

Restoring tidal swamps: practical restoration ecology



Photo: L.S. Brophy, CC BY-SA

What is a tidal swamp?

- Seagrasses
- Algae beds



Seagrass photo: Partnership for Coastal Watersheds

Tidal swamp (woody-dominated)

- Forested tidal swamp
- Shrub tidal swamp



Tidal marsh (herbaceous)

- Low marsh



- High marsh



Tidal marsh and swamp photos:
L.S. Brophy, CC BY-SA

Why do we want to restore tidal swamps?

- **Ecosystem services** – like fish habitat ¹ and carbon sequestration ²
- **Historical prevalence** – tidal swamps historically made up over half of the tidal wetlands in the Pacific NW ³
- **Disproportionate losses** – over 95% of tidal swamps have been lost from the Oregon coast and from major river deltas in Puget Sound, mostly due to diking and logging ³

1 Davis et al. 2019

2 Kauffman et al. 2020

3 Brophy 2026, Simenstad et al. 2011, Marcoe and Pilson 2017

How can we choose the right locations to restore tidal swamp?

An aerial photograph of a coastal landscape. In the top left, a body of water (likely a bay or estuary) meets a sandy beach. A river or stream flows from the bottom center towards the water. The land is a patchwork of green fields, brown agricultural plots, and dense green forest. A small town or village is visible on the right side. A semi-transparent white square with two large black question marks is centered over the landscape.

??

**Know the tidal swamp “environmental envelope” –
i.e. tidal swamp tolerances**



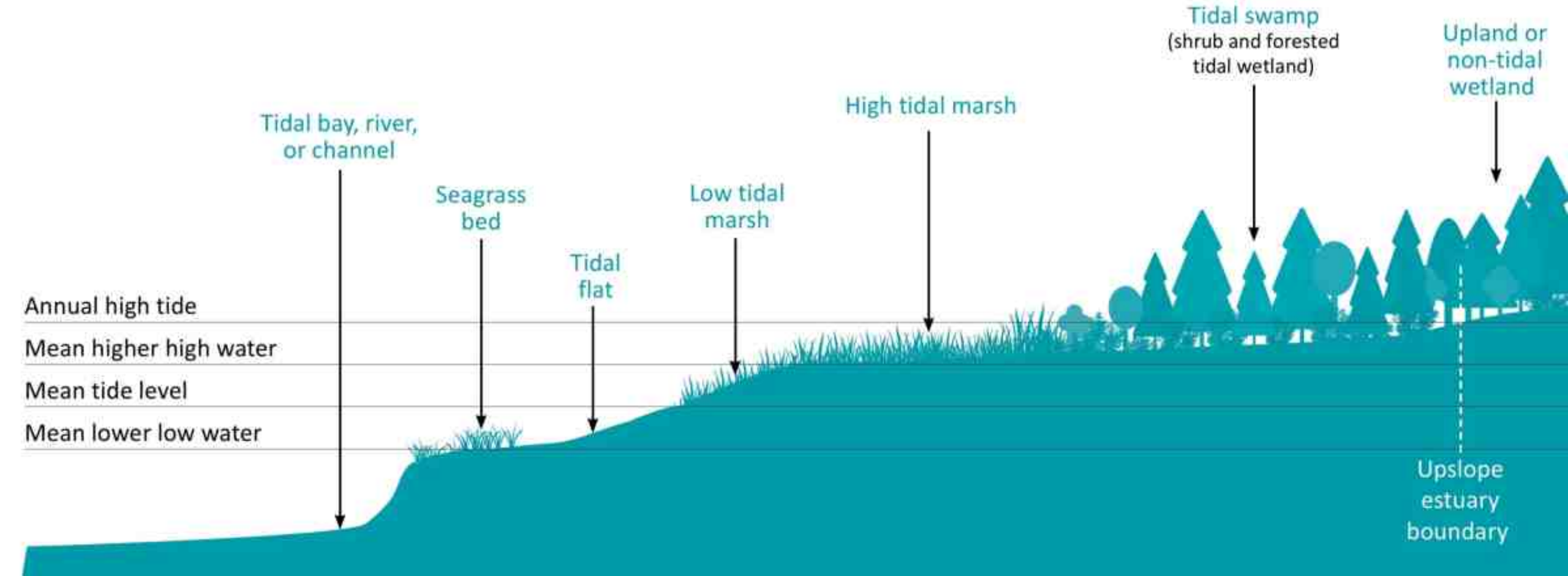
**Measure
conditions at
least-disturbed
tidal swamp
reference sites
– especially
elevation and
salinity**

Reference:
Janousek and
Williams 2024

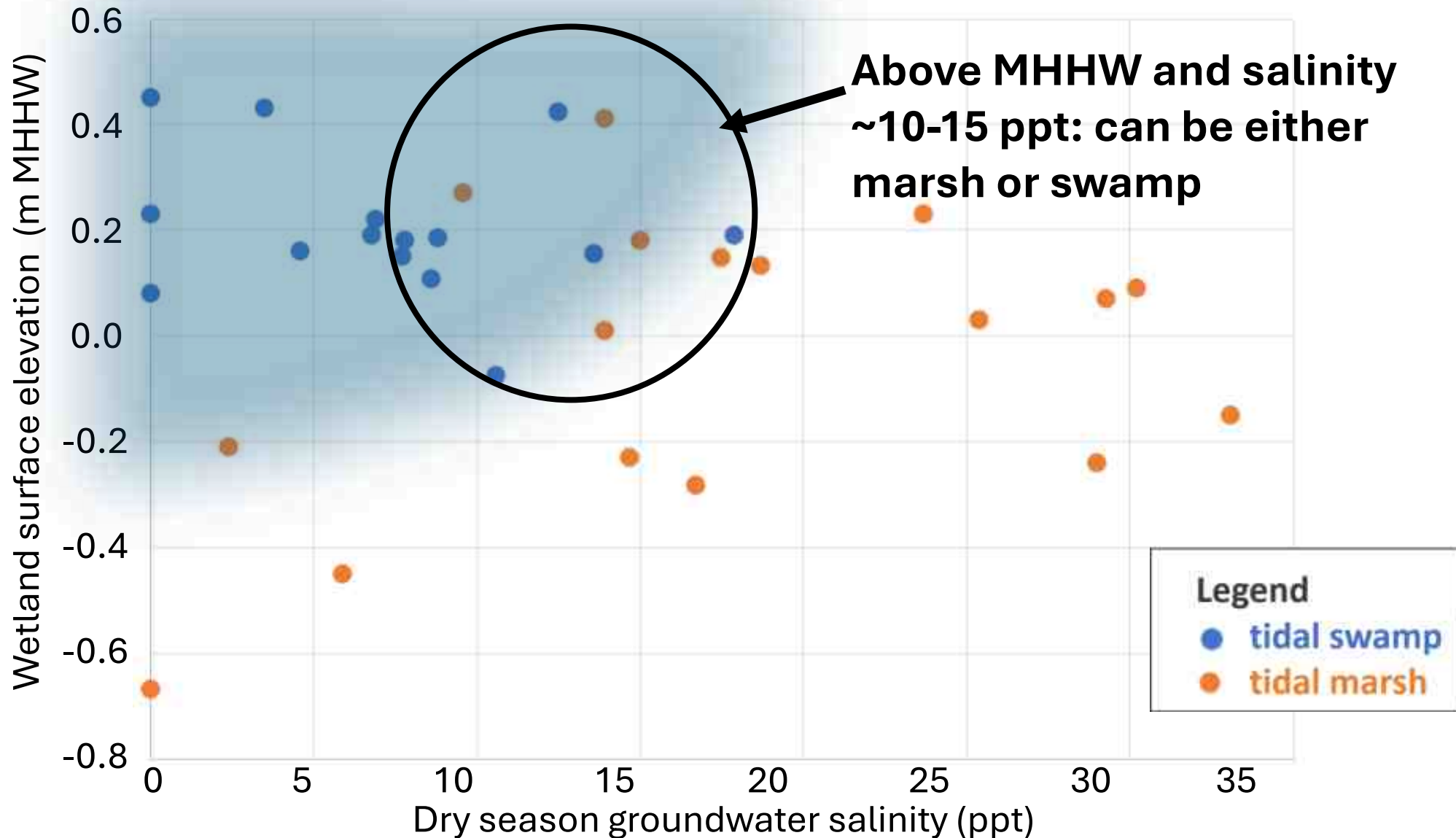


Photos: L.S. Brophy, CC BY-SA

Distribution of Pacific NW tidal wetland habitats relative to tidal datums



Elevation and salinity at US Pacific NW **tidal swamp** vs. **tidal marsh**



Sitka spruce tidal swamps



Photo: Laura S. Brophy, CC BY-NC

Freshwater tidal swamps



Cottonwood tidal swamp
(*Populus trichocarpa*), Lower
Columbia River estuary

Photo: USFWS



Oregon ash tidal swamp
(*Fraxinus latifolia*), Lower
Columbia River estuary

Photo: Laura S. Brophy, CC BY-NC

How can we choose the right locations to restore tidal swamp?

An aerial photograph of a coastal landscape. In the top left, a body of water (likely a bay or estuary) meets a sandy beach. A river or stream flows from the top left towards the bottom center, winding through a patchwork of green fields and brownish soil. A small town or village is visible in the middle right, with a cluster of buildings. The overall terrain is flat and appears to be a mix of natural and agricultural land.

??

How can we choose the right locations to restore tidal swamp?



