



# Restoration Monitoring in the Nisqually River Delta

What have we learned, and where do we go from here?

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U.S. Geological Survey, Oregon Cooperative Fish and Wildlife Research Unit

**Prepared For:**

From Watersheds to Waves: Restoring Estuaries for Salmon  
Virtual Knowledge Exchange Workshop

June 11, 2025





Photo: Russ McMillan





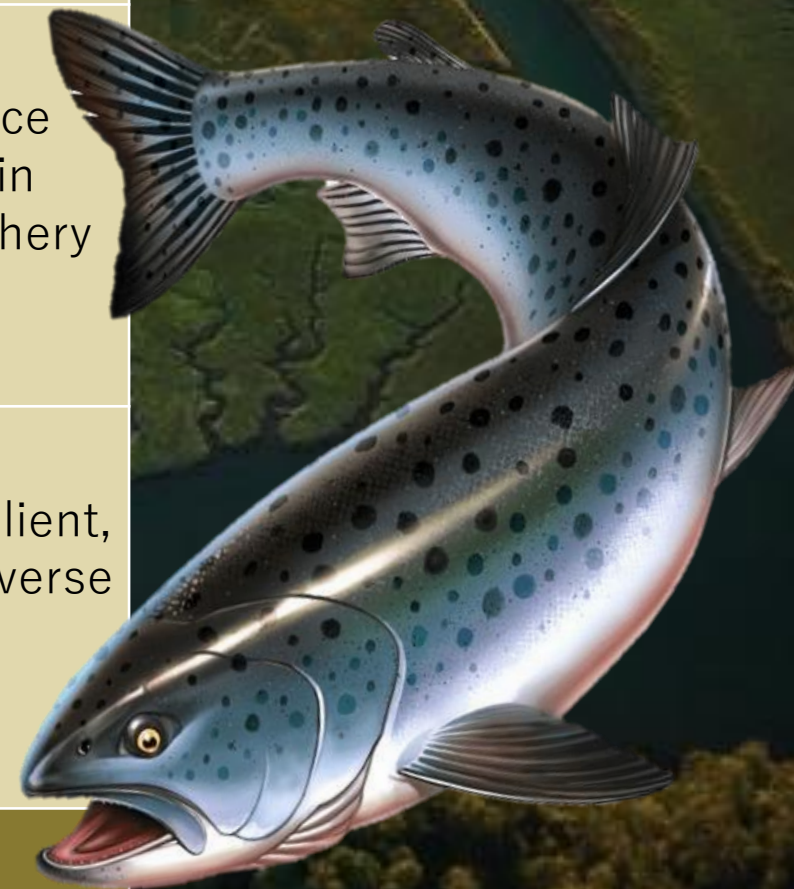




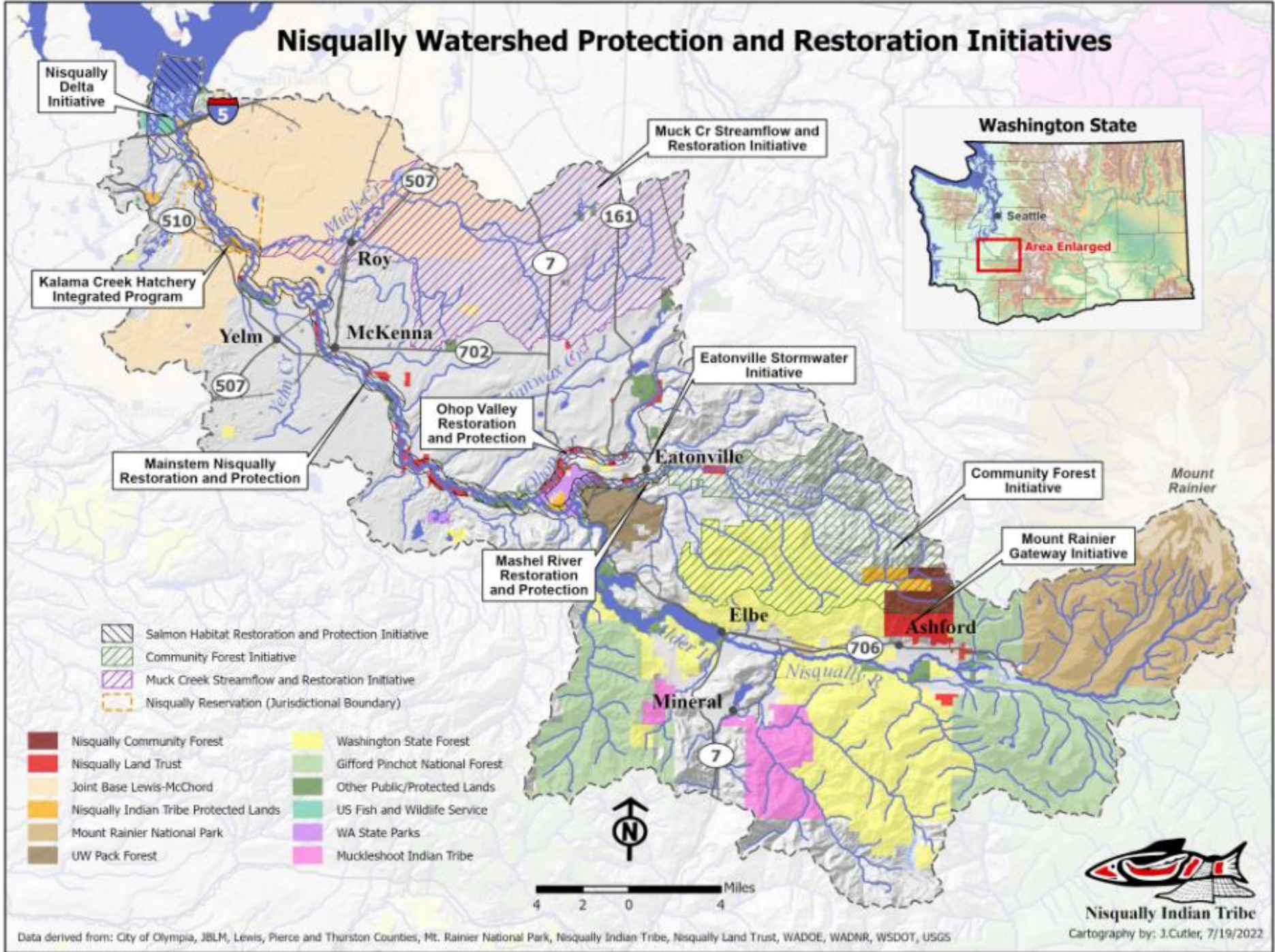


Recovery Phase	Ecosystem Conditions <sup>a</sup>	Plan Objectives
Re-Building	<b><u>Underutilized habitat available through <u>habitat restoration and improved fish access to habitats.</u></u></b>	<b><u>Repopulate vacant, underutilized, and restored habitats.</u></b>
Local Adaptation	Habitat capable of supporting abundances that minimize risk of extinction and provide harvest.	Meet and exceed abundance thresholds for natural-origin spawners and reduce hatchery influence.
Viable Population	Habitat restored and protected to allow full expression of abundance, productivity, life - history diversity, and spatial distribution.	Maintain a productive, resilient, spatially and temporally diverse population with minimal hatchery supplementation.

