

# Wetland Reference Sites in the Lower Columbia River and Estuary: Status, Trends, and Applications

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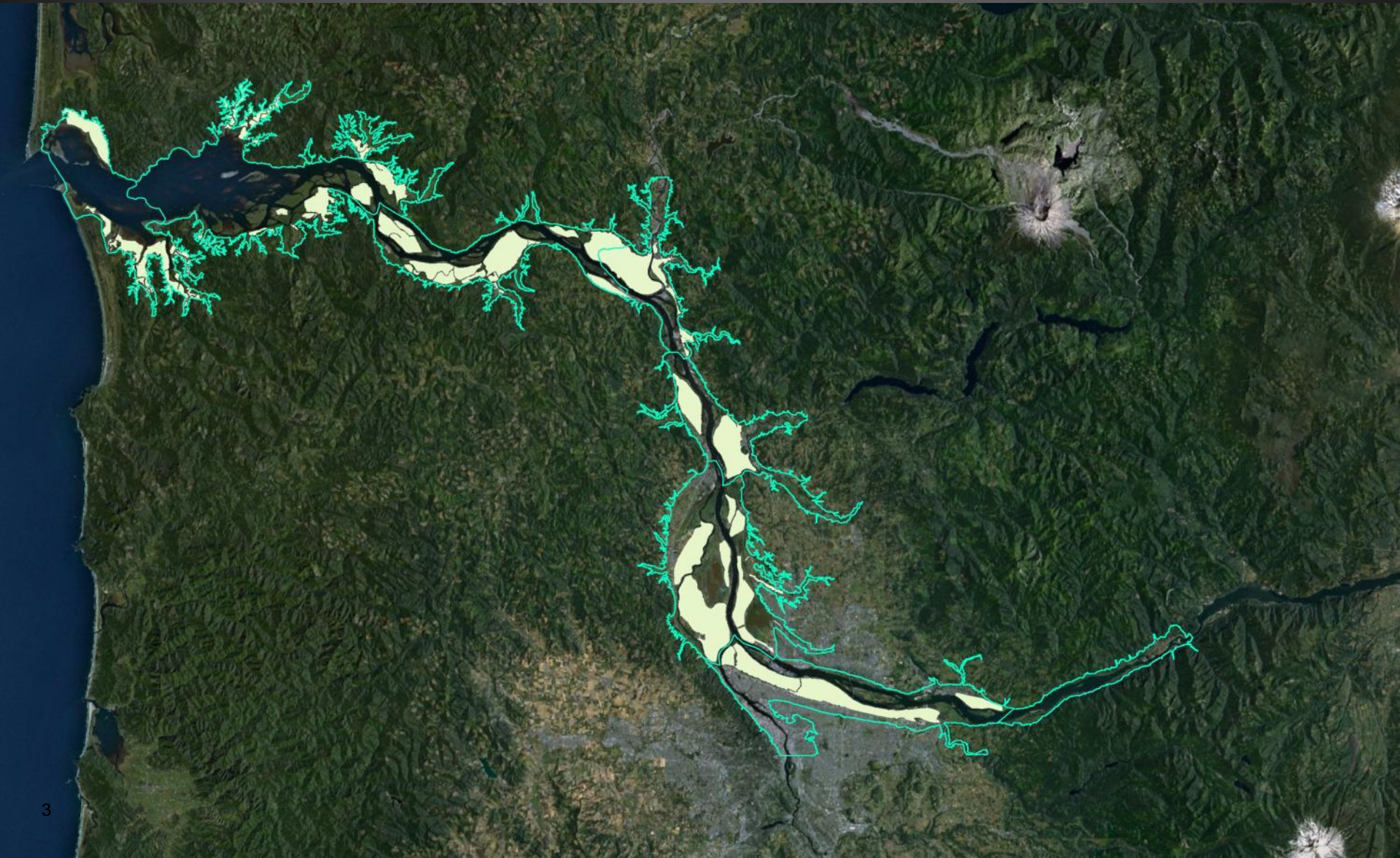
Columbia River Estuary Conference  
Astoria, Oregon  
May 16, 2012

# Overview

- ▶ Background
- ▶ Goals & Objectives
- ▶ Applications:
  - Status
  - Trends
  - Restoration Site Comparison
  - Informing Restoration Planning
  - Development of Predictive Model