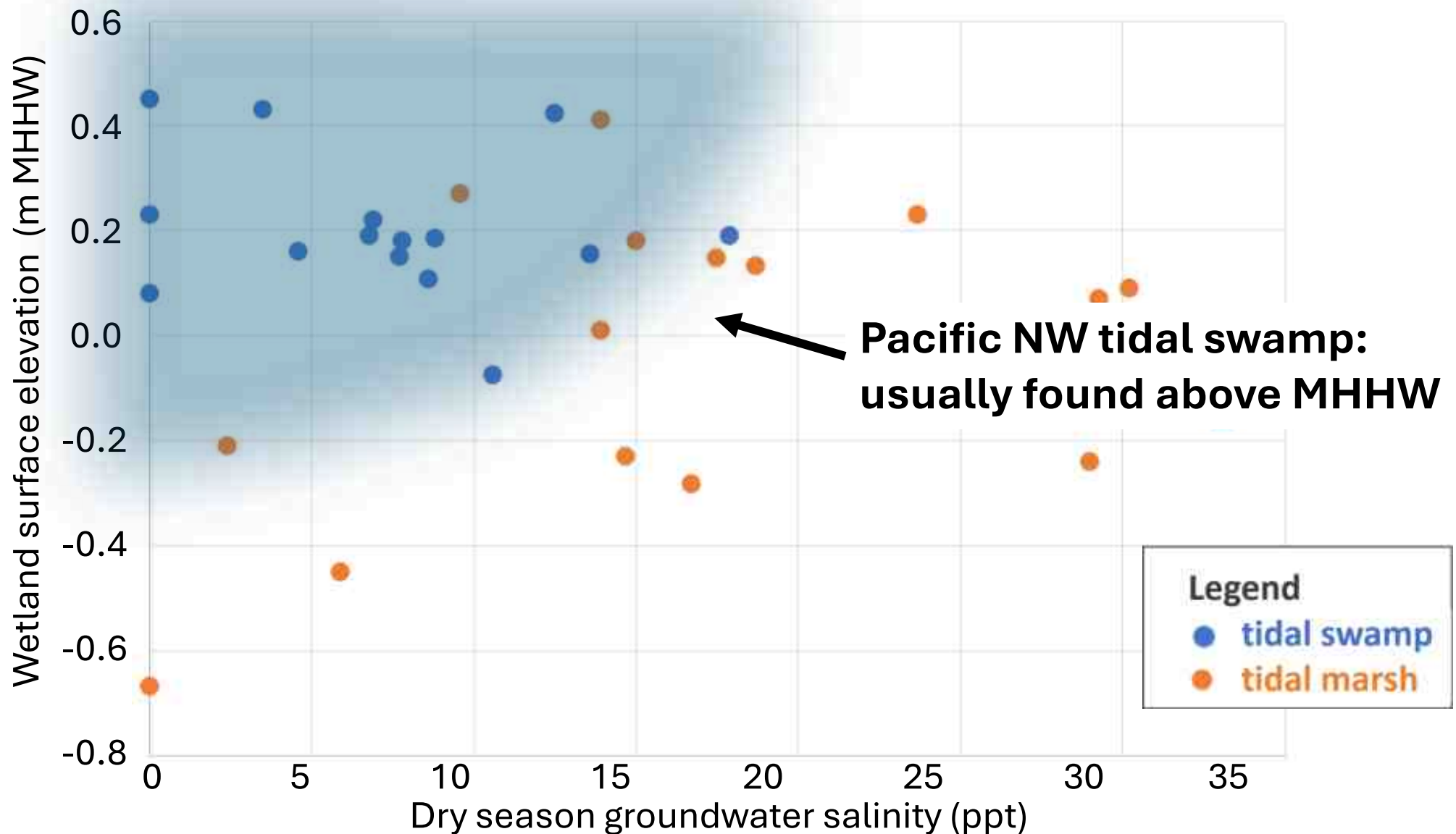
Restoration Ecology 101:
focus on natural processes

Find sites with the right environmental characteristics

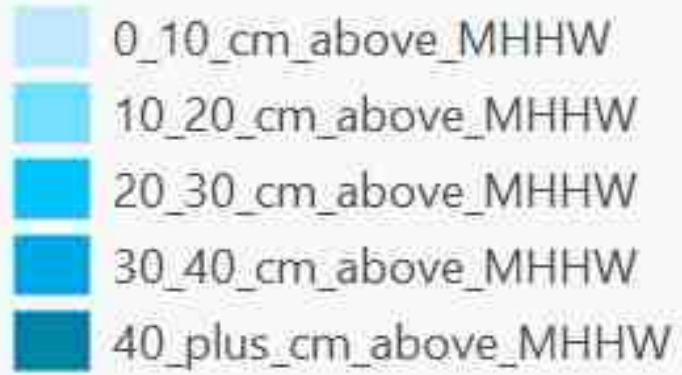
Key factors to consider:
elevation and salinity



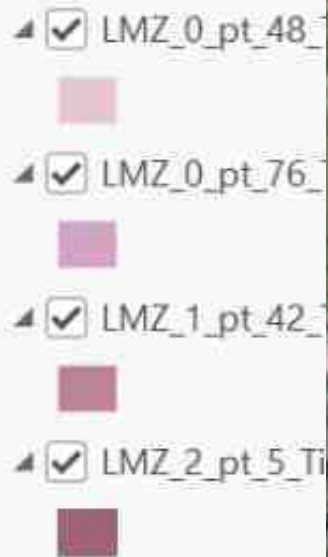
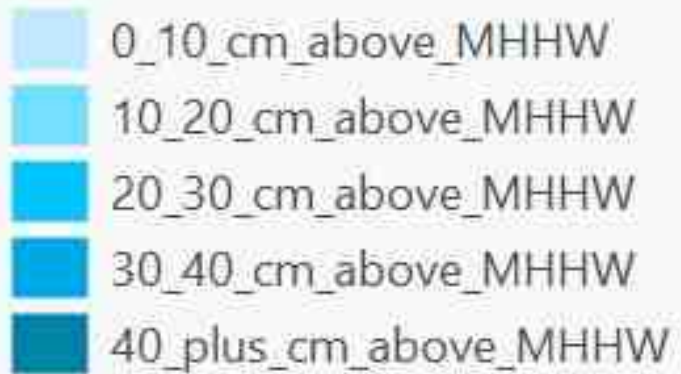
Map areas within the right elevation range



Graphic: L.S. Brophy 2024 (unpublished); data from Janousek et al. 2022 (unpublished), Schmitt 2022 (unpublished); and Brophy et al. 2007-2022



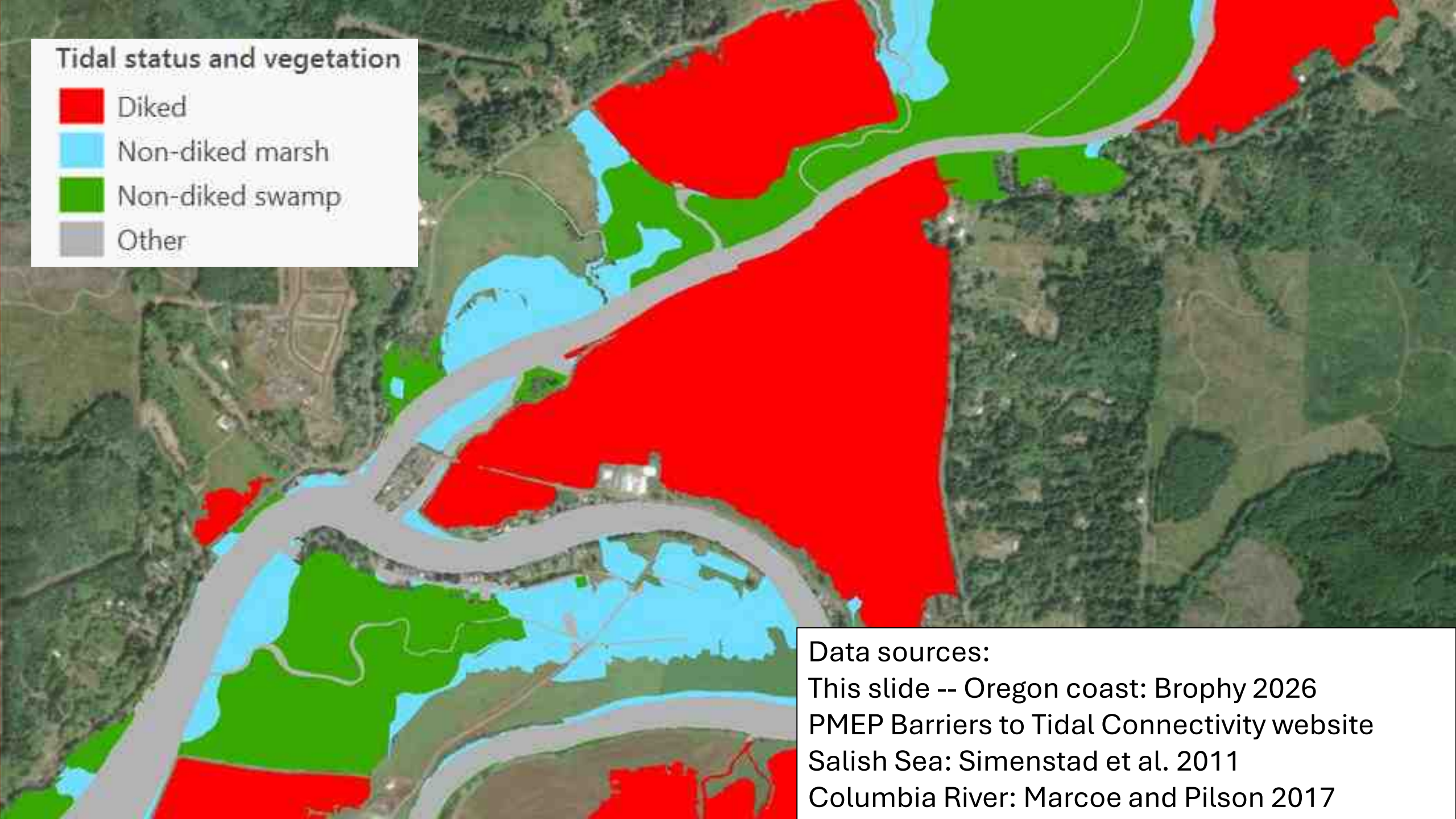
Project team: Cyndi Curtis, Jon Hart, Colin Jones, Flynn Delany, Laura Brophy; funded by the Wild Salmon Center with support from the Builders Initiative Foundation