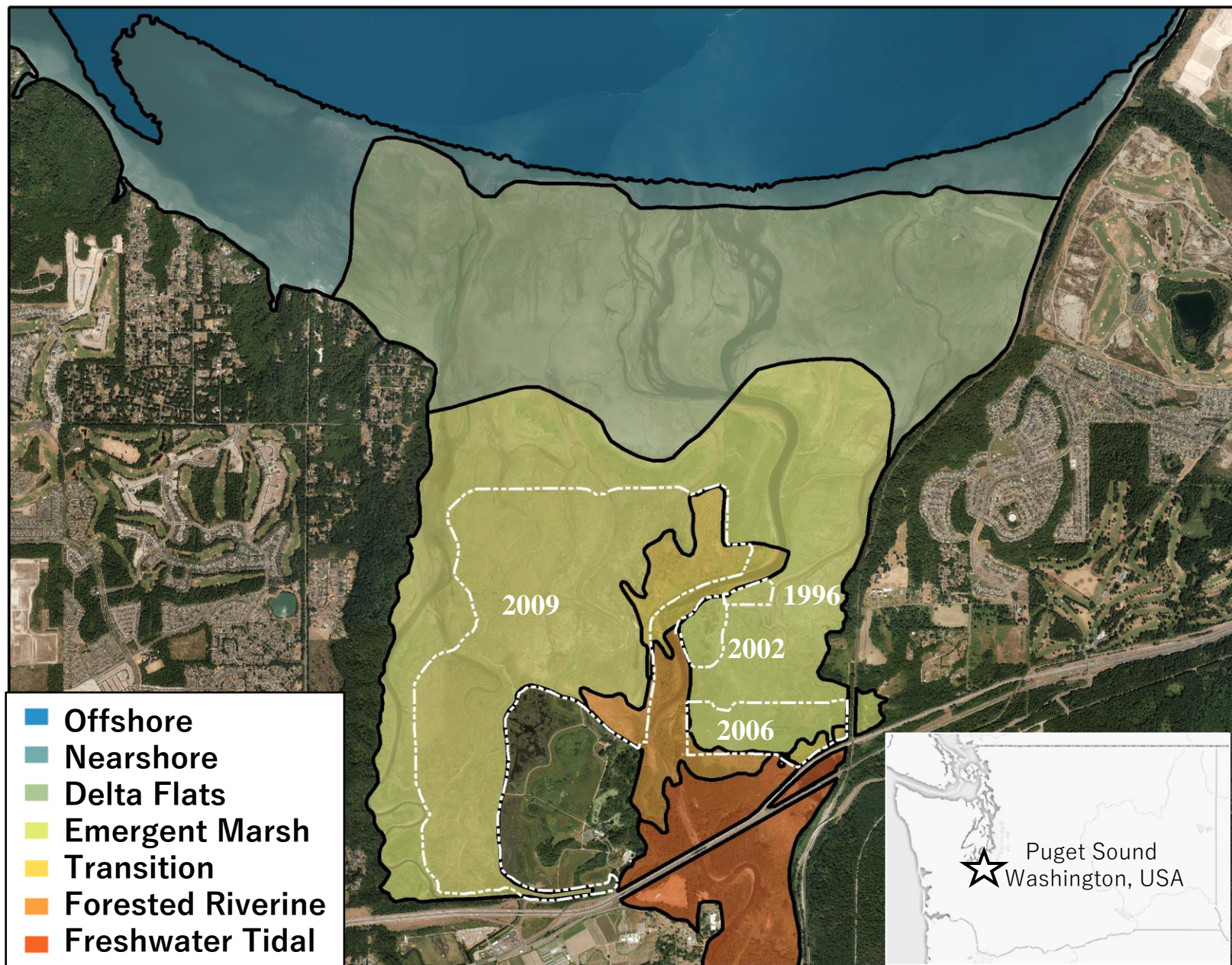
<sup>a</sup> Hatchery Scientific Review Group 2014













# Brown Farm Dike Construction

1904 - 1910









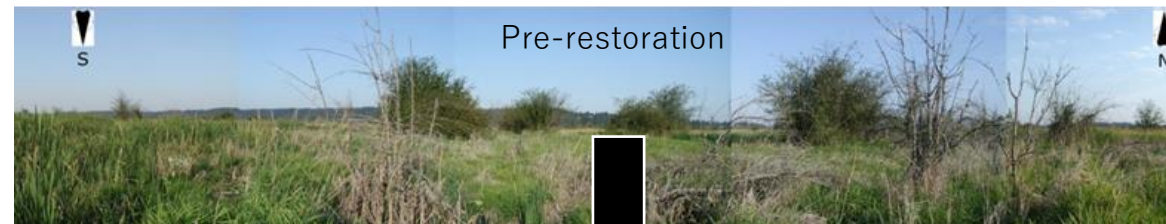
First Tide: 9/24/2009





June 2006

# Habitat Change Through Time





Pristine



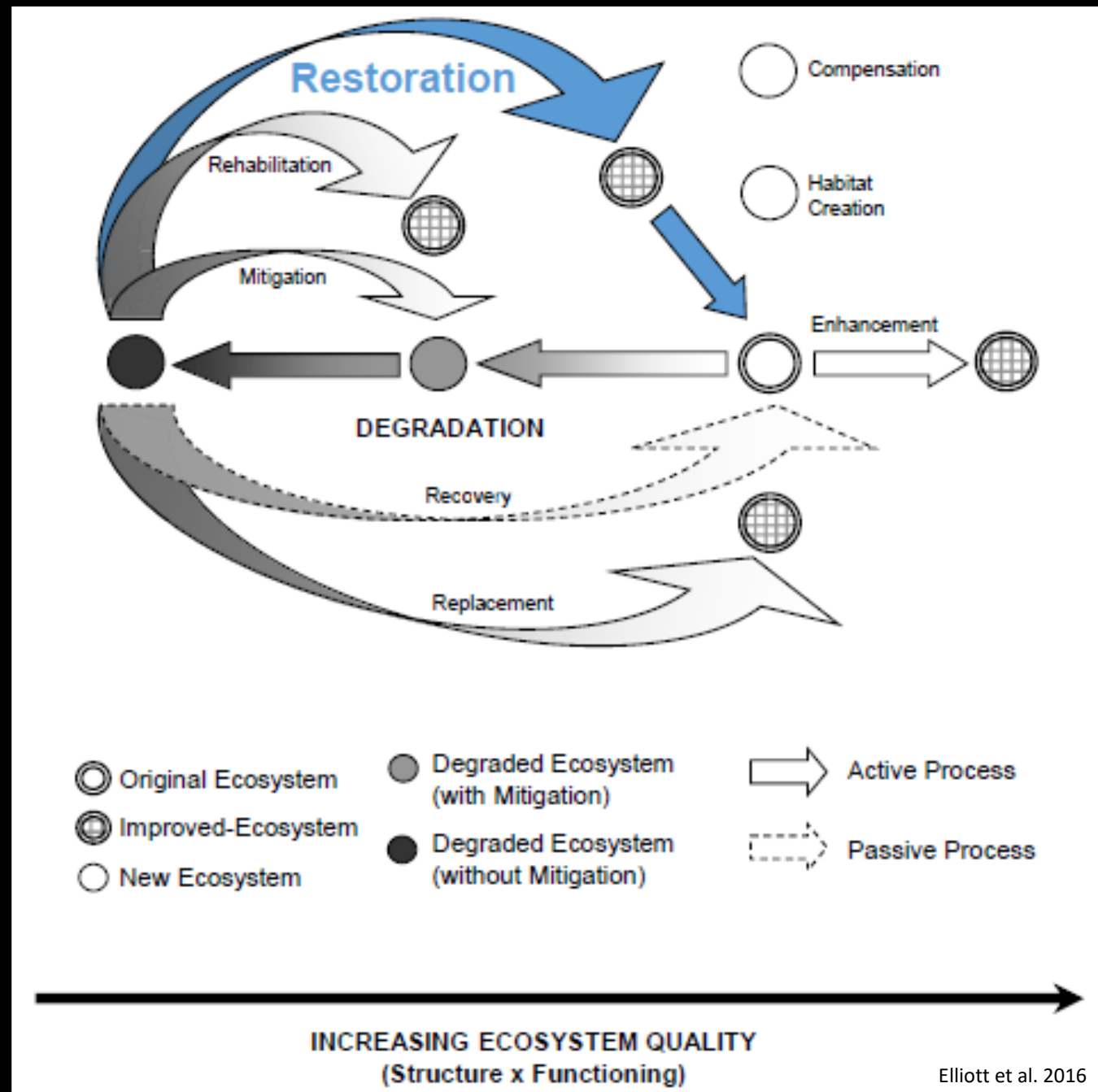
Degraded



Restoring



Restored?