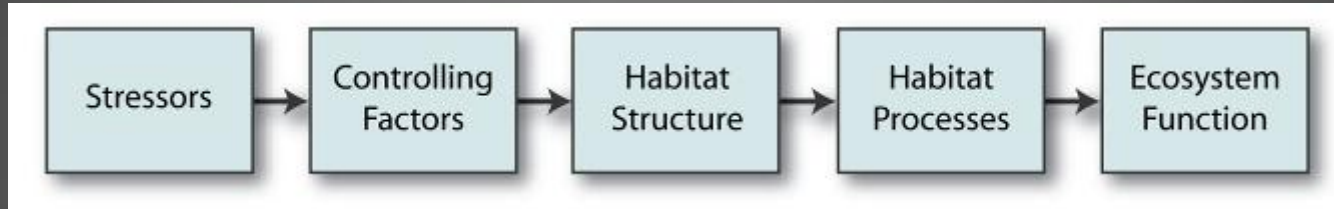
# Study Area



# Purpose of Research

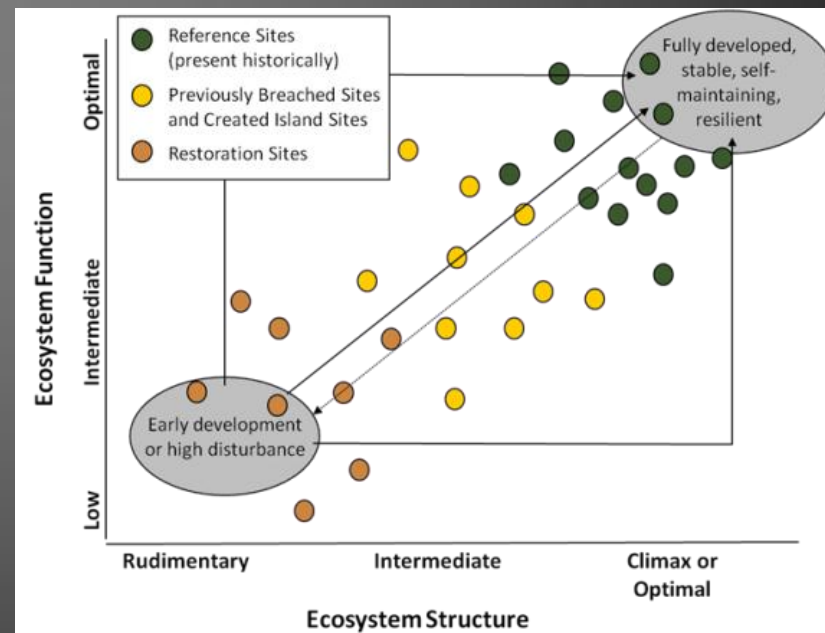
## ► Goal

- To better understand the habitat structure that provides ecosystem functions and to improve restoration effectiveness by evaluating reference conditions.