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Tidal status and vegetation

-  Diked
-  Non-diked marsh
-  Non-diked swamp
-  Other

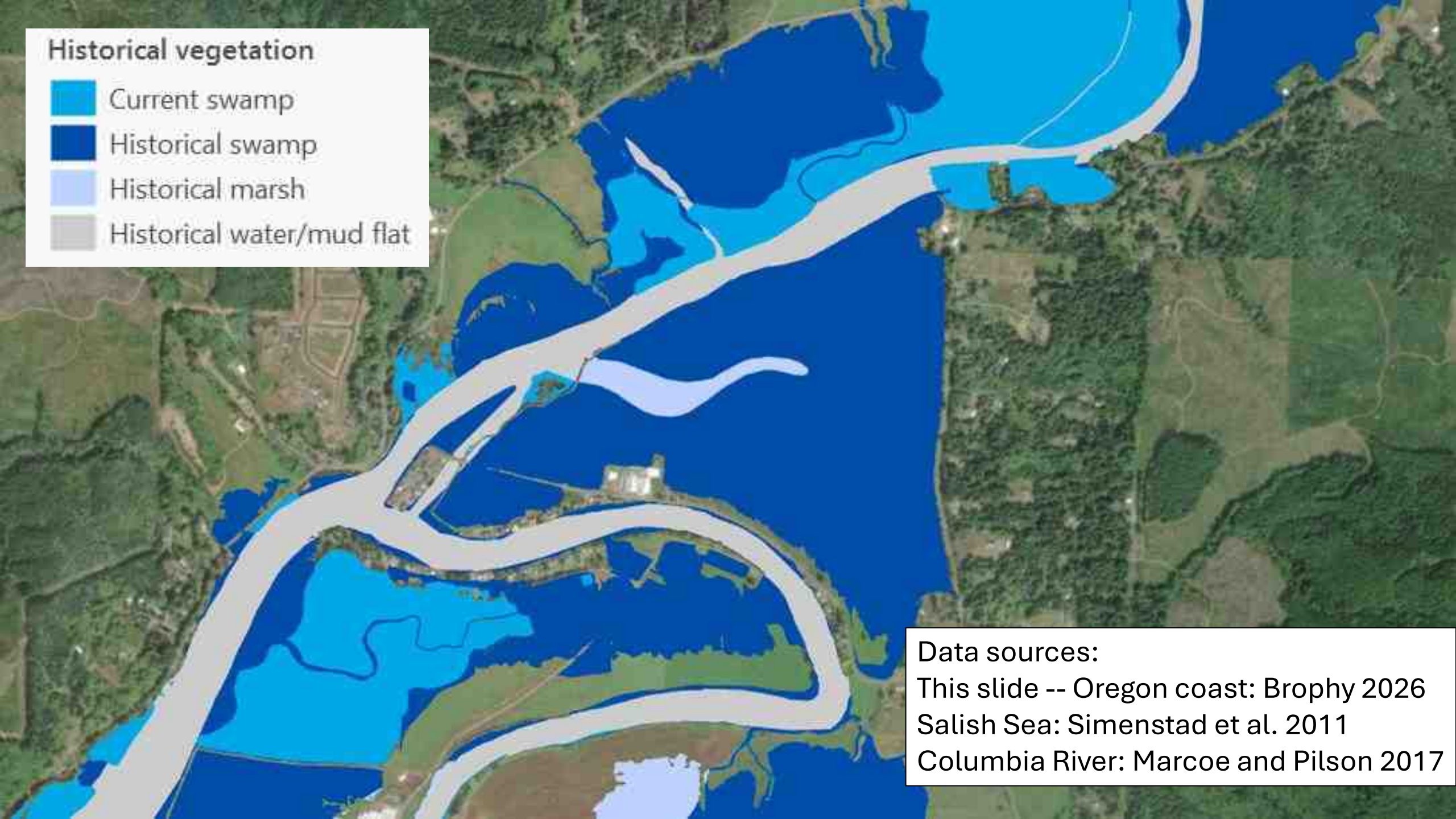


Data sources:

This slide -- Oregon coast: Brophy 2026
PMEP Barriers to Tidal Connectivity website
Salish Sea: Simenstad et al. 2011
Columbia River: Marcoe and Pilson 2017

Historical vegetation

-  Current swamp
-  Historical swamp
-  Historical marsh
-  Historical water/mud flat



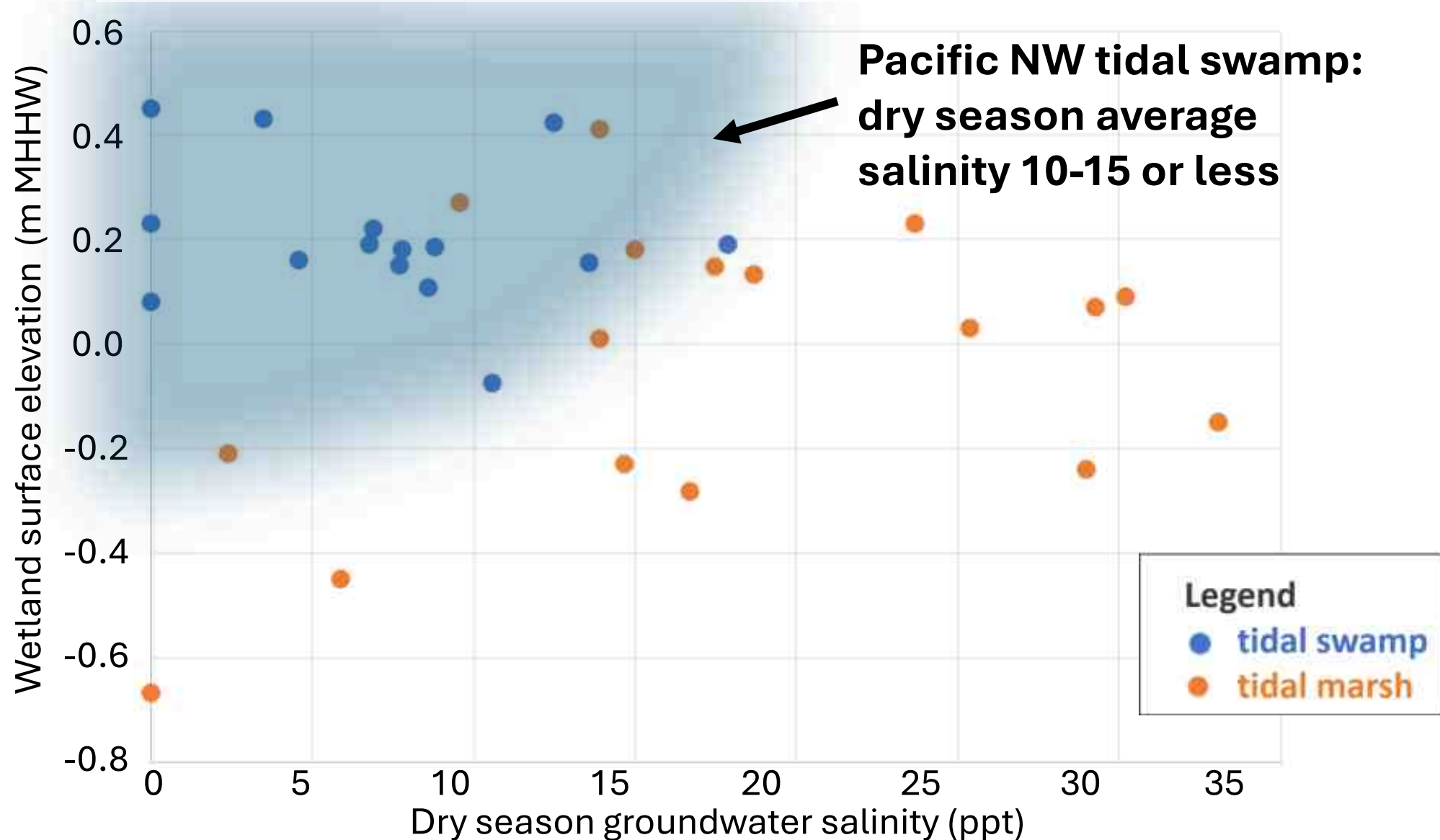
Data sources:

This slide -- Oregon coast: Brophy 2026

Salish Sea: Simenstad et al. 2011

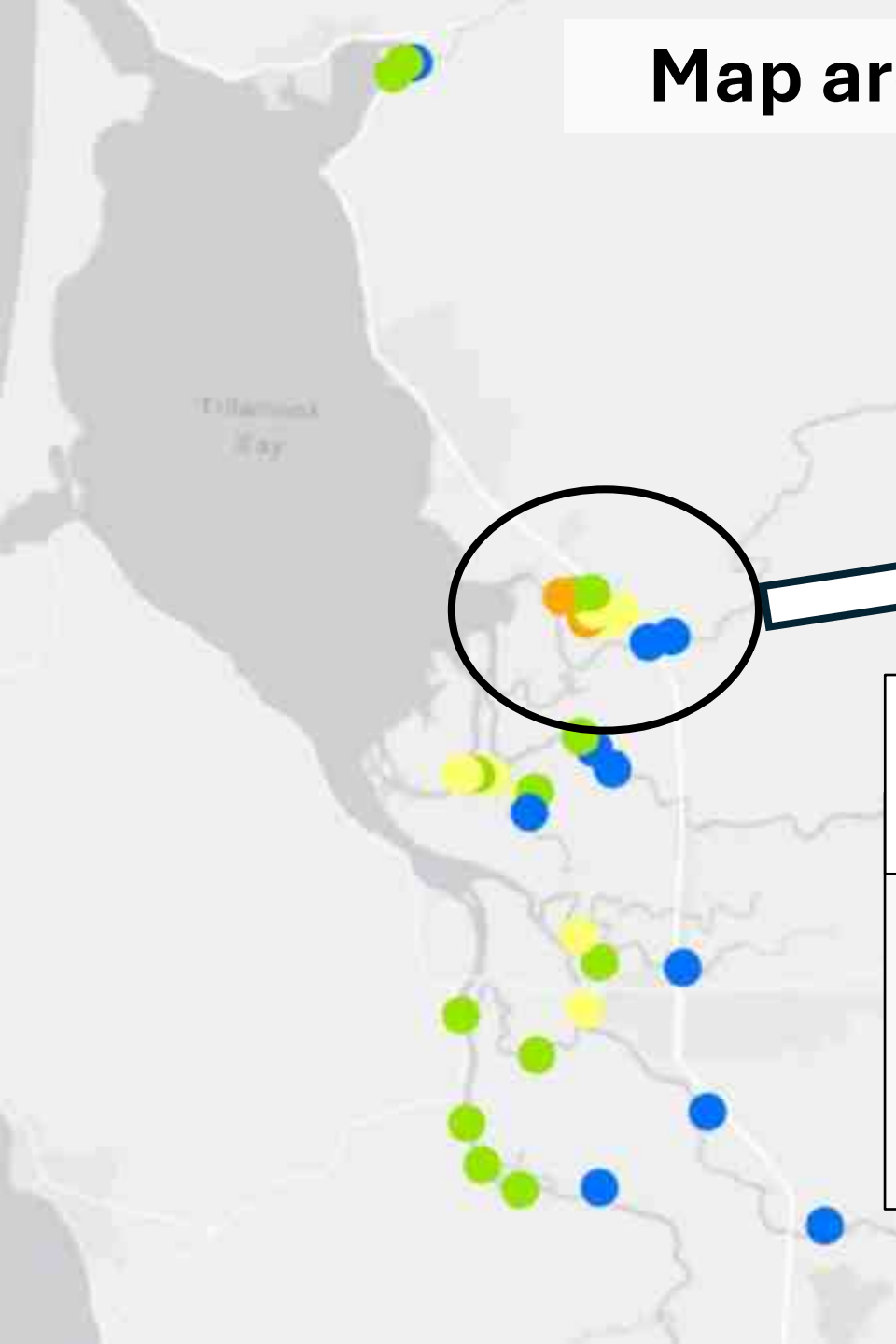
Columbia River: Marcoe and Pilson 2017

Map areas within the right salinity range

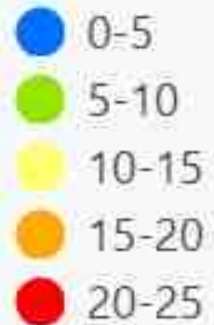


Graphic: L.S. Brophy 2024 (unpublished); data from Janousek et al. 2022 (unpublished), Schmitt 2022 (unpublished); and Brophy et al. 2007-2022

Map areas within the right salinity range



Summer dry
season porewater
salinity (2024)