# Building on Lessons Learned

## Synthesis and Integration

### Future Forecasting

- Sea-level rise and marsh accretion models
- Temperature models
- Hydrologic models
- Sediment/dam Management scenarios

Davis et al. 2019b, Davis et al. 2021, Moritsch et al. 2022, Grossman et al. 2022, Davis et al. *In Review*

### Life History and Food Web Ecology

- Wild and hatchery fish diets
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### Pre- & Post-Restoration Monitoring

- Opportunity
- Capacity
- Realized function
- “BACI”-type study design

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- Cross-system analyses
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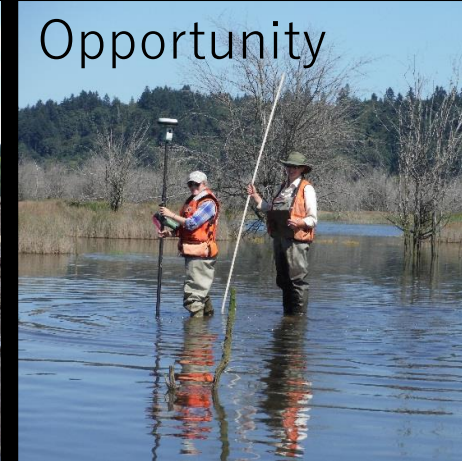
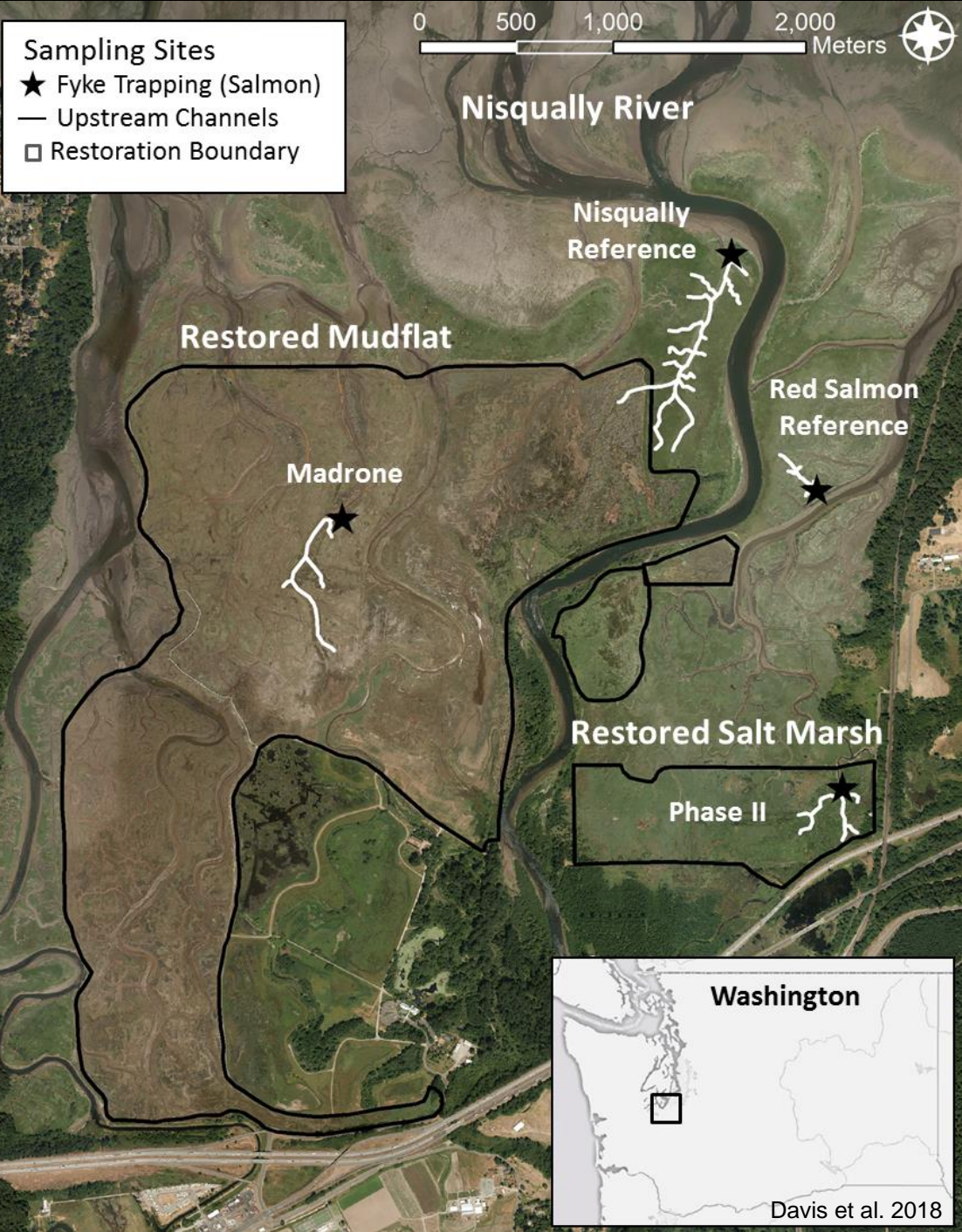




# Success Criteria (Simenstad & Cordell 2000)

- **Opportunity Potential**
  - i.e., How much habitat is available?
- **Foraging Capacity**
  - i.e., Are there sufficient prey resources there?
- **Realized Function**
  - i.e., Are individuals using newly-available habitat?

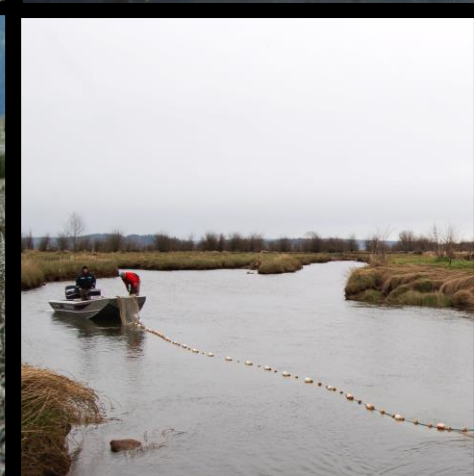




Opportunity



Capacity



Realized Function



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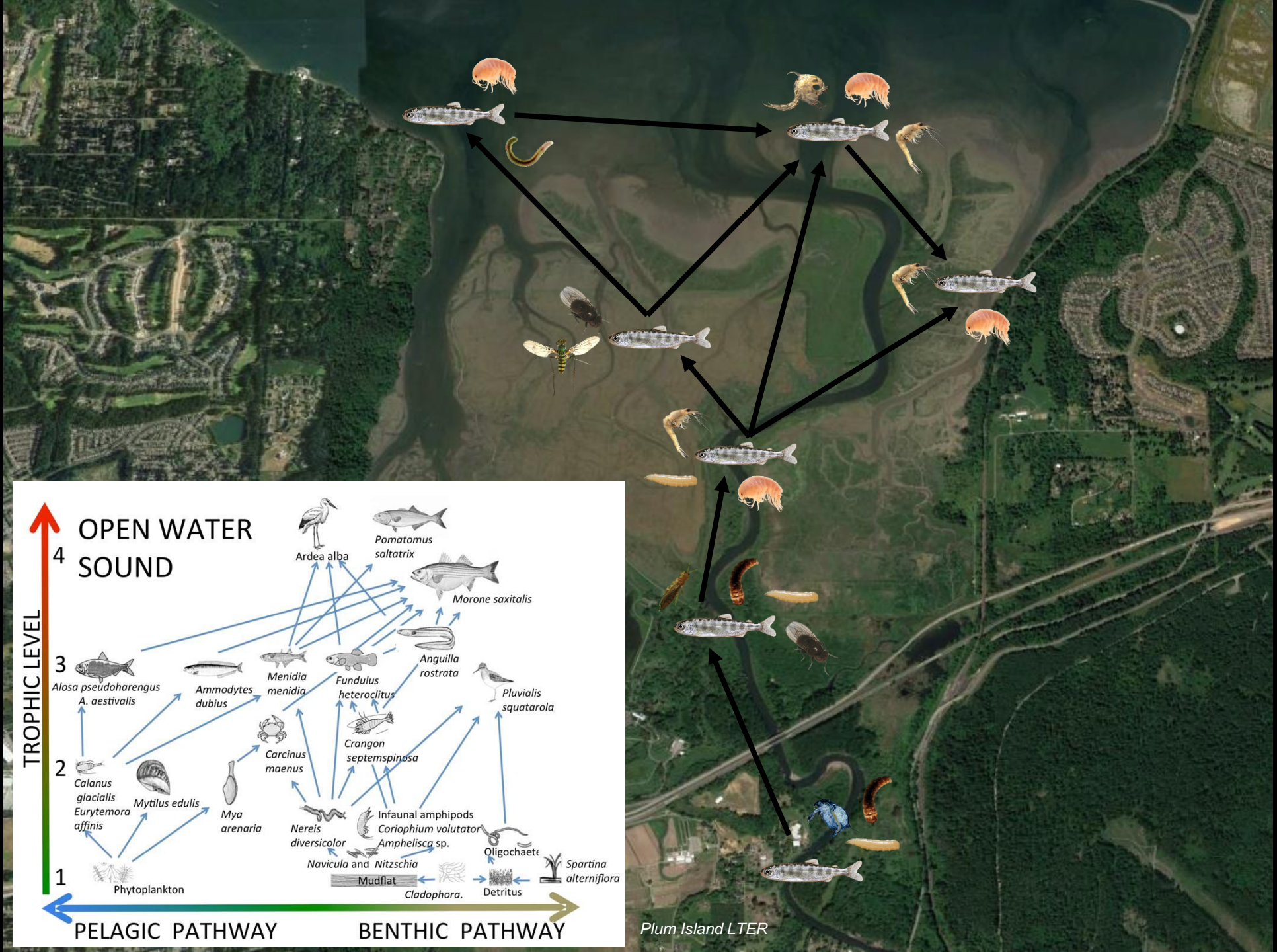