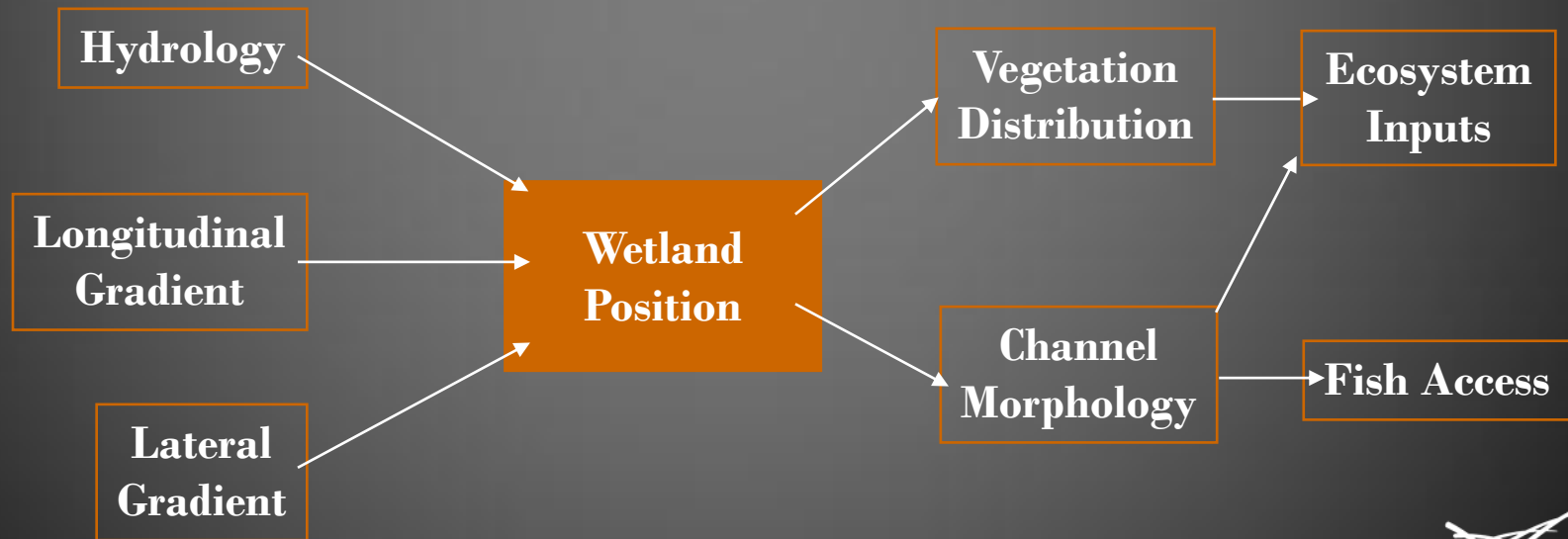
## ► Objectives

- Evaluate status and trends of the estuary wetland ecosystems
- Provide a means of evaluating restoration actions
