EMP Science Workgroup update 2023 Mainstem and Habitat Water Quality

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#### Welcome to the Mainstem and Abiotic Site Conditions Ecosystem Monitoring Dashboard

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**Overview Map** 



Ilwaco Slough Whites Island Campbell Slough Franz Lako 50 km

This Dashboard Provides a Brief Methods Overview and Links to all the Results Summaries: Click any of the buttons below to access more data.



Navigate to Section 1 - Sampling Effort and Data Inventory

Navigate to Section 2 - Mainstem Conditions

#### Navigate to Section 3 - Abiotic Site Conditions

#### **Executive Summary of Results**

The 2022 water year in the Columbia River was characterized by periods of high pluvial flow associated with the Willamette River in the winter, below average flows in the early spring, and higher-than-average flows associated with the spring freshet, which peaked in mid-June.

Columbia River discharge at Bonneville Dam was close to the 2009-2022 average during the winter months; after mid-March flows were lower than average and reached minimum values for the time period in mid-April. Flows increased from early and peaked in mid-June at volumes close to the long-term maximum, observed in 2017. The decline in river discharge following peak flows was steeper than in 2017, but flow remained above average through the end of August after which they were close the long-term average. River discharge associated with the Willamette was higher than average during a few peaks in winter and spring (early January, early March, early May and early June) and was otherwise close to or below average values observed between 2009-2022.

The average daily water temperature in 2022 was average in the winter, slightly below average in the spring leading up to the freshet, average during the freshet, and higher than average after the freshet. There were 50 days having temperatures exceeding 19oC, similar to the long-term average. At the off-channel EMP sites, temperatures were highest after July at Campbell Slough and Franz Lake Slough.

Water quality was generally good at the off-channel EMP sites in 2022, with pH being in the acceptable range except at Campbell Slough after early August where values exceeded 8.5 units, alongside peaks in dissolved oxygen saturation and chlorophyll, indicating that environmental conditions were dominated by biological activity.

#### Management Implications:

Environmental characteristics of the shallow, EMP sites are dictated by mainstem conditions, discharge volumes, and water elevation.

- Periods of lower flows lead to evolution in habitat characteristics that sometimes result in poor water quality, including high pH, high chlorophyll, low dissolved oxygen, and pH that is outside of the acceptable range. *If poor water quality develops, elevated discharge can mitigate these conditions.*  The **Ecosystem Monitoring Program** is providing longterm data about minimally disturbed wetland habitat in the lower Columbia River to develop and inform recovery strategies for salmonids



<sup>1</sup> Ecosystem Monitoring Program sites.

EMP includes water quality data from 2008-present: 16 years (spring/summer)

▶ Temperature Conductivity Dissolved oxygen ▶ pH Chlorophyll







### Ilwaco marsh and Welch Island





Source: Esri, i-cubed, USDA, USGS, AEX, GeoEye, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

### Whites Island





### Ridgefield National Wildlife Refuge





#### Franz Lake National Wildlife Refuge







### Water Quality Monitoring - in situ sensors







#### 3.2.1\_Availabillity\_temp\_data



Figure 3.1 Periods of deployment of YSI water quality sondes that include temperature sensor measurements.



Figure 3.2. Periods of deployment of YSI water quality sondes that include dissolved oxygen (percent saturation relative to air; DO % saturation) sensor measurements.



#### 3.2.1\_Availability\_chl\_data

#### Number of days exceeding 19°C in the Columbia River mainstem (1994-2022)

We can identify:

- years that are cooler than average (Z-score < 0): 2012, 2020</li>
- years that are warmer than average (Zscore >1, 2): 2015, 2021



#### Annual variability in Spring Freshet



#### Annual variability in Spring Freshet



## Among the off-channel sites, Campbell Slough and Franz Lake Slough exceed 19°C threshold most consistently



Figure 2.2.3. Box-and-Whisker plots showing variability in temperature by month at the EMP sites over the period of 2008-2022. The shaded area indicates temperatures above a threshold of 19oC. The data show that at Campbell Slough, Franz Lake Slough, Welch Island and Whites Island, the median monthly temperature is above 19oC for the months of July, August, and September.





### What have we learned?

**Temperature:** while summer temperatures can exceed 19°C at all sites but Ilwaco, the longest periods and hottest temps are seen at Campbell and Franz Lake Sloughs

# Chlorophyll peaks tend to be observed at sites less well-connected to the mainstem



#### Seasonal cycle in water column productivity

#### 3.3.2\_Chlorophyll ug/L



**Figure 3-20**. Time series of chlorophyll a data measured using in situ fluorometers at EMP sites in 2021. RFU = Relative Fluorescence Units. Consecutive monthly measurements above 15  $\mu$ g L-1 are indicative of poor water quality; this benchmark is indicated by a dashed line.

### What have we learned?

**Chlorophyll:** River phytoplankton show seasonal changes, with highest densities prior to the freshet. In the summer, noxious cyanobacteria can grow to high densities, which is detected by pigment fluorescence. Phytoplankton densities are highest at sites least connected to the river mainstem.

#### **Dissolved oxygen 2008-2022**





Hypoxia resulted from receding Spring freshet and algal bloom coinciding



2023 - Hypoxia resulted from a combination of high water, rapid growth of algae, and limited air-water interaction

2023 - Strong relationship between decreasing water depth and algal blooms



#### 2017 - Wet winter and large freshet





### What have we learned?

**Dissolved oxygen:** DO levels decrease in shallow, wetland habitats but this is modulated by water depth. During peak flows, there is less opportunity for convective exchange and DO saturation can decline, especially at Campbell and Franz where sites are relatively disconnected from mainstem.

### Off-channel habitats 2015 vs 2017





#### Synthesis activities 2023-2024

- Off-channel wetland sites reveal periods of good and poor habitat opportunity for juvenile salmonids.
- Warmer water, algae blooms, and hypoxia develop as a result of interrelated effects of size of seasonal freshet and degree of connection with mainstem.
- Timing of Spring Freshet with algal blooms and hypoxia events as a metric for ecosystem/habitat quality

### **Project Team**

- Joe Needoba and Tawnya Peterson (OHSU) Mainstem and Abiotic Site Conditions
- Narayan Elasmar, April Silva, (CREST) -Really Awesome!! Field Support!
- Students and Staff of ESHH
  - Alyson Meister and Jordan Lancaster

