview

2 Monitoring Programs:

- **Ecosystem Monitoring Program** (EMP)
  - Status and trends monitoring of ecosystem condition
  - Provides basic understanding, fills knowledge gaps on estuarine - tidal freshwater section of lower river
  - Provides suite of reference sites for AEM
- **Action Effectiveness Monitoring Program** (AEM)
  - Allows evaluation of whether restoration actions achieved the goals of the project
  - Provides understanding of benefits of restoration actions
  - Depends on EMP for evaluation of results



Ecosystem Monitoring Program

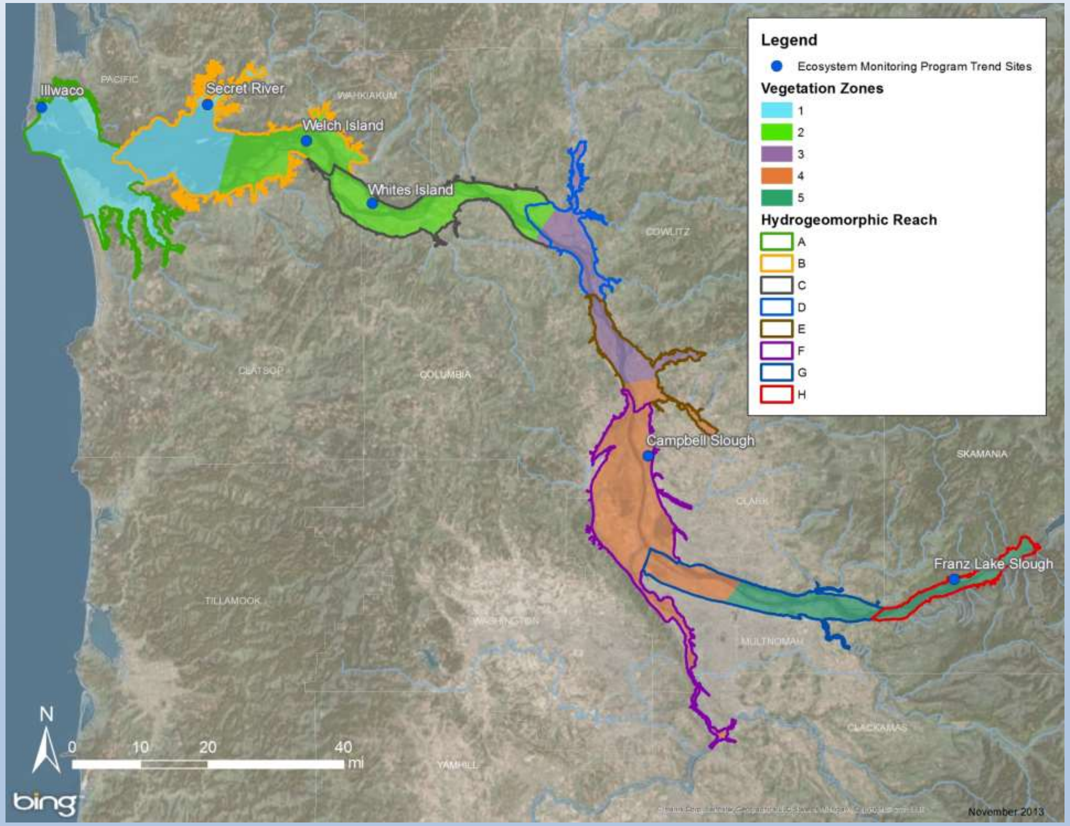
Status and trends monitoring of conditions in lower river

- Started in 2005 to provide basic information and fill knowledge gaps on tidal freshwater section of lower river
- Data used extensively in restoration design and comparison to action effectiveness data
    - Assesses spatial and temporal variability of habitat, fish, food web, and abiotic conditions
    - Tidally influenced emergent habitats used by juvenile salmonids for rearing and refugia
    - Sites are relatively undisturbed shallow water vegetated habitats – used as targets for restoration project design
- Funded by BPA/NPCC
- Partnership with NOAA Fisheries, OHSU, UW, CREST and landowners (USFWS, WDNR, others)

EMP Sampling Timeline (2005-Now)

Stratified sampling based on 8 hydrogeomorphic reaches (A-H)