- Inform restoration design

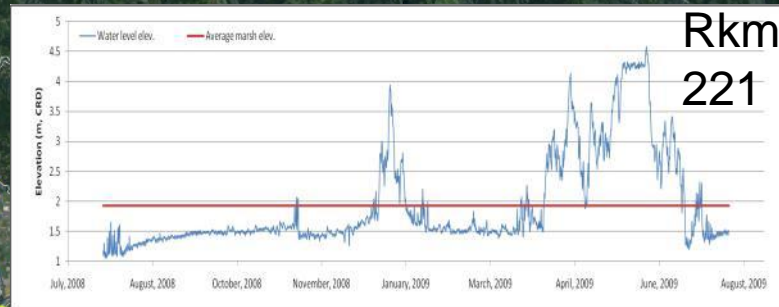
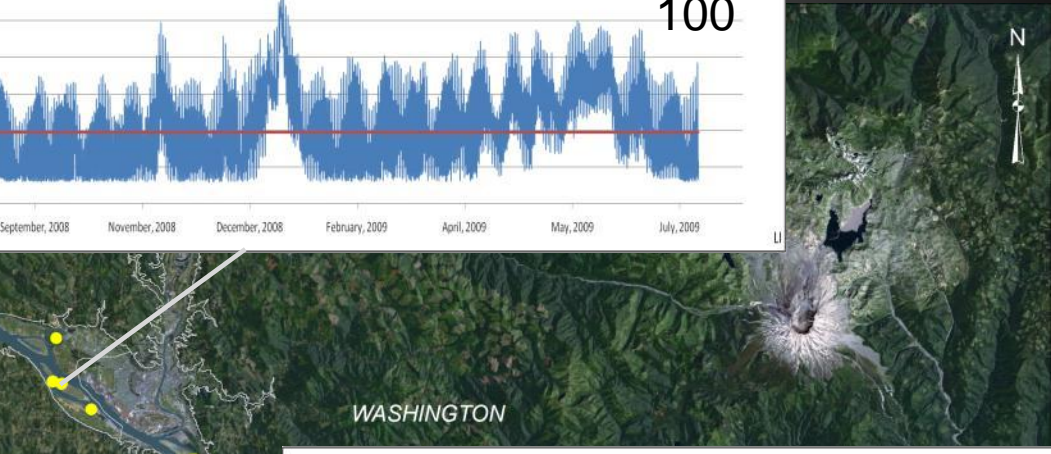
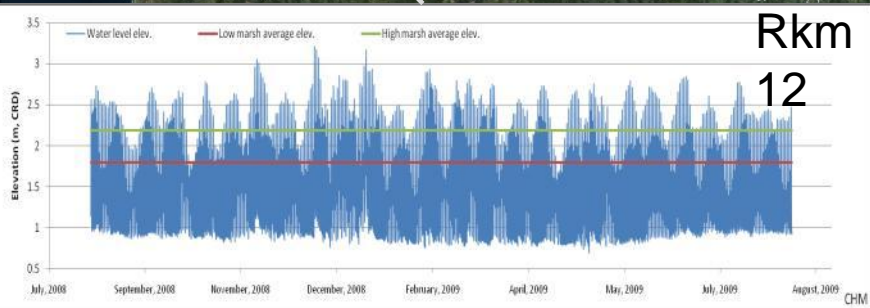
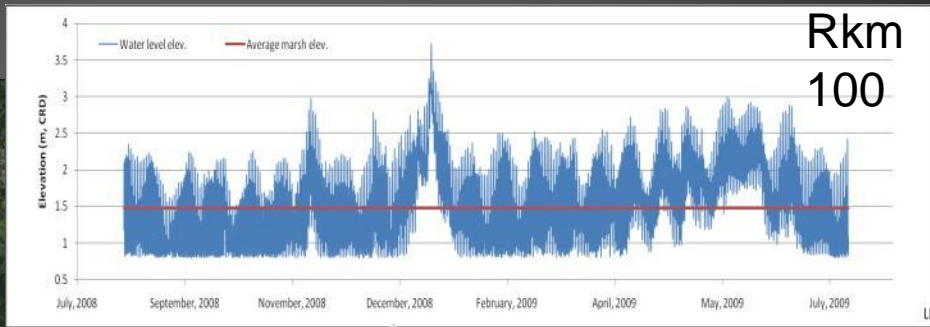