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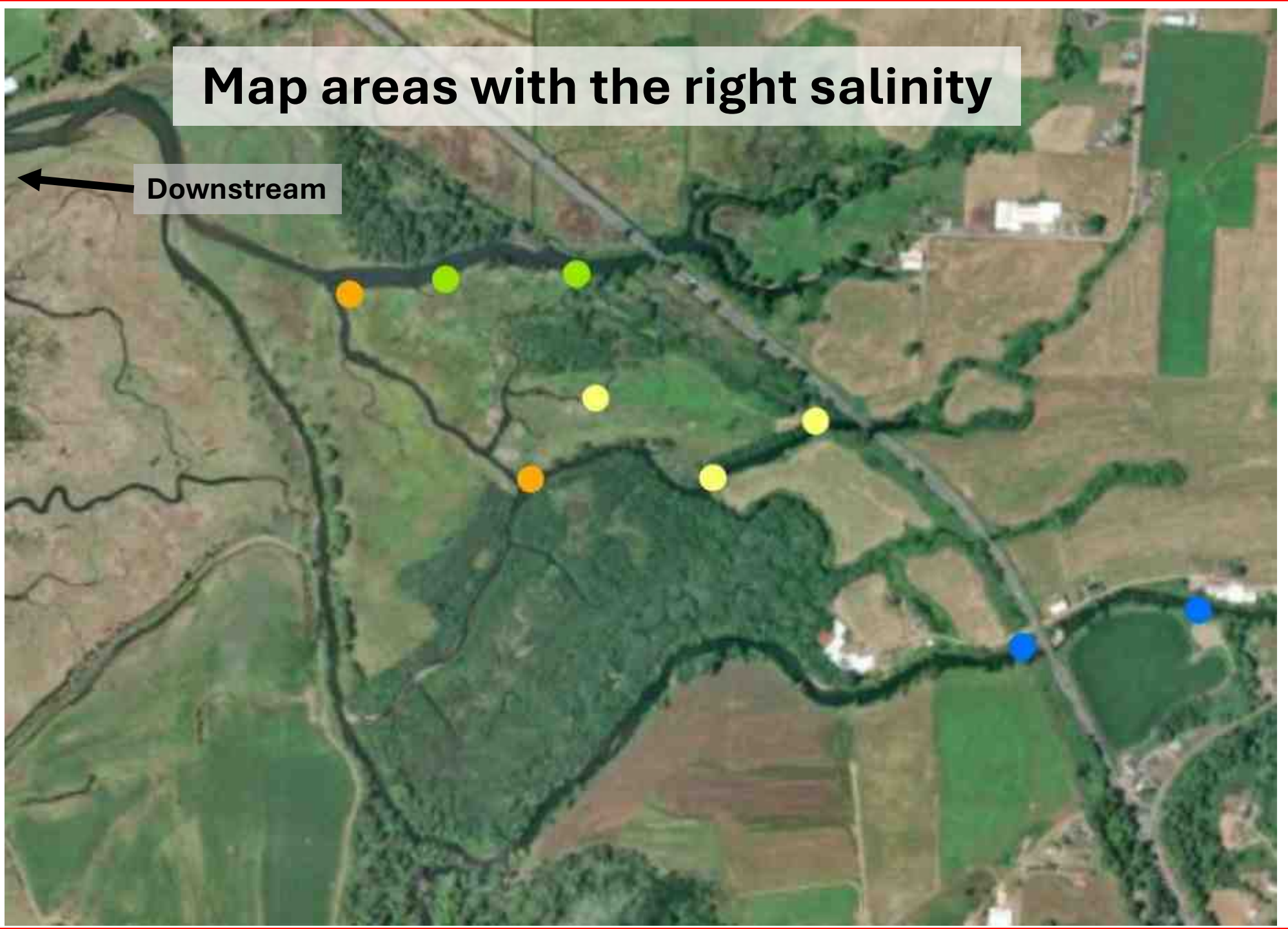
Map areas with the right salinity



Downstream

Summer dry
season porewater
salinity (2024)

- 0-5
- 5-10
- 10-15
- 15-20
- 20-25



[Home](#) / [Find Data](#) / [Data Catalog](#) / [Wetland Salinity Maps of Select Estuary Sites In The United States, 2020](#)

Wetland Salinity Maps of Select Estuary Sites in the United States, 2020

Wetland_Salinity_Maps_2392

VERSION 1

 DOI [HTTPS://DOI.ORG/10.3334/ORNLDAAC/2392](https://doi.org/10.3334/ornldaac/2392)

CENTER/PROJECT Oak Ridge National Laboratory DAAC (ORNL DAAC)