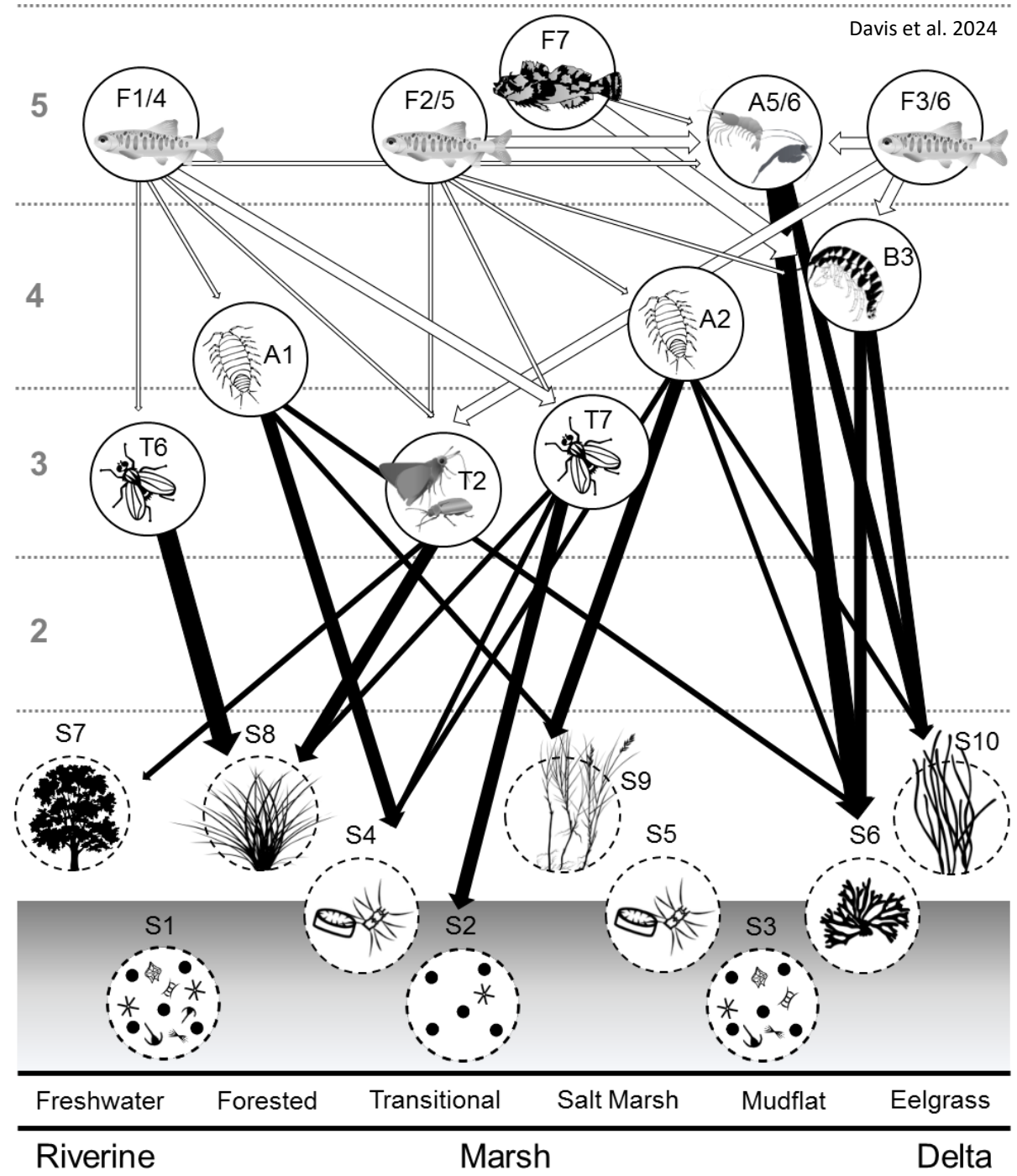
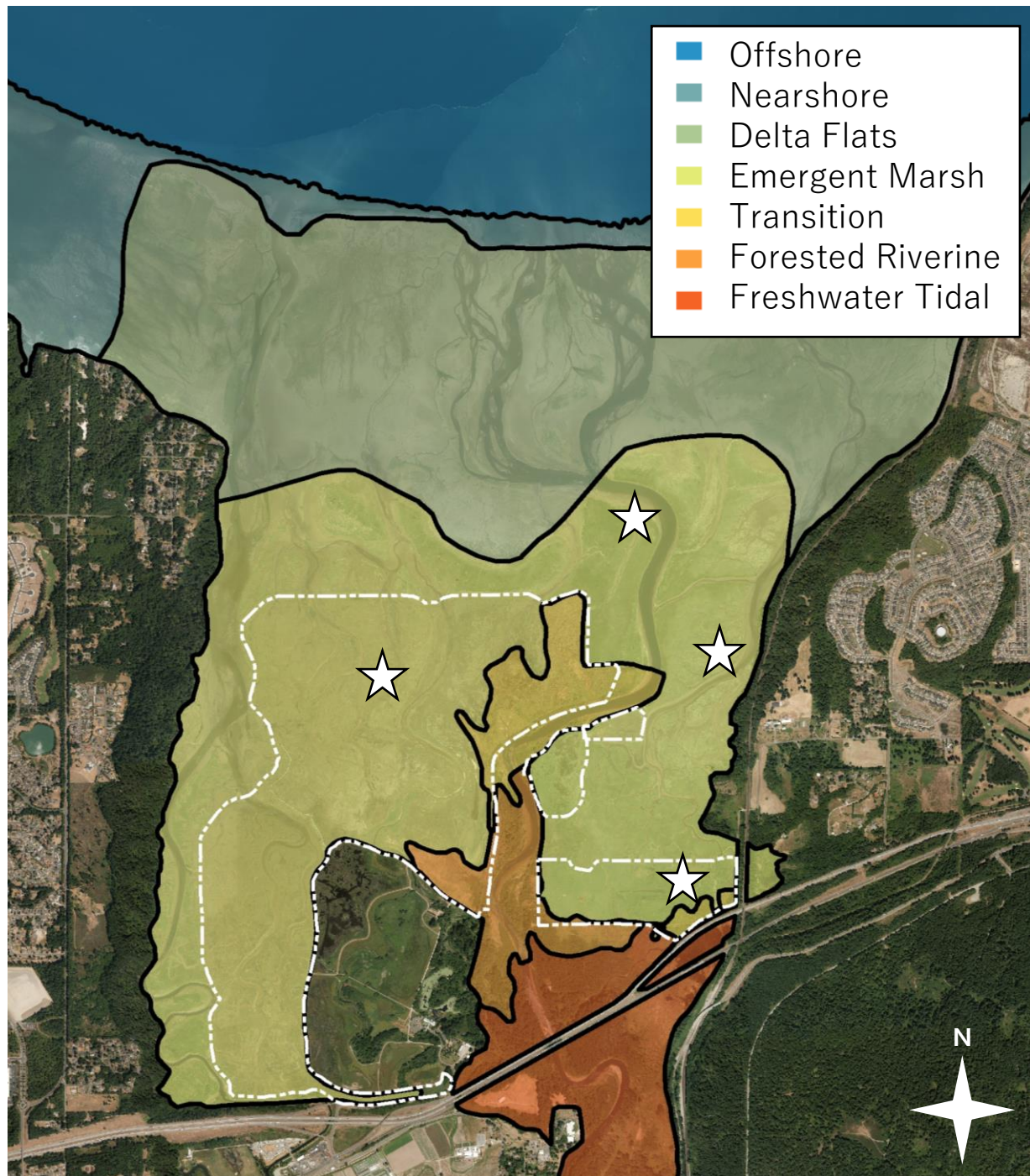