- 2007-2012: focus on identifying spatial heterogeneity
  - rotated sites annually to new, un-sampled reach
  - 1 fixed site at Campbell Slough in Reach F
  - Focused on habitat, fish, prey and water temp, pH, DO
- 2011: Added food web (primary, secondary production, isotopes, biogeochemistry)
- 2011-2013: Shift focus to temporal variability - added fixed sites, dropped rotating
- 2012 – Now: 5 sentinel sites represent estuarine-tidal freshwater continuum:
    - Ilwaco Slough (Reach A)
    - Welch Island (Reach B)
    - Whites Island (Reach C)
    - Campbell Slough (Reach F)
    - Franz Lake (Reach H)



Ecosystem Monitoring Components

- **Habitat and Hydrology** - Habitat accessibility/quality for fish, macrodetritus production and flux offsite
- **Mainstem and Abiotic Site Conditions** – water quality, organic matter and nutrient flux; factors affecting primary productivity and food-web resources during spring, early summer
- **Food Web** - Role of different food web components in supporting juvenile salmon (primary/secondary production)
- **Fish and Fish Prey** - Assessment of salmonid habitat use, prey availability, and diet preference




2022 - Ecosystem Monitoring Team

Joe Needoba (OHSU) – Mainstem and Abiotic Site Conditions

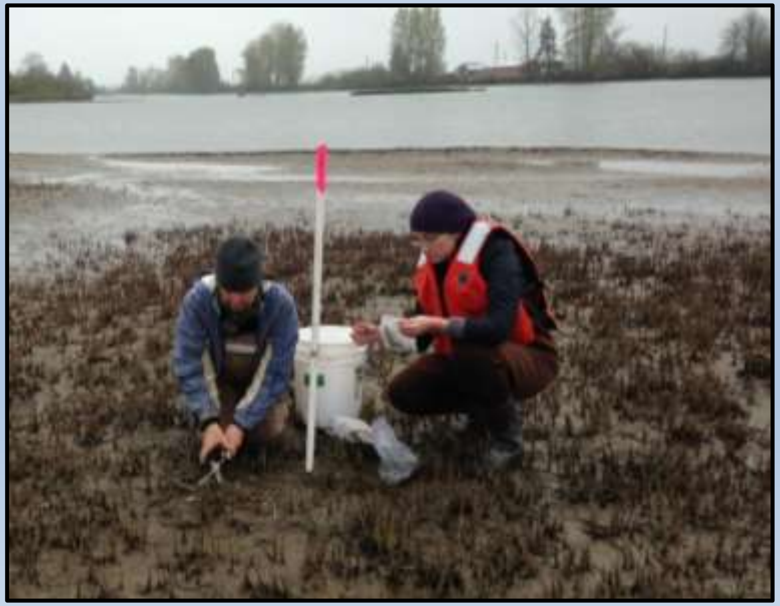
Sarah Kidd, Sneha Rao, Ian Edgar (LCEP)– Habitat Structure, Hydrology, Soils, Sediment Accretion, Detritus

Tawnya Peterson (OHSU) – Food Web, e.g., Planktonic and Macrophyte contributions to Juvenile Salmon Food Web