Data at a Glance

Data Format

multiple

Dataset Size

292.493 MB

Spatial Extent

N: 48.808 S: 26.3235 E:-69.4718

MORE

Location

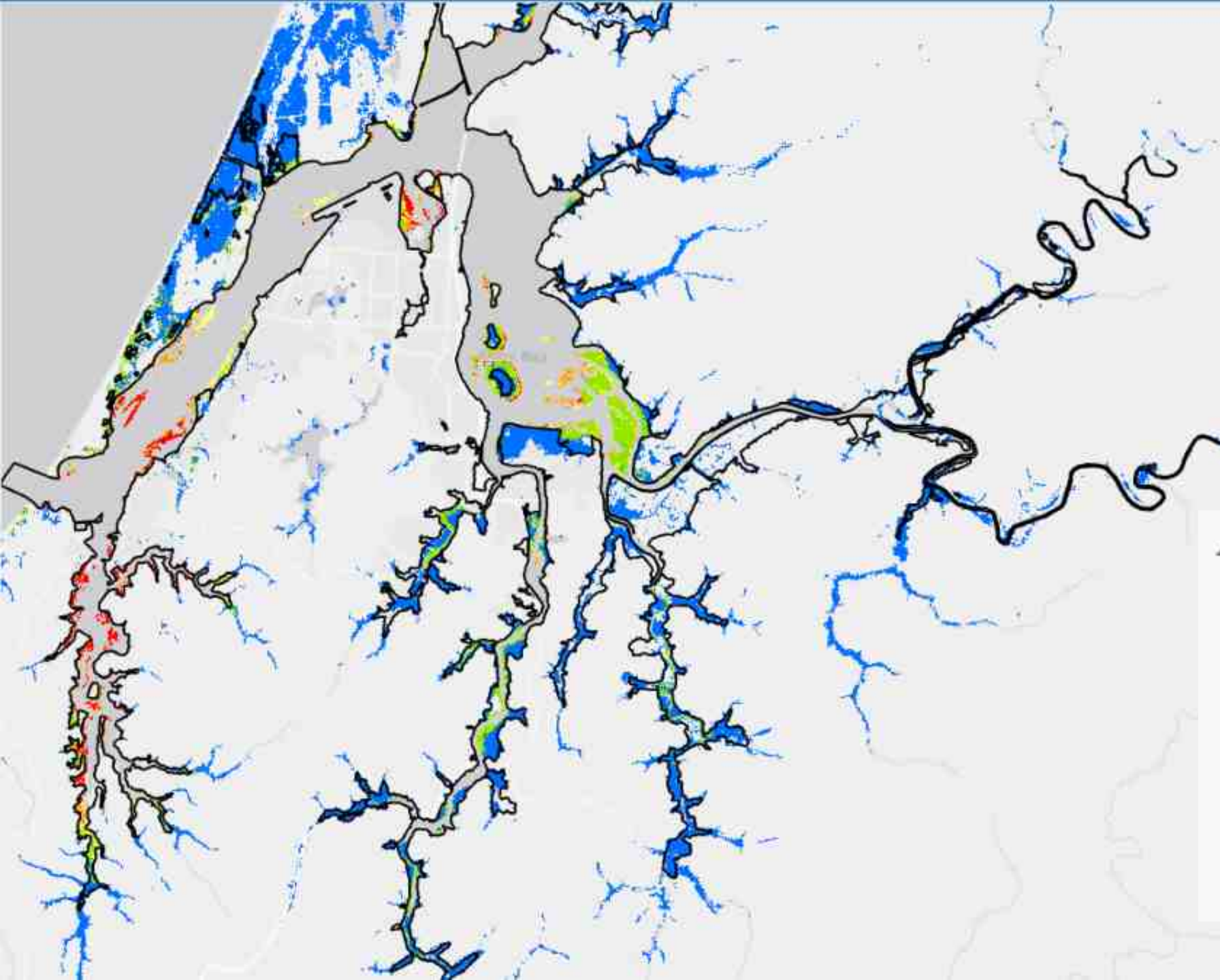
UNITED STATES OF AMERICA

Temporal Extent

2020-01-01 to 2020-12-31

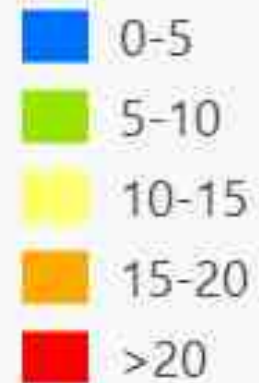
Data Access

**Average annual
salinity model
(Holmquist and
Carr 2025):
Coos Bay, OR**

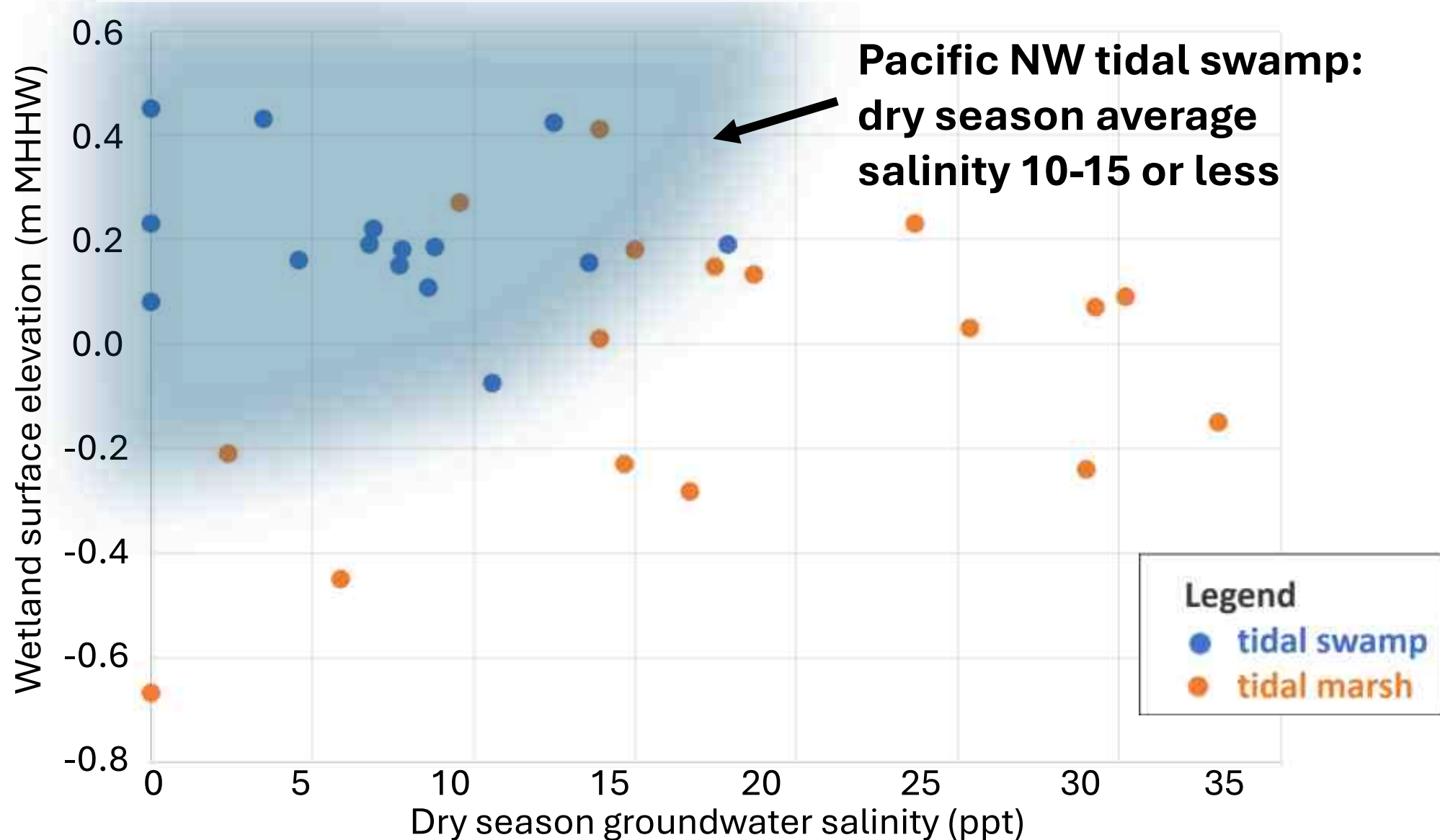


☑ Modeled avg annual salinity

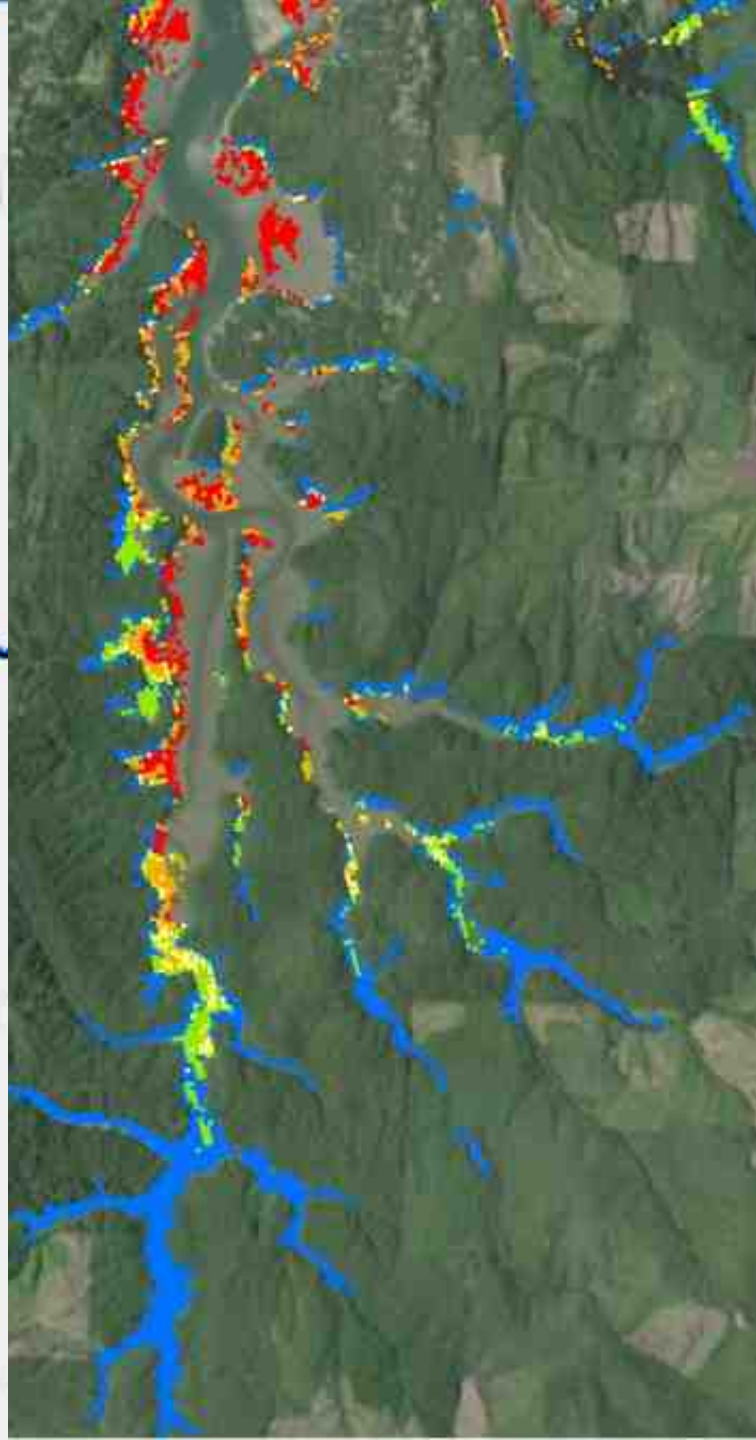
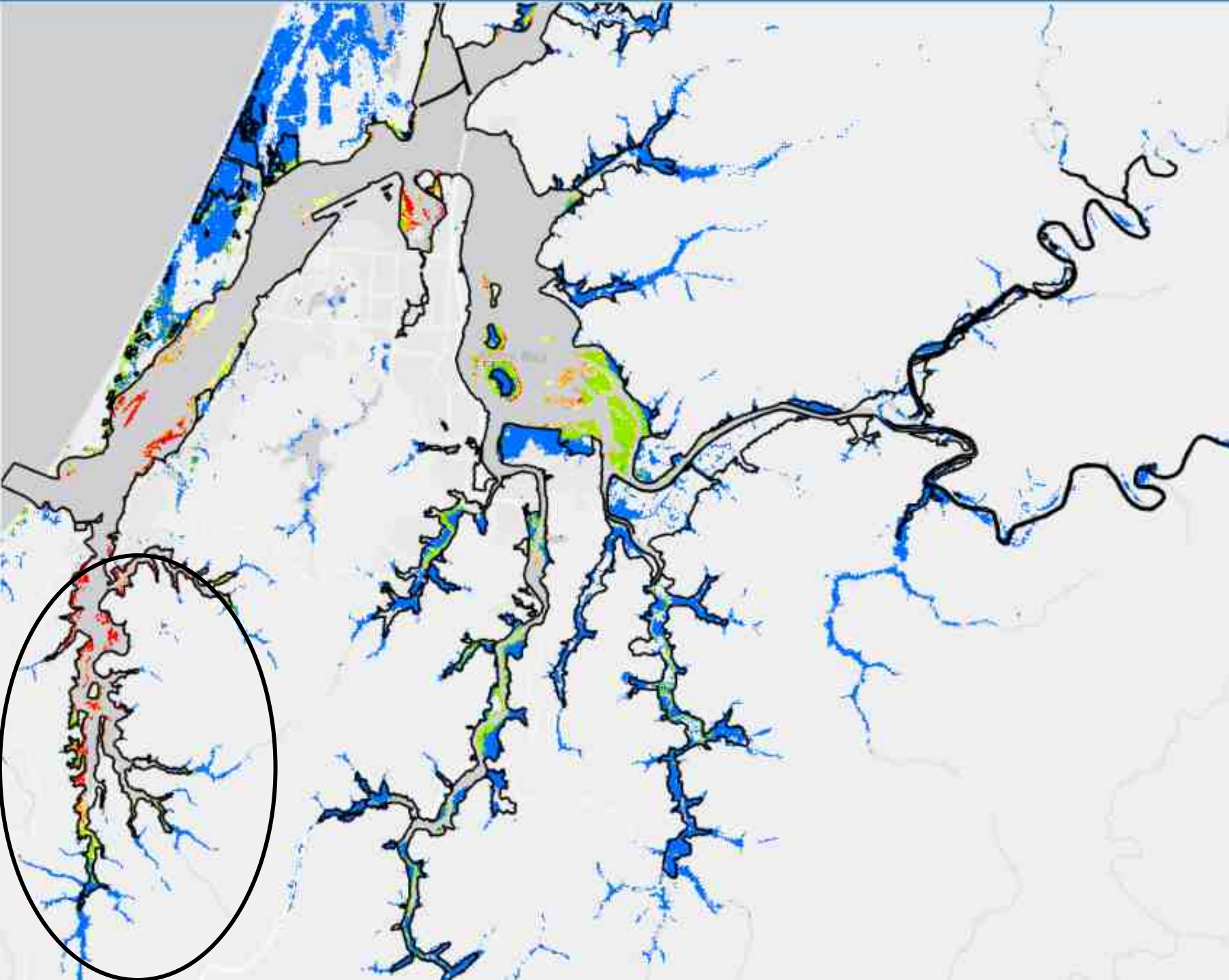
Value