Weinstein et al. 2013: “Restoration planners should and must view restoration goals in the context of the full estuarine mosaic”











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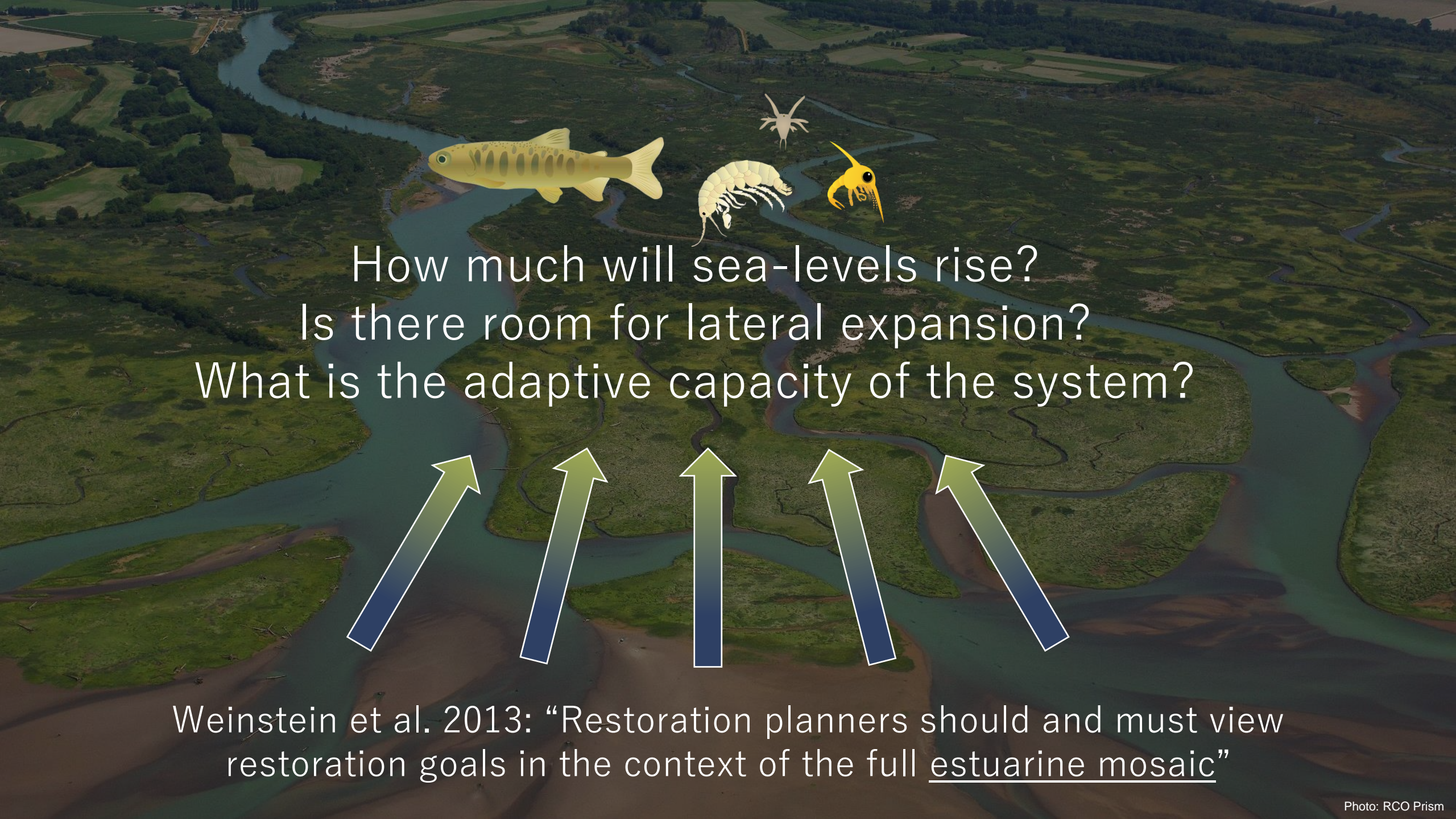
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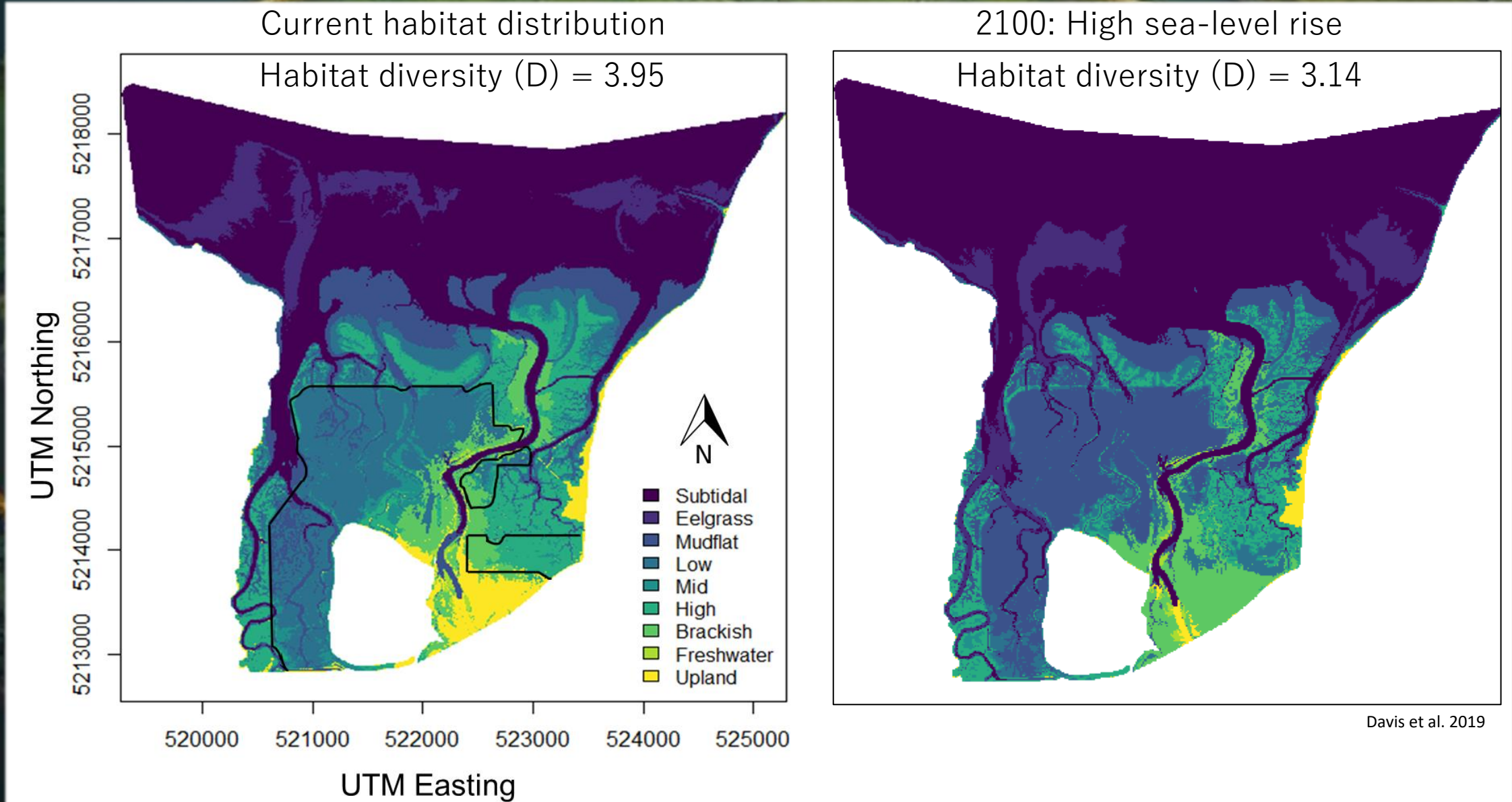
An aerial photograph of a river delta with a winding river and green marshland. Overlaid on the river are four illustrations: a yellow fish with dark spots, a white amphipod, a white insect, and a yellow shrimp. Below the text, five green arrows with blue outlines point upwards towards the river.

How much will sea-levels rise?  
Is there room for lateral expansion?  
What is the adaptive capacity of the system?