# Conceptual Model

- What are the bounds of the controlling factors?
- Are there differences in the controlling factors and the ecosystem structures due to:
  - Location (distance from the mouth or the main channel)
  - Wetland type
  - Inter-annual variability



# Study Sites



- ▶ Tidal influence
- ▶ River flows
- ▶ Power peaking
- ▶ Seasonal variability
- ▶ Inter-annual variability

0 3 6 12 18 24 Kilometers

# Wetland Types



Brackish Marsh



Tidal Freshwater Marsh



Sitka Spruce Swamp



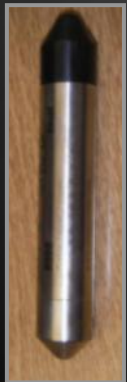
Scrub Shrub Wetland



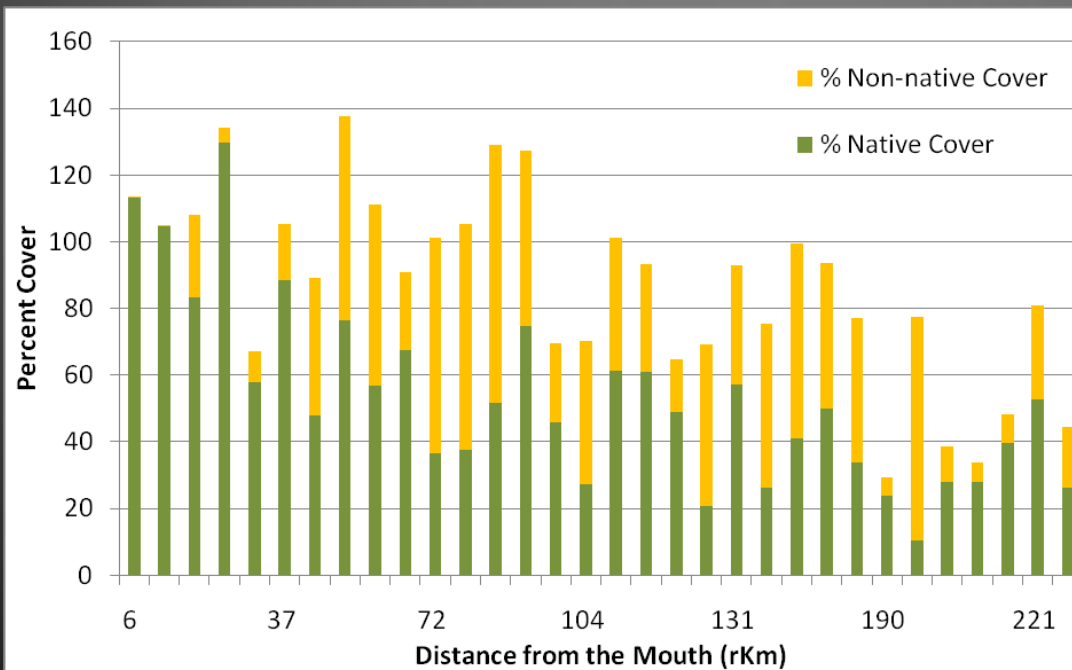
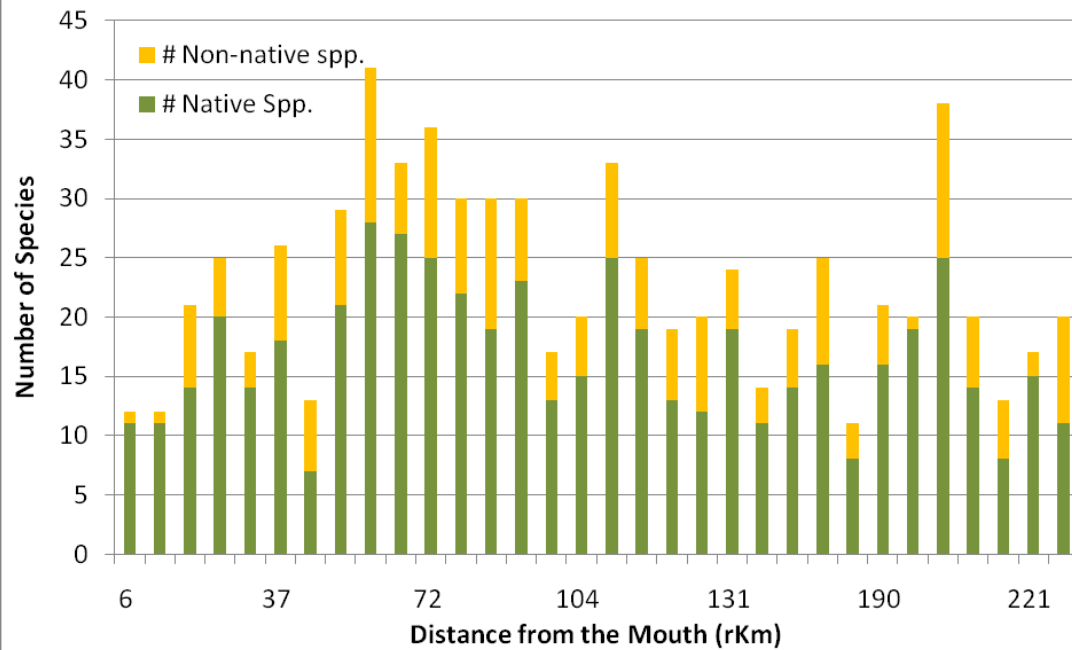
Riparian Forested Wetland