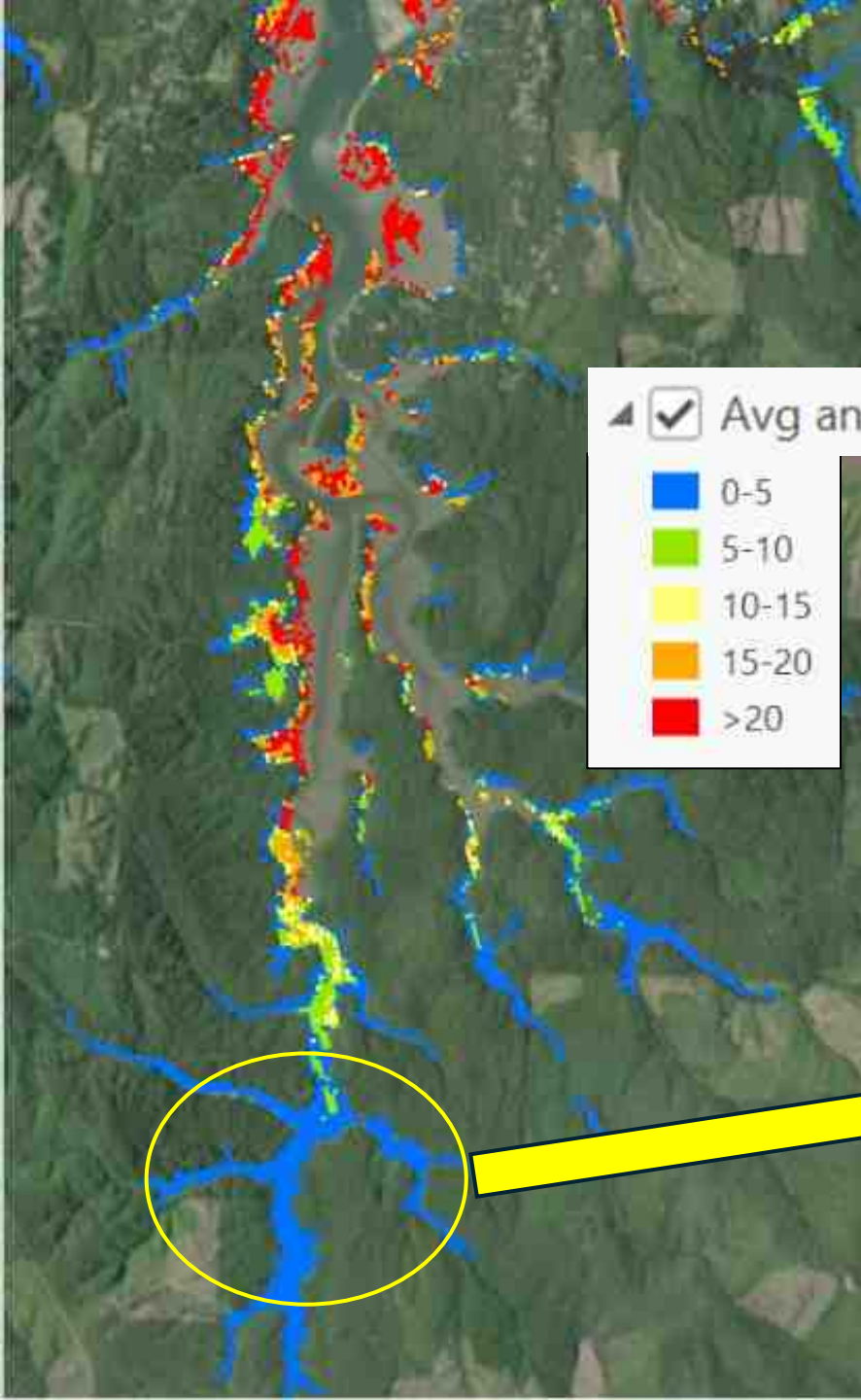


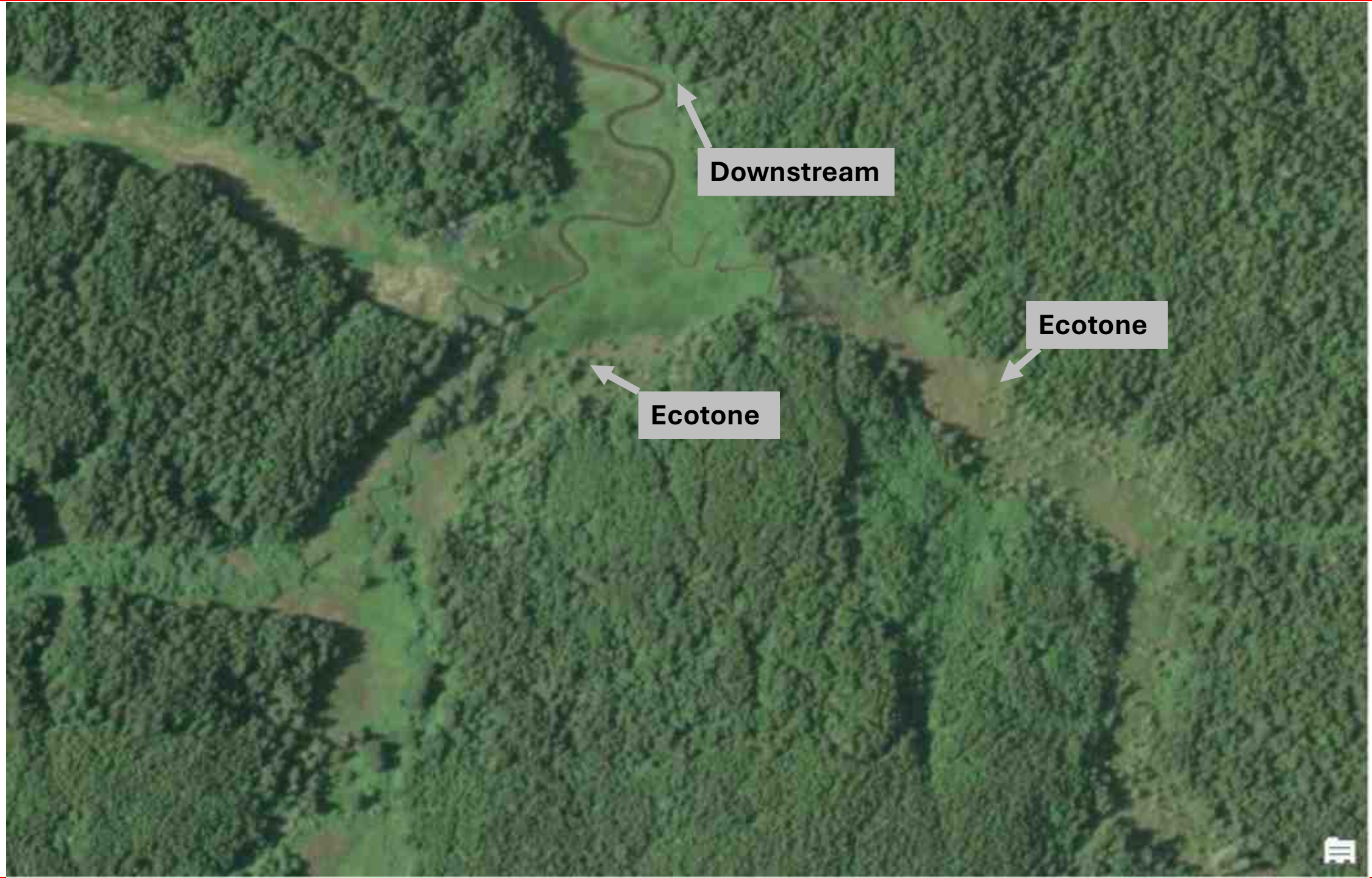
Map areas within the right salinity range



Graphic: L.S. Brophy 2024 (unpublished); data from Janousek et al. 2022 (unpublished), Schmitt 2022 (unpublished); and Brophy et al. 2007-2022