Weinstein et al. 2013: “Restoration planners should and must view restoration goals in the context of the full estuarine mosaic”

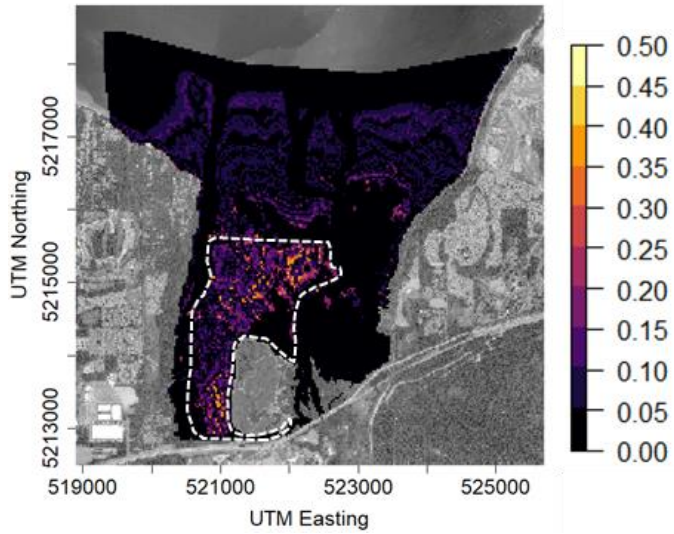


# MOSAICS: Marsh accretion model output

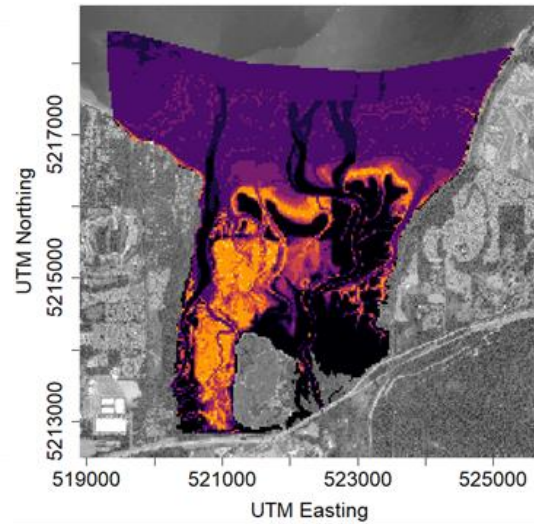




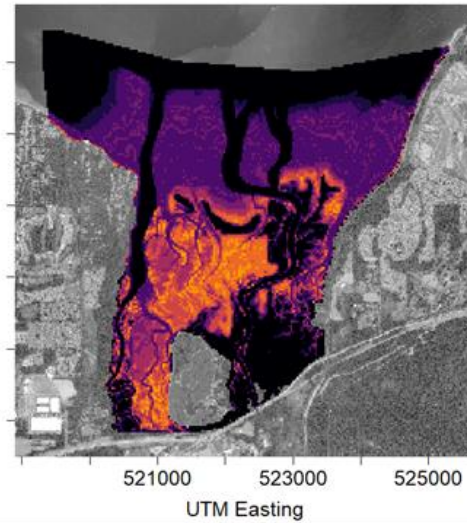
**Present Day**



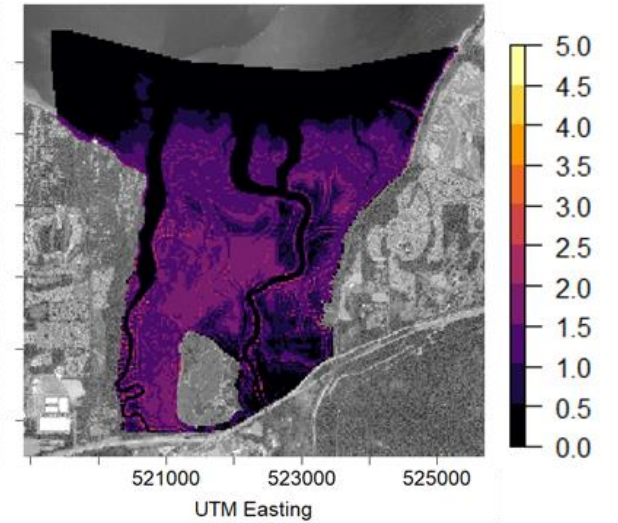
**+3°C**



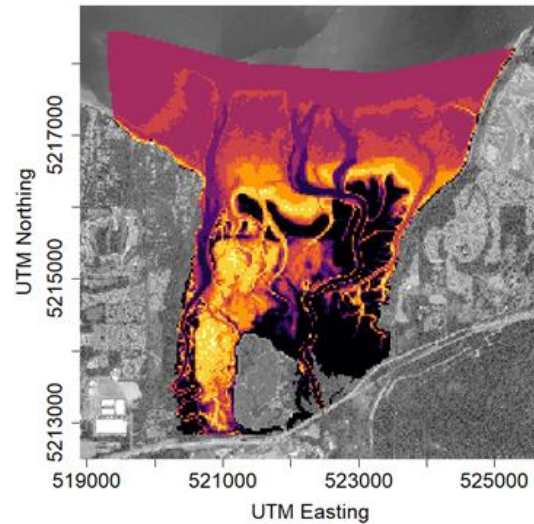
**+3°C, Moderate SLR**



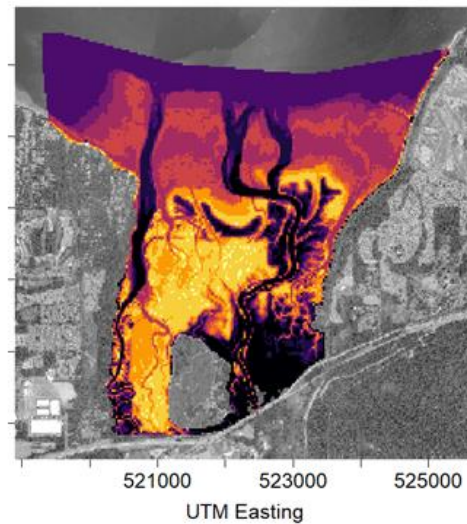