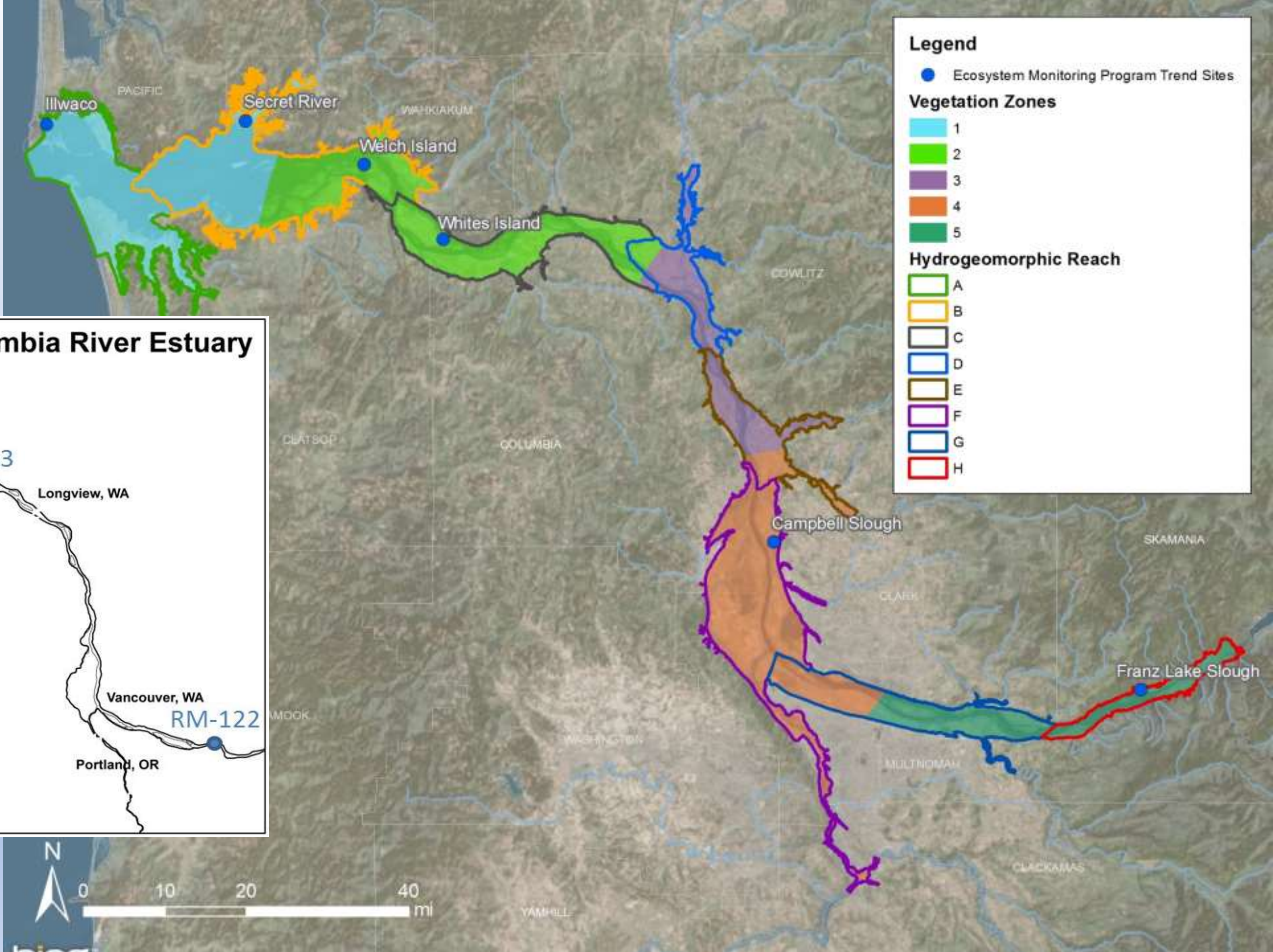
Jeff Cordell, Jason Toft, Kerry Accola (UW) - Fish Prey and Macroinvertebrate Community

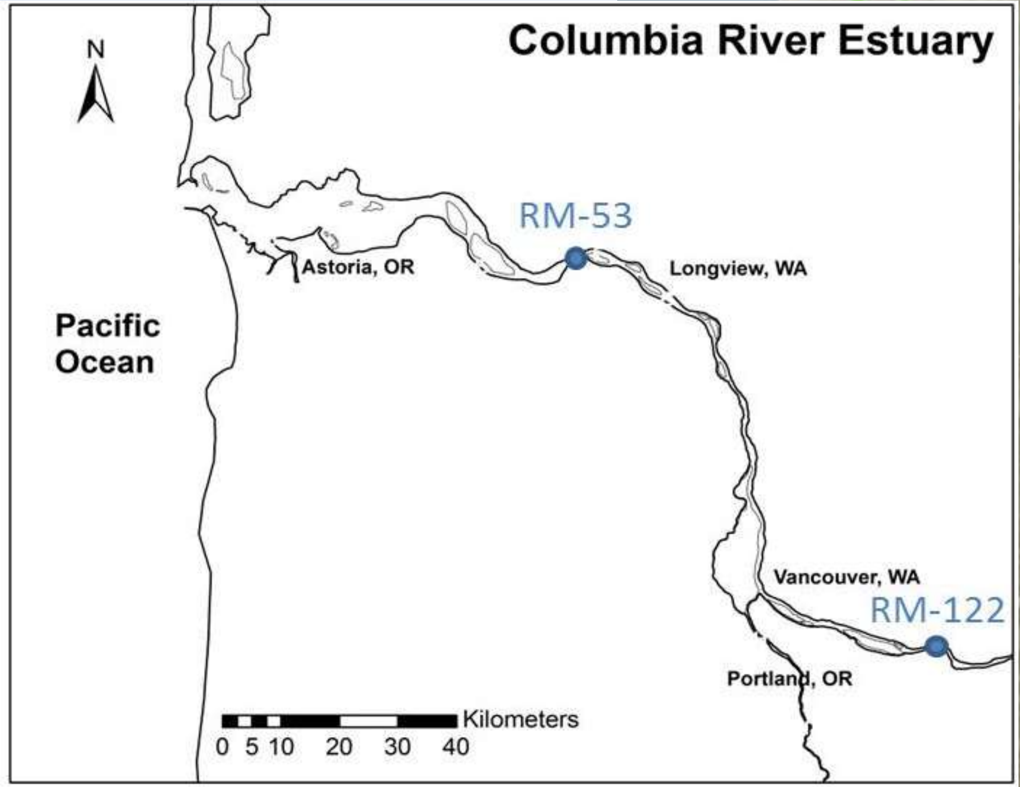
Regan McNatt, Susan Hinton, Jeff Grote, Paul Chittaro, Dan Lomax (NOAA) – Fish Community and Occurrence