# Metrics

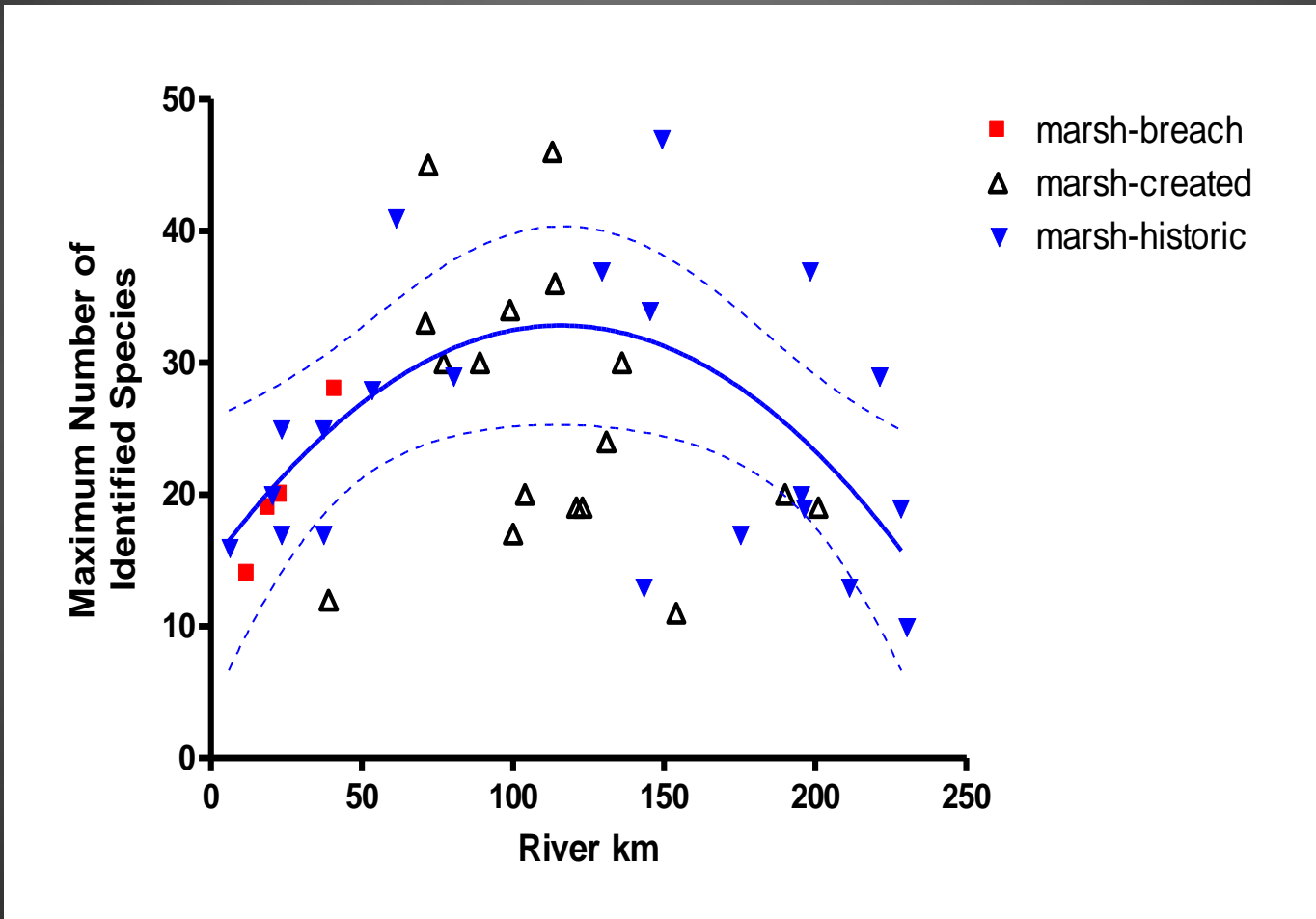
- ▶ Vegetation percent cover surveys
- ▶ Vegetation community mapping
- ▶ Elevation collected with Real Time Kinematic (RTK) GPS, with auto level for areas of high tree cover
- ▶ Referenced to NAVD88
- ▶ Water level sensors were surveyed to evaluate hydrology relative to wetland morphology