**+3°C, High SLR**



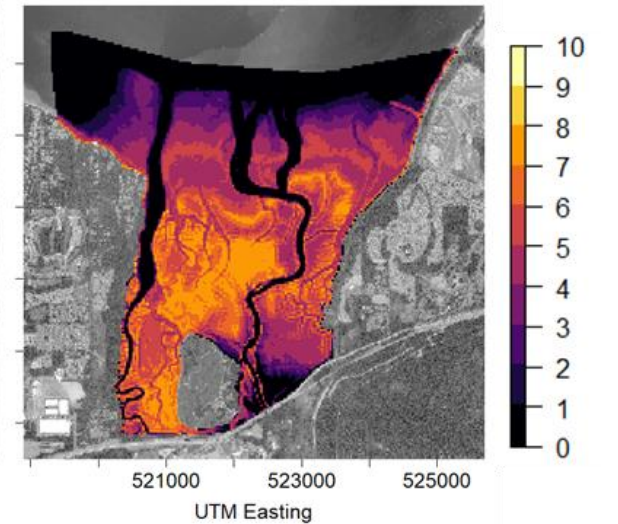
**+7°C**



**+7°C, Moderate SLR**



**+7°C, High SLR**





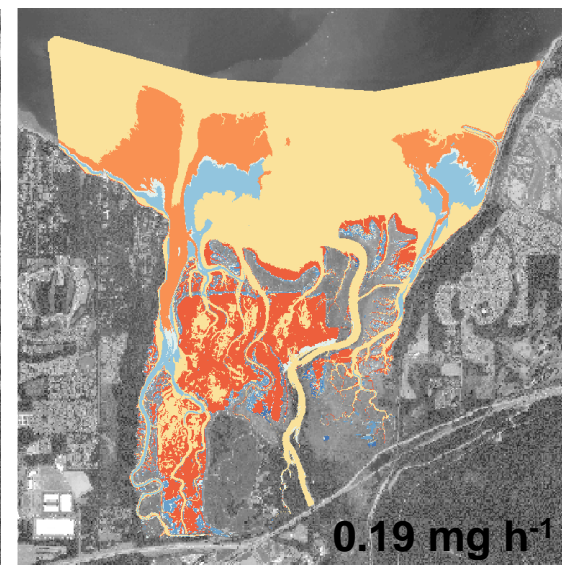
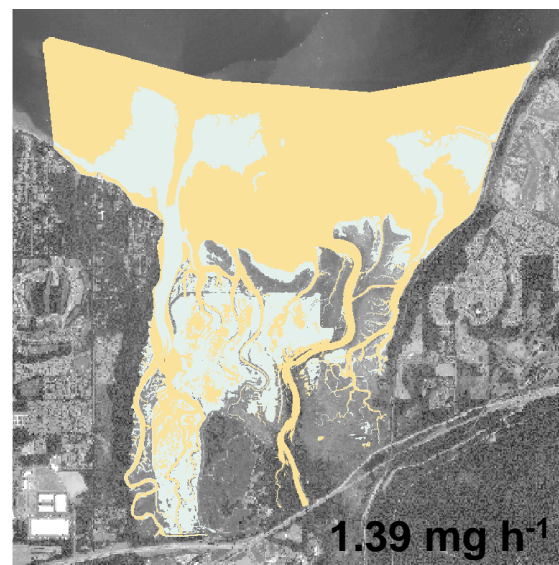
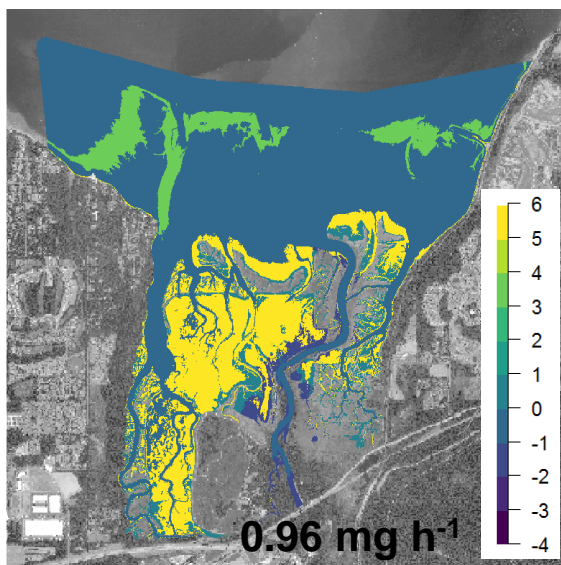
# Model output: May

Baseline

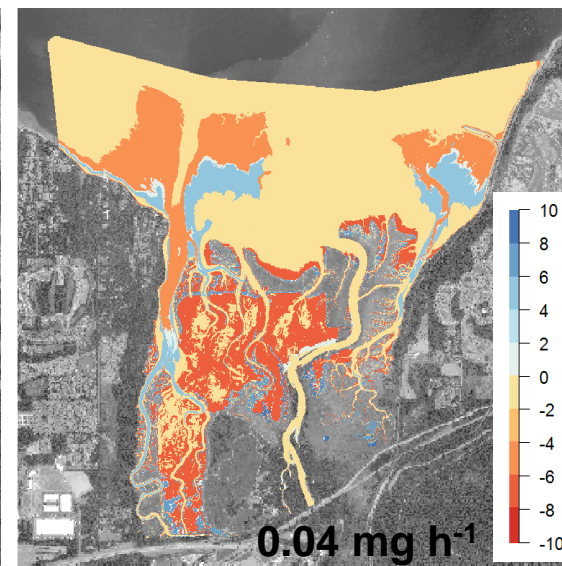
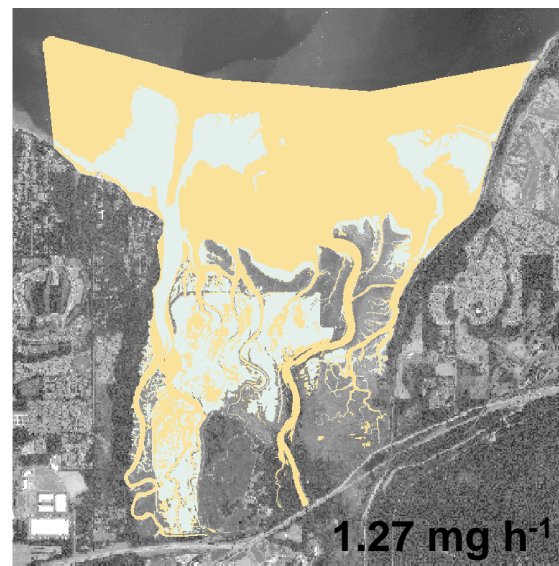
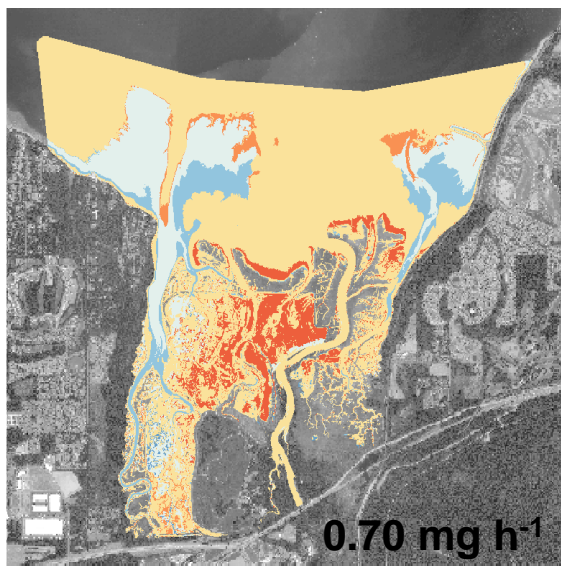
Present Day