April Silva, Narayan Elasmar (CREST) – Critical Field and Lab Support



Ecosystem Monitoring Sites



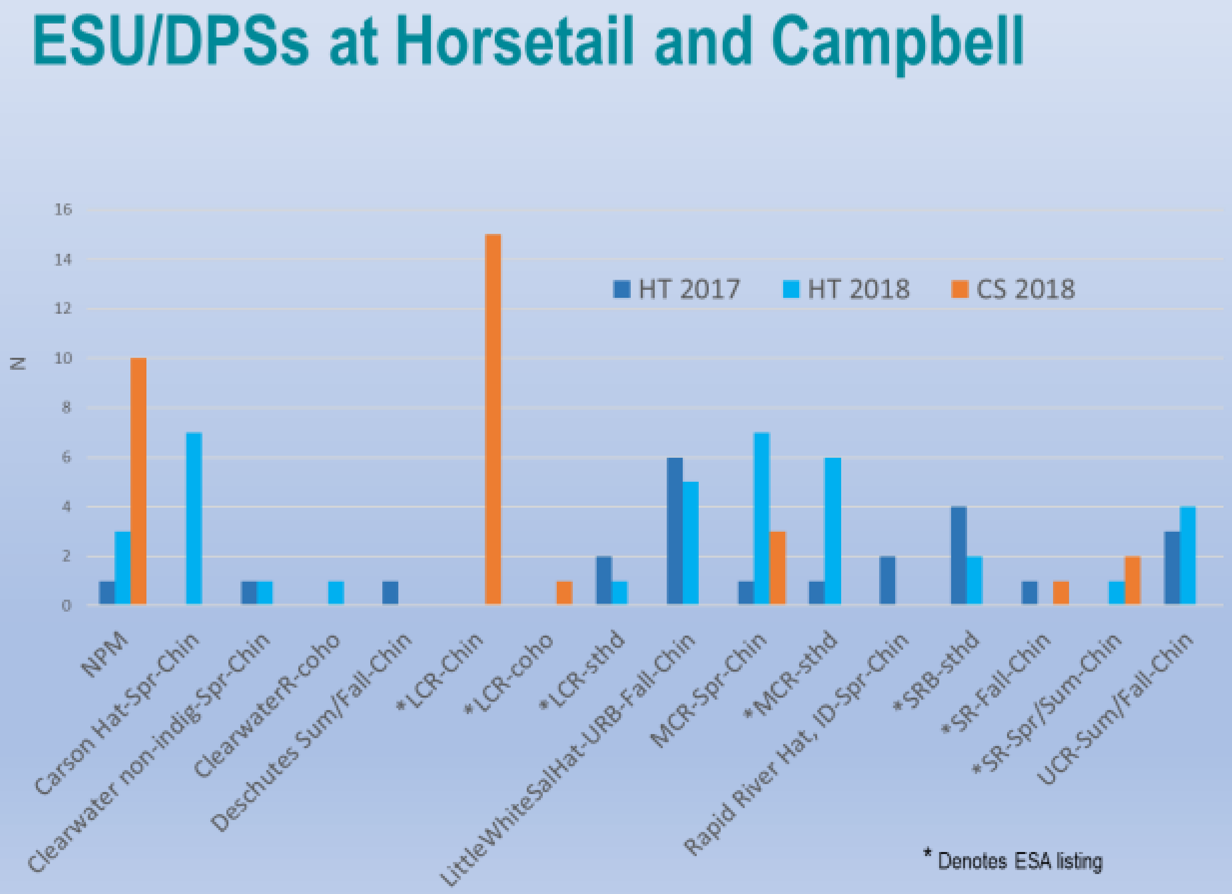


Ecosystem Monitoring

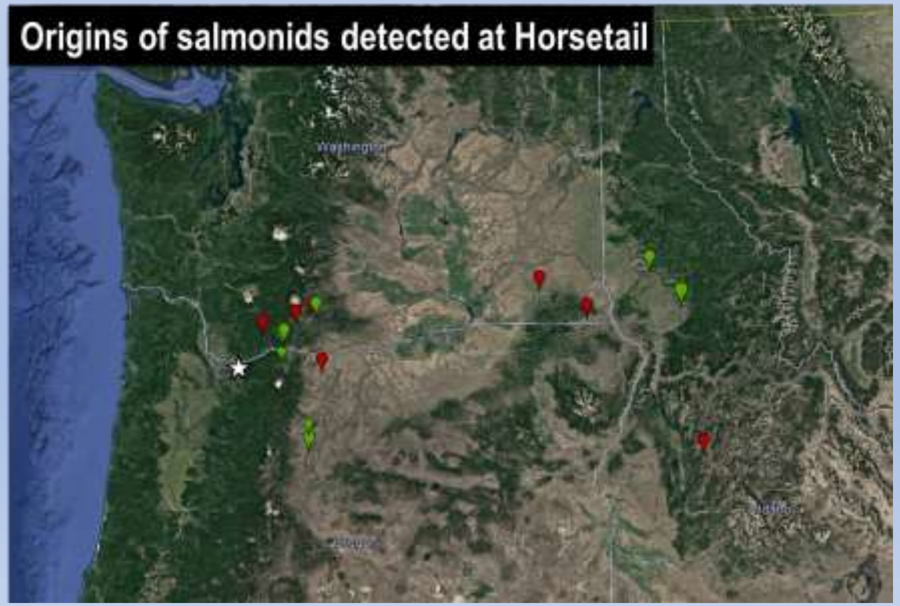
What patterns of fish use do we see in tidal wetlands?

2007-2021, Reaches A-H by NOAA NMFS
Monthly seine sampling (Feb – June, then quarterly)
Fish: Species richness, abundance, CPUE, stock ID, length, weight, otoliths (growth), marked/unmarked, condition, residency