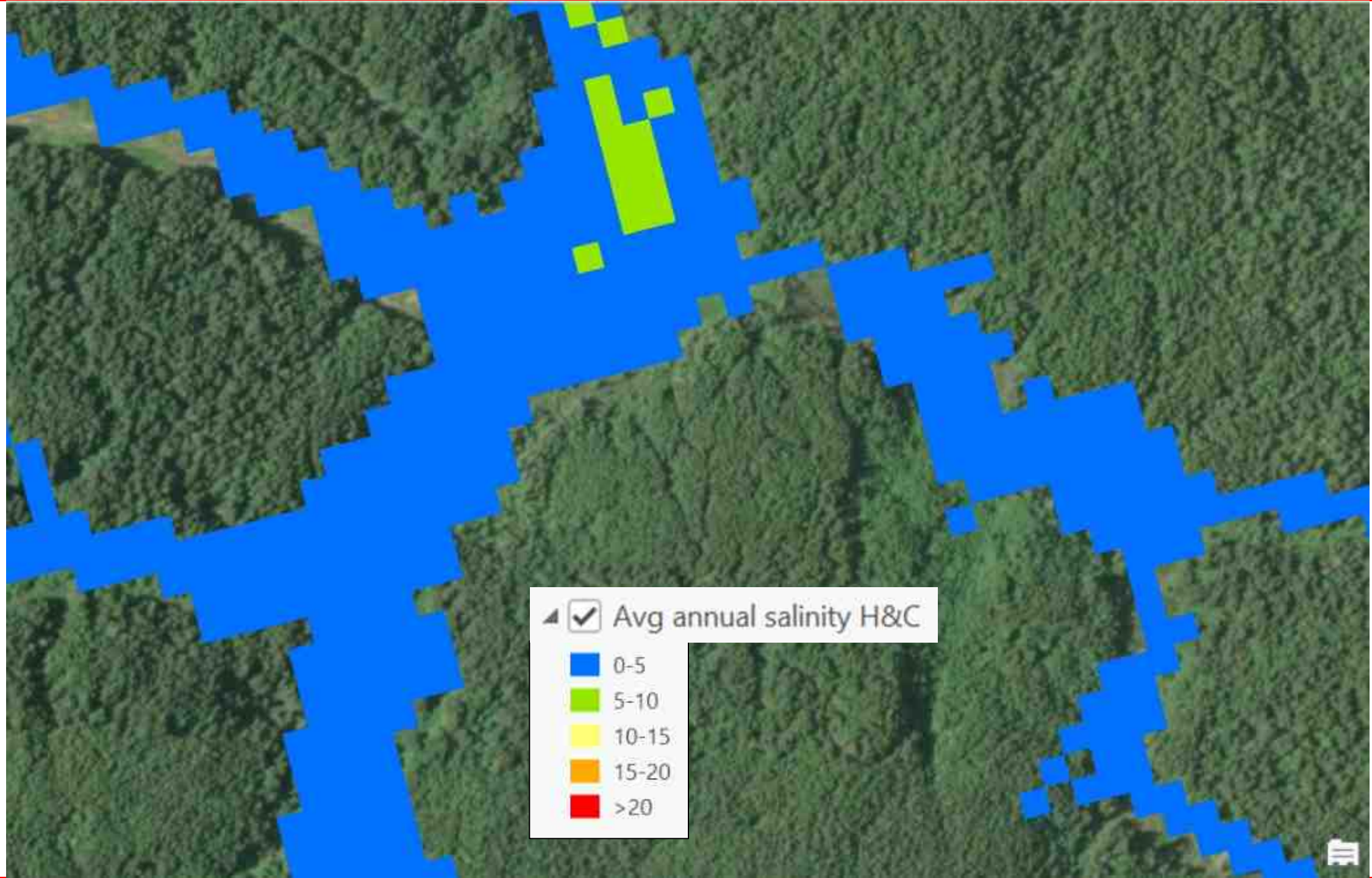


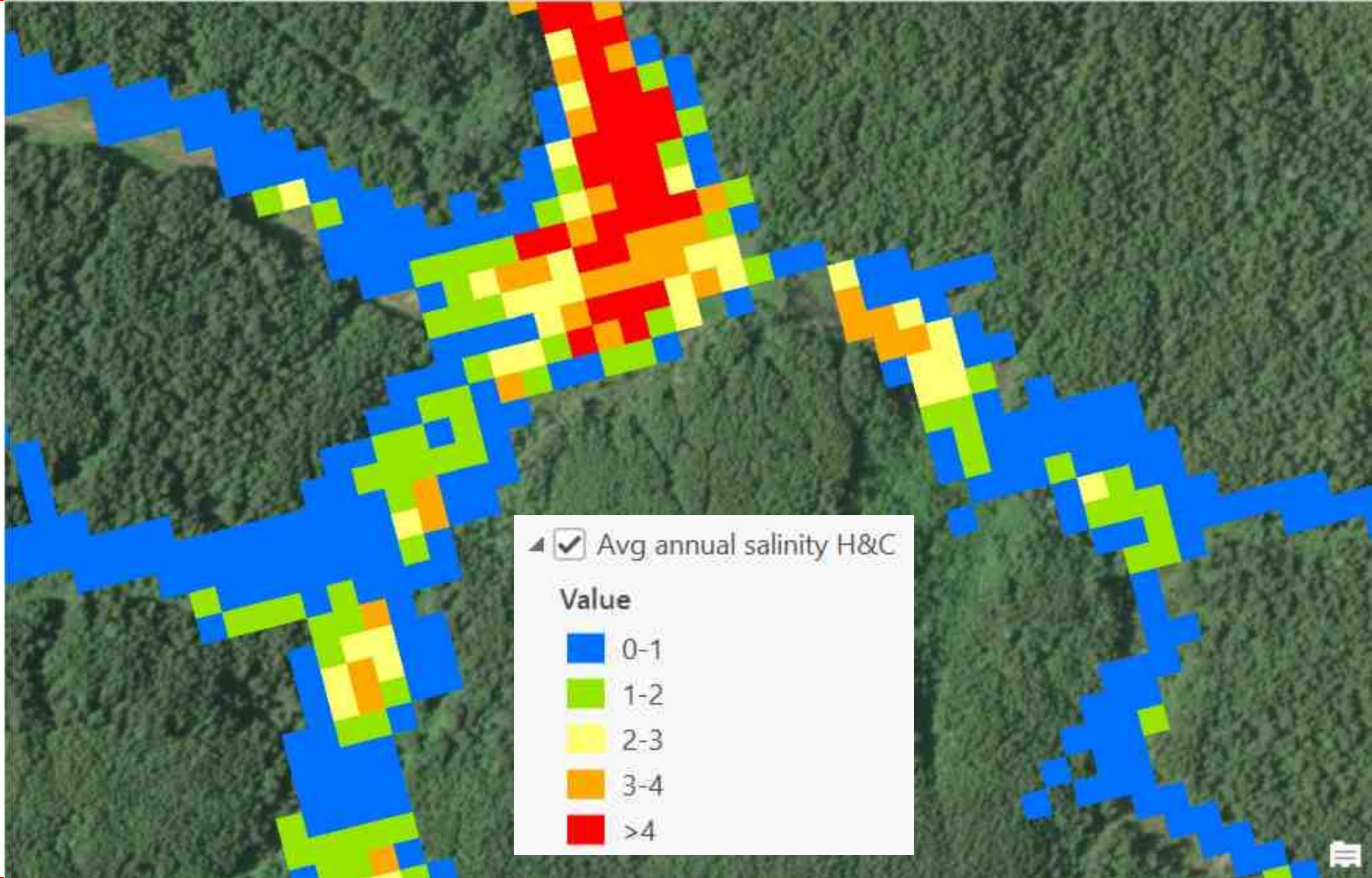
Downstream

Ecotone

Ecotone











Where to plant tidal swamp species at the site scale?



A satellite map showing a complex network of dark, winding water channels (tidal swamps) interspersed with green, vegetated land. A white arrow points from the bottom center towards a specific area in the upper right quadrant of the map. In the bottom right corner, there is a small inset map showing the location of the study area within a larger regional context.

SFC North Zone Tidal Swamp Study

Goals:

- Assess planting methods
- Assess tidal swamp tolerances
- Restore tidal swamp in favorable areas

Stratify your site to choose tidal swamp planting locations

Stratification requires data on controlling factors,
with good spatial and temporal resolution

Drone Imagery (March 2025)

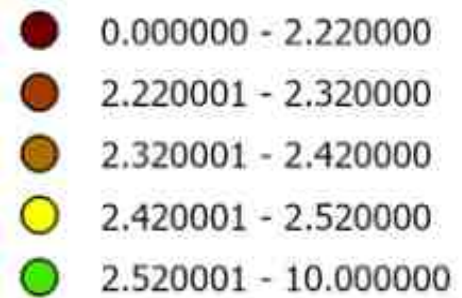
RGB

Red: Band_1
Green: Band_2
Blue: Band_3

Image courtesy of Colin Jones, Tillamook Estuaries Partnership

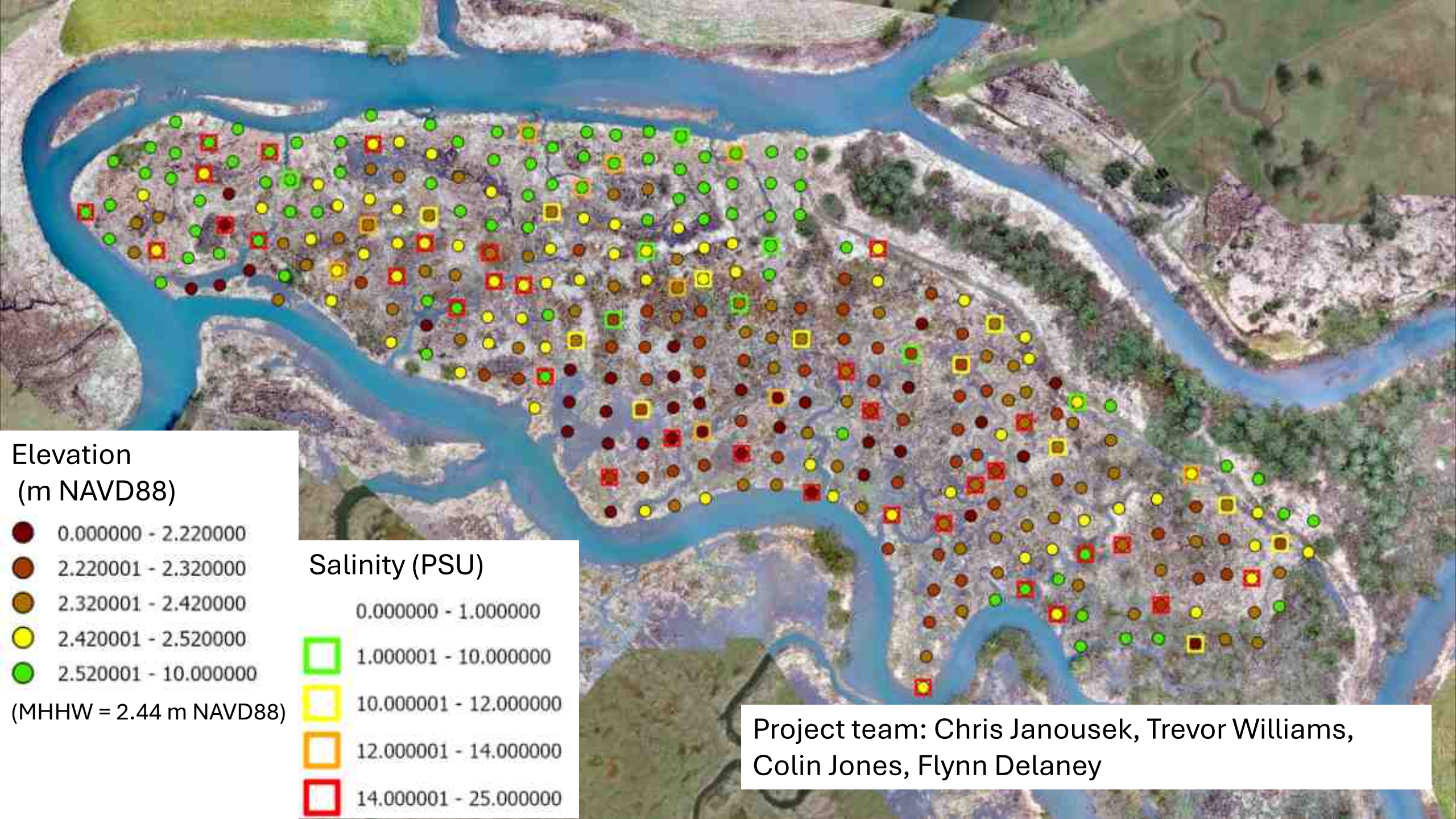
Controlling factor: elevation

Elevation
(m NAVD88)



(MHHW = 2.44 m NAVD88)

Project team: Chris Janousek, Trevor Williams, Colin Jones, Flynn Delaney



Elevation
(m NAVD88)

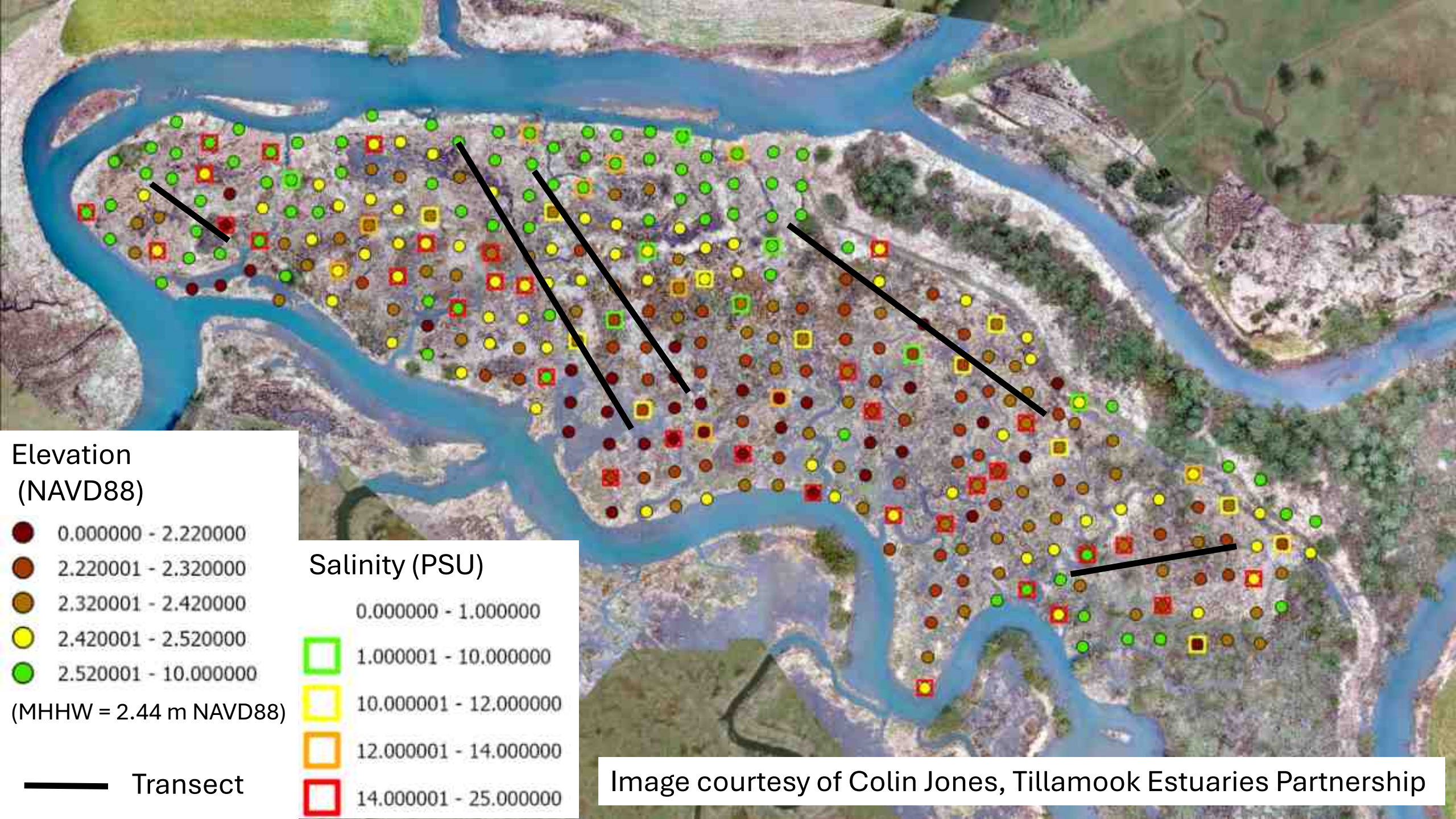
● 0.000000 - 2.220000
● 2.220001 - 2.320000
● 2.320001 - 2.420000
● 2.420001 - 2.520000
● 2.520001 - 10.000000