Moderate SLR

High SLR



+5° C





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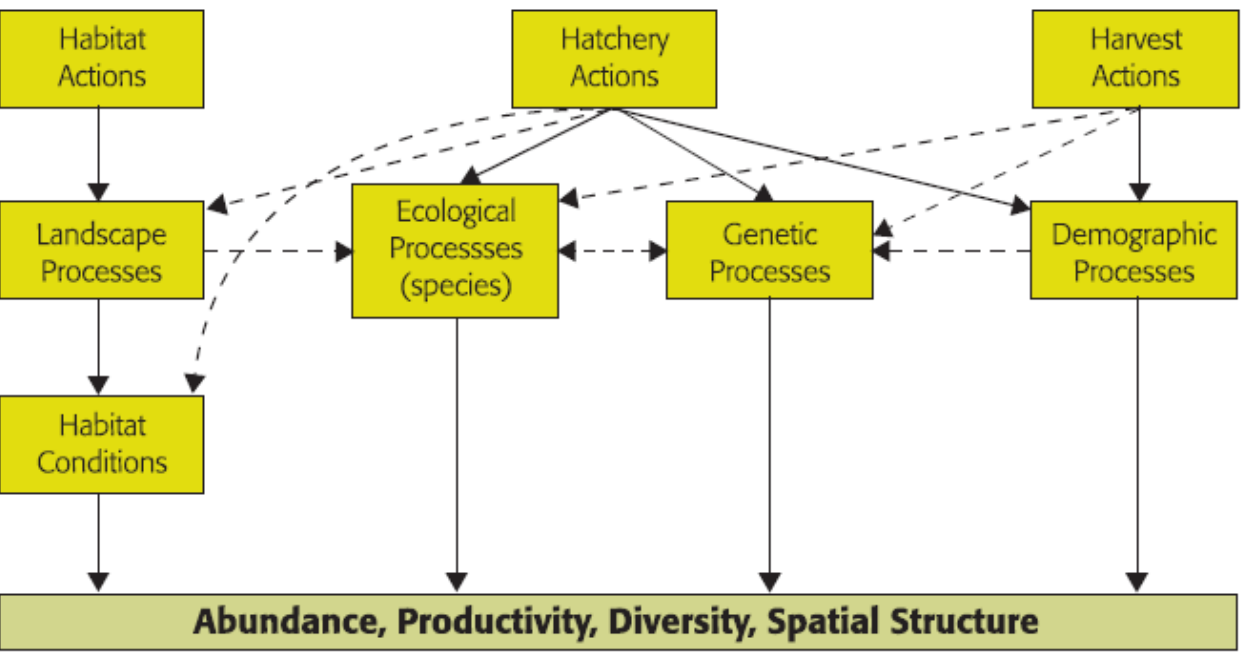
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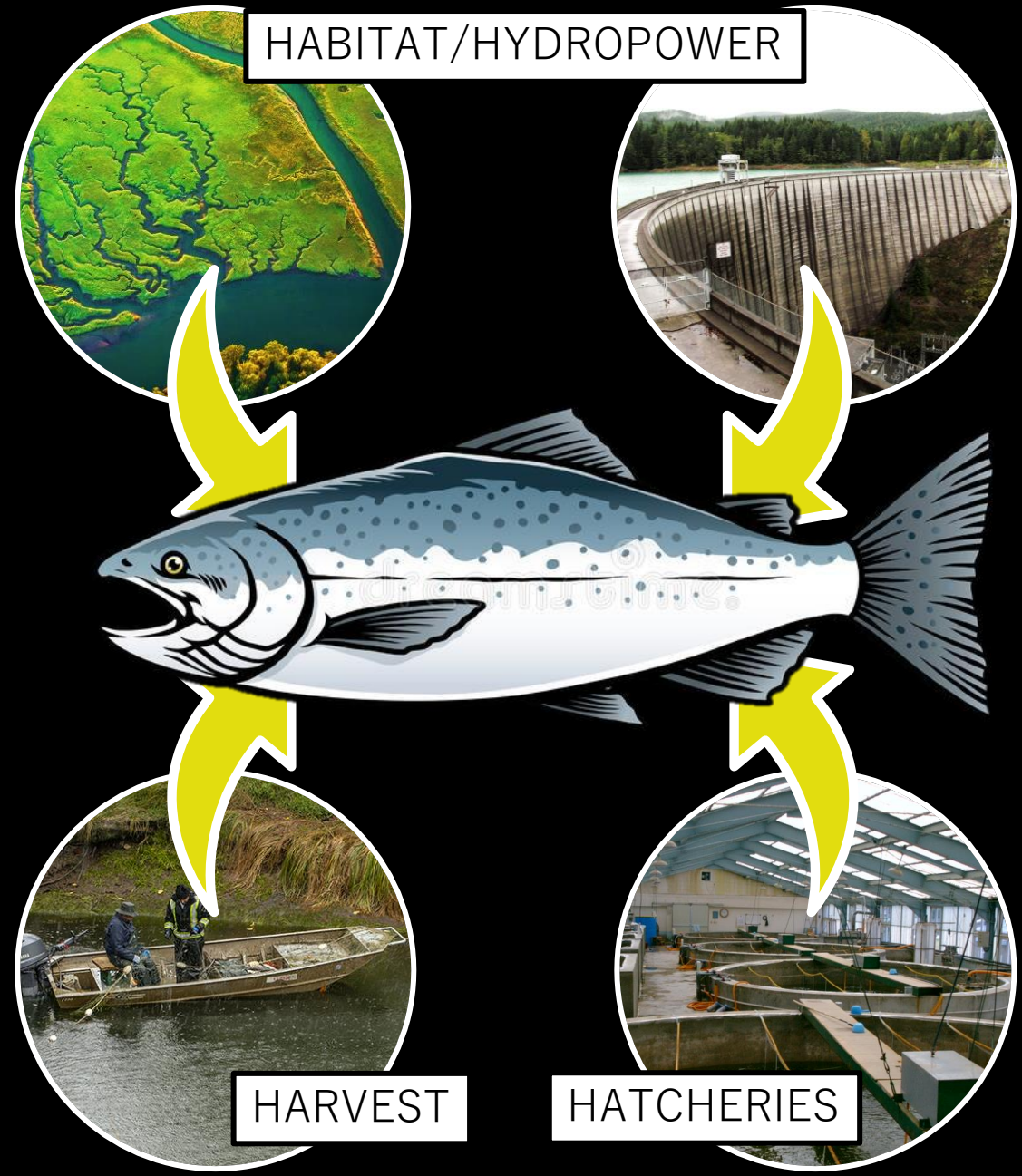
# The Importance of H-Integration

*“Considering the effects of one factor at a time (e.g. harvest, habitat, or hatchery management actions) on salmon population characteristics is more tractable from a technical standpoint, but such estimates of effects are sure to be wrong in most instances. **Managers [are asked] to consider suites of habitat, harvest, and hatchery actions together, especially with a view towards how these factors interact...**” – Puget Sound Technical Recovery Team (2003)*



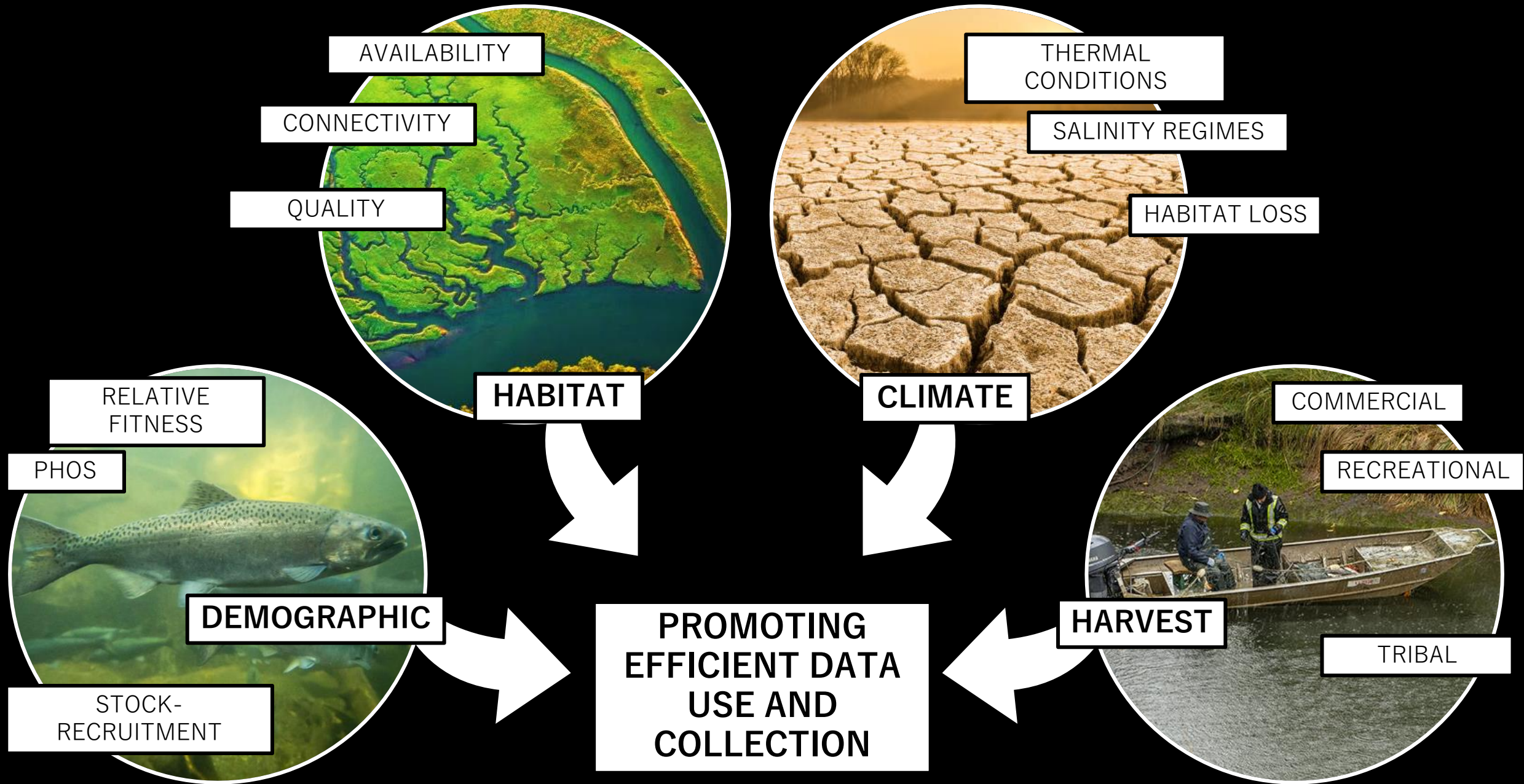
**Figure 6.8** Example of the interactions among habitat, hatchery, and harvest management actions and their potential effects on the VSP parameters of a population. (PSTRT, 2003) page 37

Shared Strategy for Puget Sound: Puget Sound Salmon Recovery Plan





# Application to Capital Restoration & Protection





# Questions?



Nisqually Indian Tribe



WASHINGTON STATE  
Recreation and  
Conservation Office



Photo: NW Treaty Tribes



Photo: Elizabeth Earl



Photo: Art Wolfe



Photo: Scott Thompson