- Most monitoring sites are dominated by Chinook
- Greatest diversity of species seen in the upriver sites (e.g., Campbell and Franz Lake)
- PIT-tag data (Horsetail and Campbell) indicates a diversity of stock use, including steelhead, and resident times



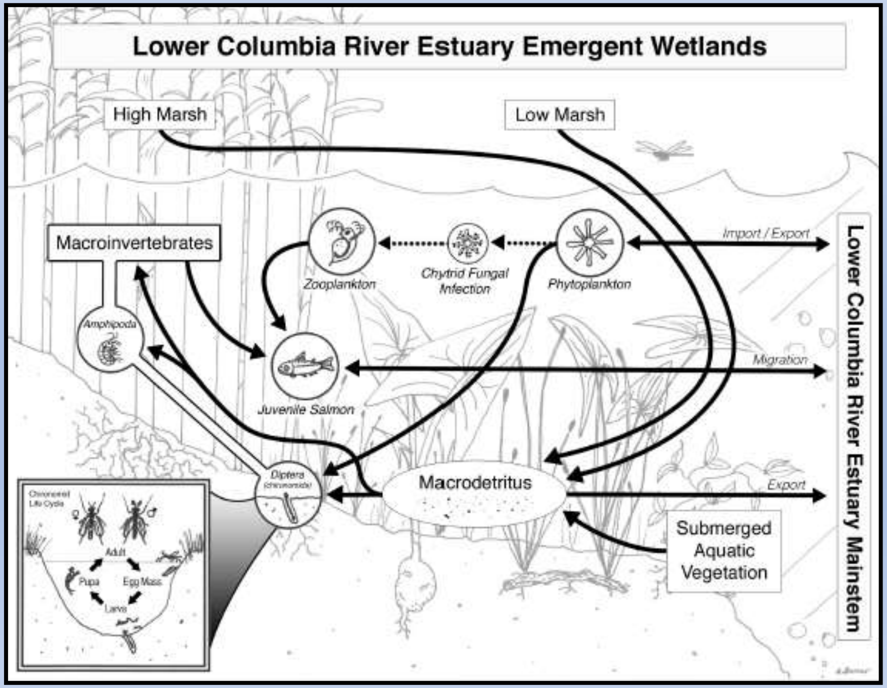
Adapted from McNatt et al. 2018 EMP Presentation



Ecosystem Monitoring

What are prey of juvenile salmonids eating?