(MHHW = 2.44 m NAVD88)

Salinity (PSU)

□ 0.000000 - 1.000000
□ 1.000001 - 10.000000
□ 10.000001 - 12.000000
□ 12.000001 - 14.000000
□ 14.000001 - 25.000000

Project team: Chris Janousek, Trevor Williams,
Colin Jones, Flynn Delaney



Elevation
(NAVD88)

- 0.000000 - 2.220000
- 2.220001 - 2.320000
- 2.320001 - 2.420000
- 2.420001 - 2.520000
- 2.520001 - 10.000000

(MHHW = 2.44 m NAVD88)

— Transect

Salinity (PSU)

- 0.000000 - 1.000000
- 1.000001 - 10.000000
- 10.000001 - 12.000000
- 12.000001 - 14.000000
- 14.000001 - 25.000000

Image courtesy of Colin Jones, Tillamook Estuaries Partnership

**80 Plots: 1 plot
is illustrated**

Brushing/disking:
50 cm radius

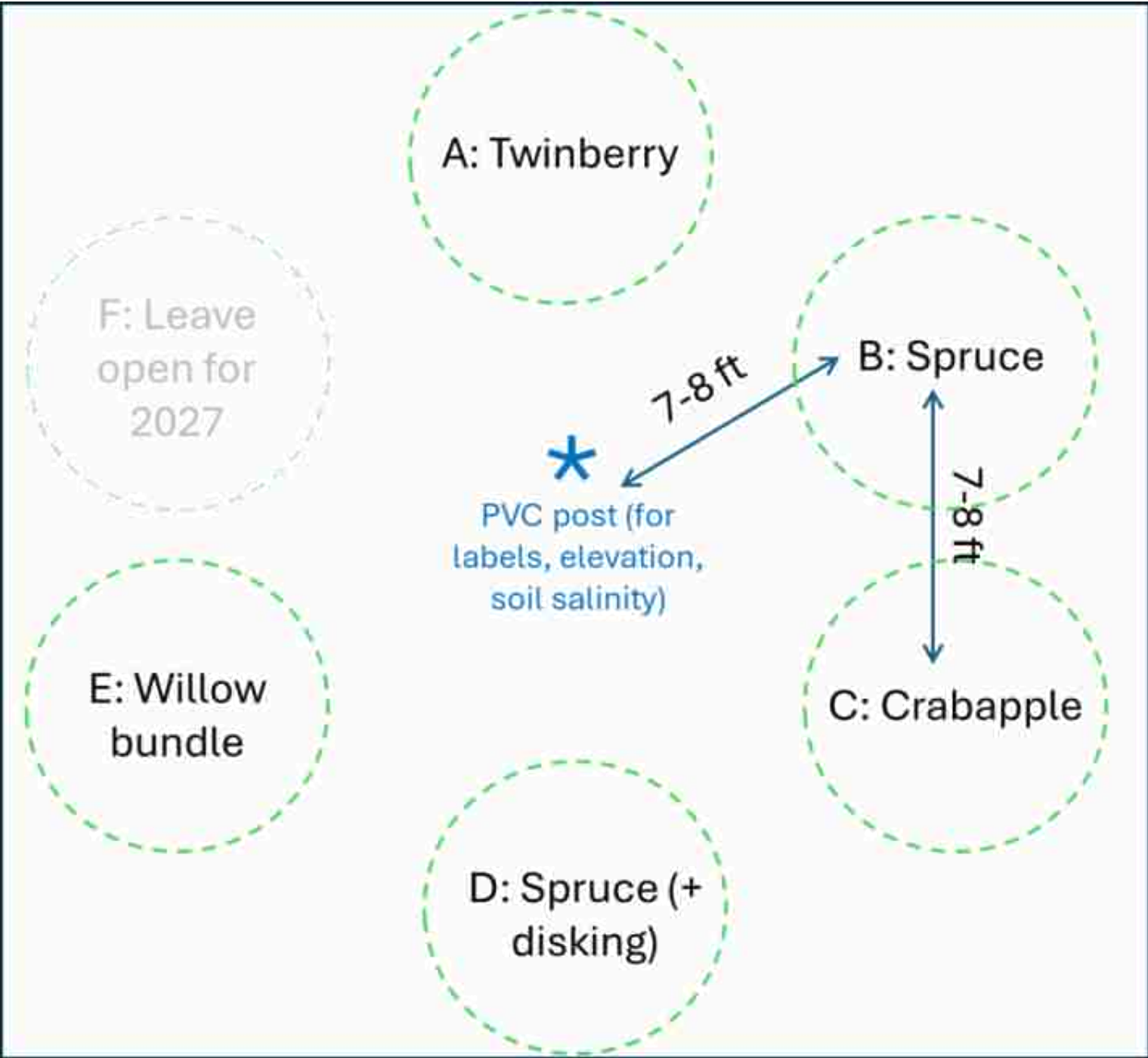
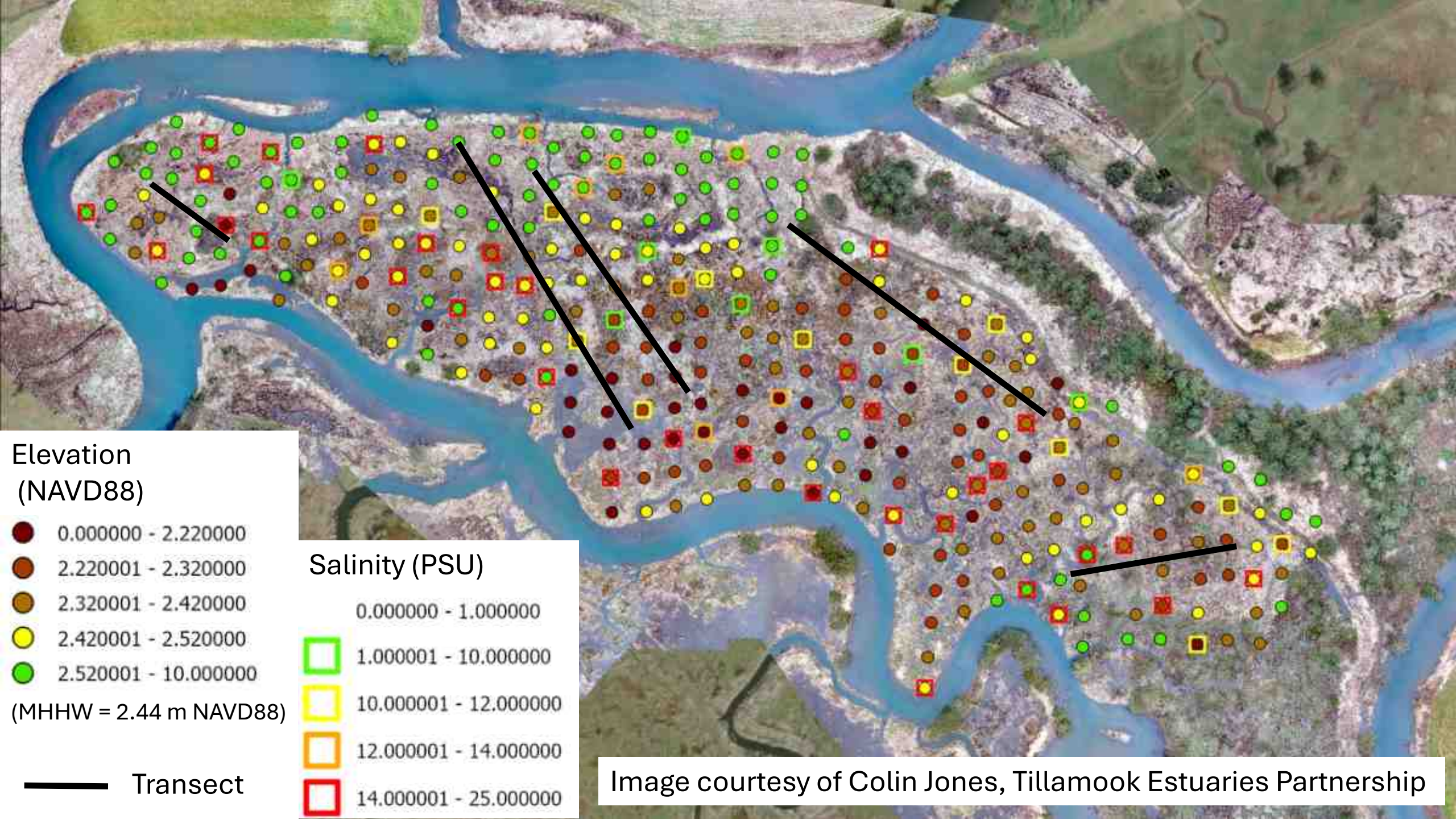


Image courtesy of Colin Jones,
Tillamook Estuaries Partnership



Elevation
(NAVD88)

- 0.000000 - 2.220000
- 2.220001 - 2.320000
- 2.320001 - 2.420000
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- 2.520001 - 10.000000

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Salinity (PSU)

- 0.000000 - 1.000000
- 1.000001 - 10.000000
- 10.000001 - 12.000000
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- 14.000001 - 25.000000

Image courtesy of Colin Jones, Tillamook Estuaries Partnership



Tidal swamp restoration working groups are forming – join one or start one for your area!

South Slough NERR and Oregon State University Tidal Swamp Community of Practice

- Geographic scope: U.S. Pacific Northwest
- Objectives: Share and disseminate information on tidal swamp ecology and restoration
- 1 year NERRS Capacity Building Grant
- Contact Jenni Schmitt, Jenni.SCHMITT@dsl.oregon.gov

Oregon Central Coast Estuary Collaborative Spruce Swamp Working Group

Others? Add yours to the chat!

Links to publications cited

Brophy 2026, <https://doi.org/10.1016/j.ecss.2025.109542>

Brophy 2024, https://drive.google.com/file/d/1pvliZHb6bTcXdqKfBJ5SwlWYt5WsjL_5

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Davis et al. 2019, <https://doi.org/10.1002/tafs.10134>

Holmquist and Carr 2025, <https://doi.org/10.3334/ORNLDAAAC/2392>

Janousek and Williams 2024, https://ir.library.oregonstate.edu/concern/technical_reports/4t64gx51f

Kauffman et al. 2020, <https://doi.org/10.1111/gcb.15248>,

Marcoe and Pilson 2017, <https://doi.org/10.1007/s11852-017-0523-7>

PMEP Barriers to Tidal Connectivity website, <https://btc-psmfc.hub.arcgis.com/>

Simenstad et al. 2011, <https://wdfw.wa.gov/sites/default/files/publications/02186/wdfw02186.pdf>

Questions?