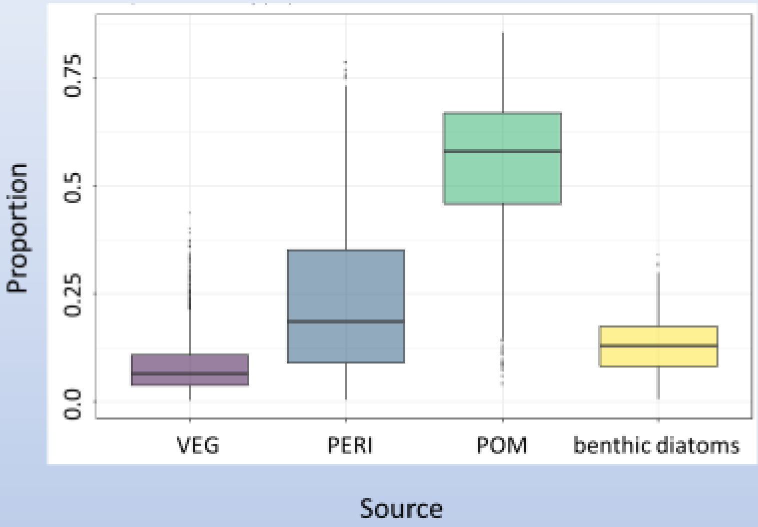
- OHSU, UW
- Primary Production: biomass and productivity of phytoplankton and periphyton, stable-isotope analysis (plant, insect, and fish tissue), nutrient concentrations, macrodetritus
- Secondary Production: zooplankton abundance, species composition
- Unraveling the importance of periphyton, particulate organic matter, diatoms, and vegetation to chironomid and amphipod diets



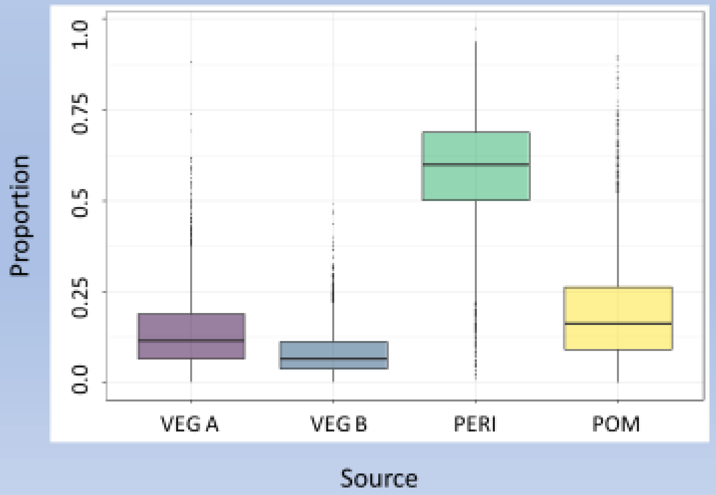
Conceptual Model of Juvenile Salmonid Estuarine Food Web

From 2015 Synthesis (Sagar et al.)

Based on mixing model results, amphipods mainly assimilate particulate matter



Based on mixing model results, chironomids assimilate organic matter from periphyton



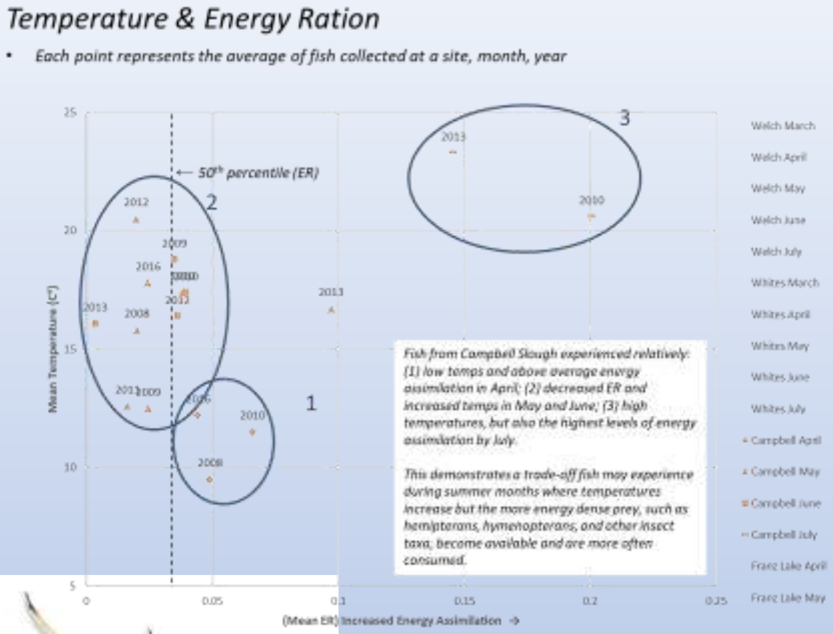
Adapted from Tawnya Peterson et al. 2018 EMP Presentation

Ecosystem Monitoring

How do juvenile salmonids diet change during different conditions?

UW found that during warm summer months when temperatures can be thermally stressful coincides with timing of more energy-dense prey availability and consumption, such as hemipterans, hymenopterans, and other insect taxa with high energy ration.

Implications: Highlights tradeoffs in diet that compensate for changing habitat conditions



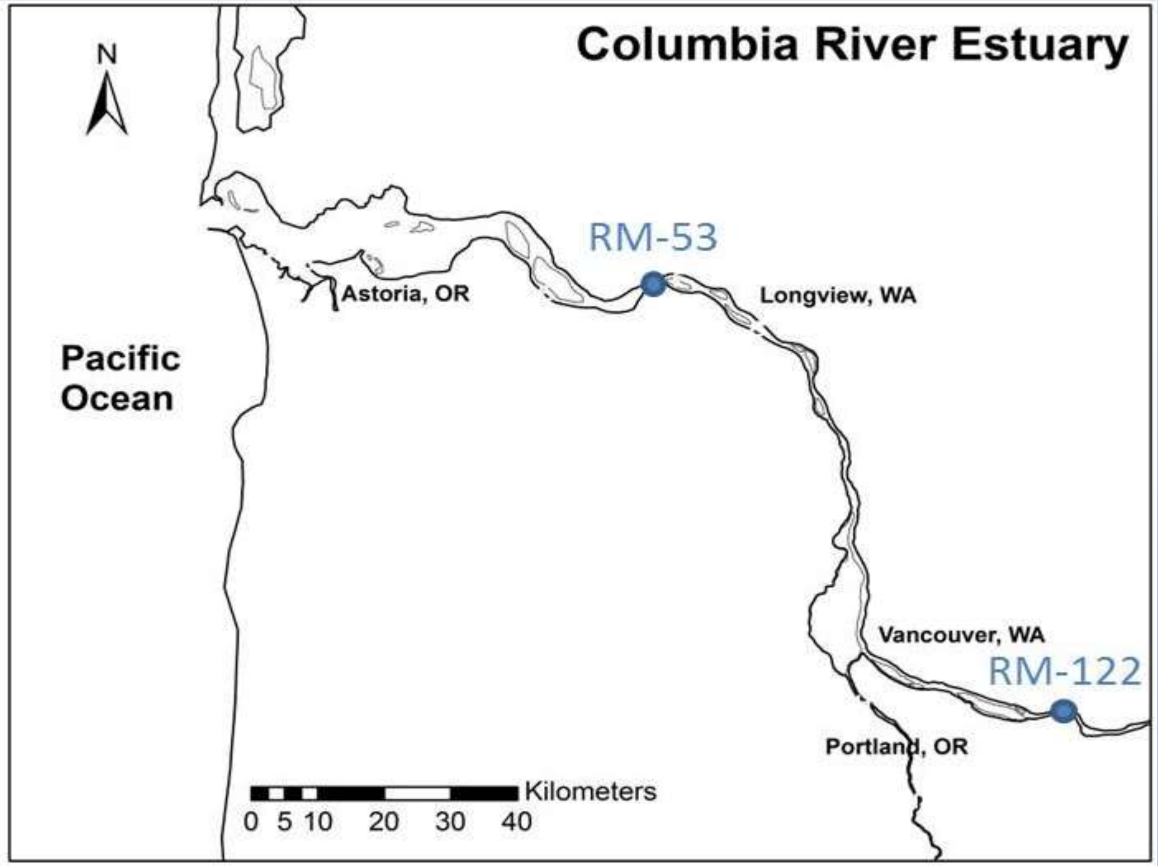
Adapted from Ramirez et al. 2017 EMP Presentation & Report

Ecosystem Monitoring

How do mainstem conditions drive changes in habitat, fish and prey? (OHSU)

- Center for Coastal Margin Observation and Prediction (CMOP) platforms
  - RM122 (Port of Camas-Washougal; Reach G), 2012-2020
  - RM53 (Beaver Army Terminal; Reach C)
- Temperature, conductivity, chlorophyll *a* fluorescence, dissolved oxygen, colored dissolved organic matter, nitrate, nitrite, and dissolved ortho-phosphate
- Cycling and flux of OM and nutrients

  - ➢ Understanding of riverine influences on floodplain habitat conditions
  - ➢ Understanding of riverine vs marine influences on estuary
  - ➢ Understanding of how lower Columbia tributaries effect conditions in mainstem
  - ➢ Developing an Estuarine Index (to support NOAA's ocean index)



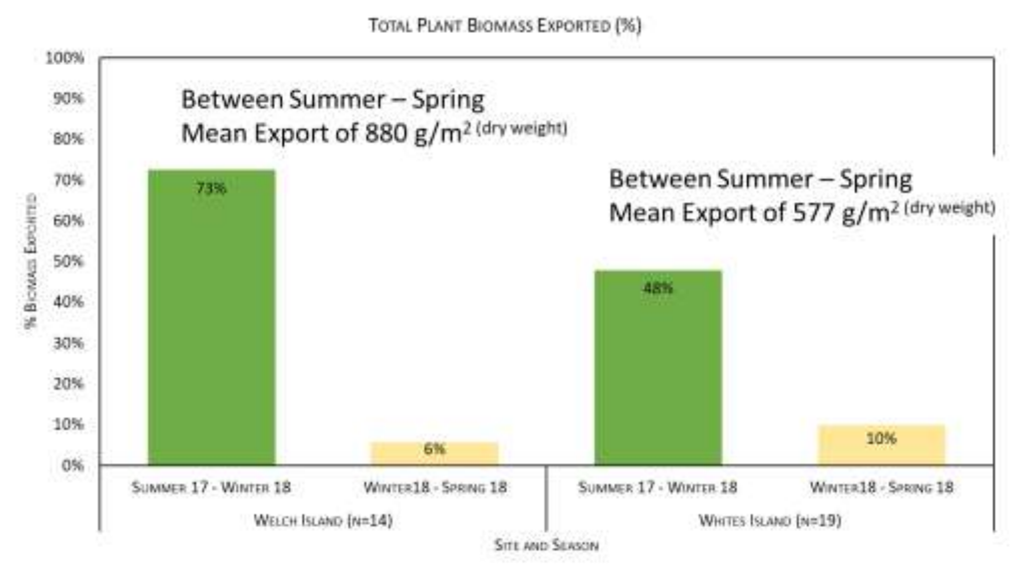
Ecosystem Monitoring

What are the contributions of plant communities?

- Plant community composition, biomass, detrital export, lignin contents led by LCEP
- Tracking wetland plant biomass production, export, nutrients, and lignin content highlights the potential contribution of vegetation to the juvenile salmonid food web.
    - Indirect benefits documented in PNNL and NMFS 2020

Implications:

- Understanding wetland plant contributions to the macrodetritus food web is critical for understanding the ecological impacts of restoration efforts.



Estimated that there is over 170,000-112,00 tons of plant biomass produced annually from tidal marsh habitats in the lower Columbia River

Adapted from Kidd et al. 2018 EMP Presentation

Ecosystem Monitoring and Action Effectiveness Program Results

Continues to be at the forefront of estuarine ecological research

- Working towards understanding estuary ecological processes, functions, and their restoration

Contributing to over

- 75 Peer Reviewed Articles, Reports, Theses, and Conference Papers
- 2 EMP- Dedicated Syntheses and integrated into USACE Syntheses Memos
- Anticipated in 2022 - @ 8 manuscripts for refereed journals

Research Partners

THANK YOU

BONNEVILLE POWER ADMINISTRATION

COWLITZ INDIAN TRIBE

OHSU

Columbia Land Trust

OREGON Fish & Wildlife

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