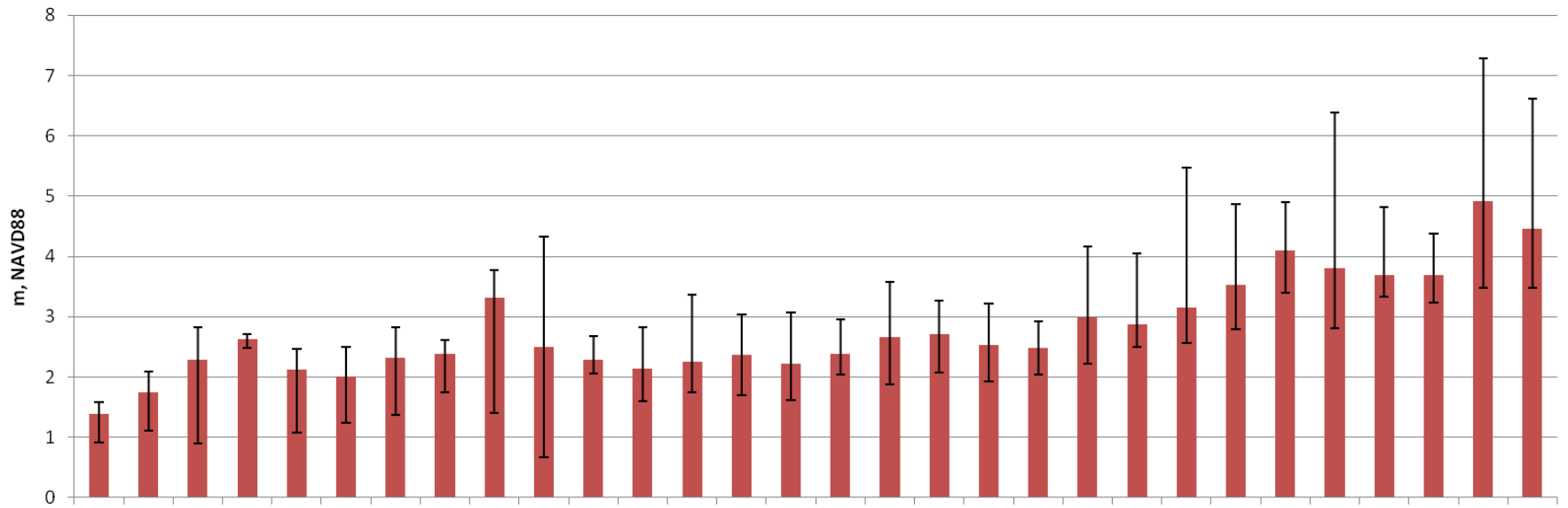




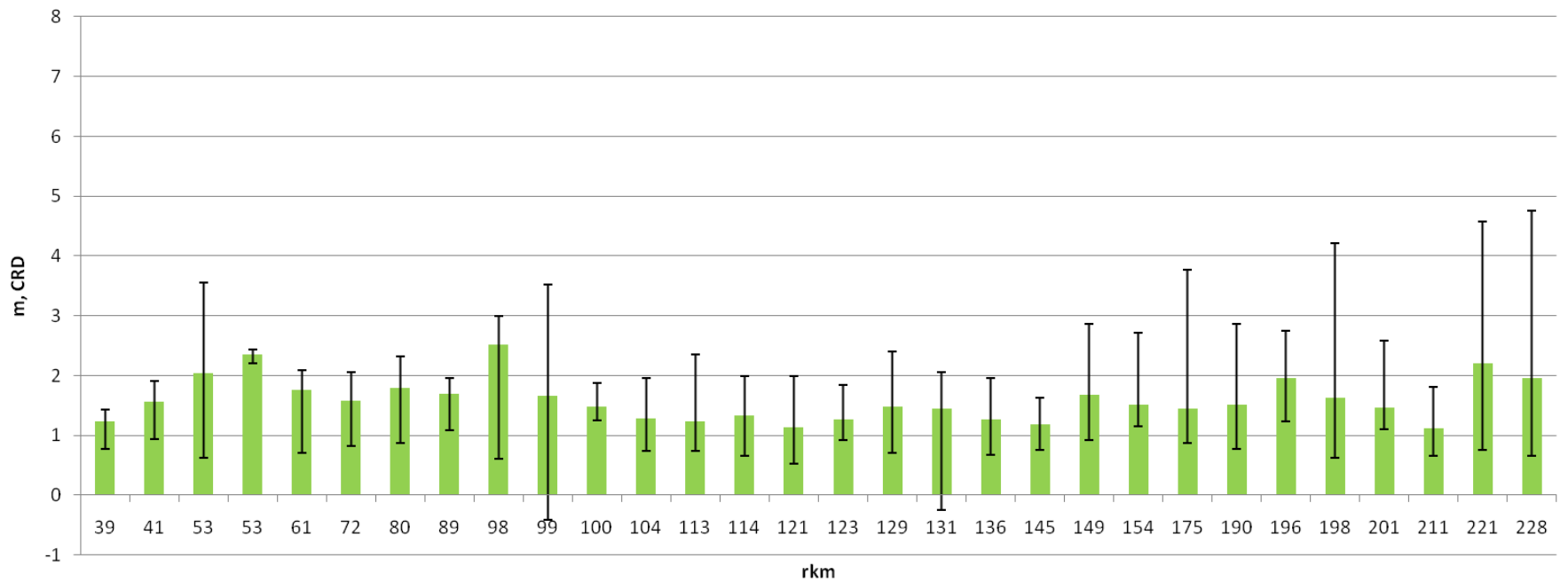
# Species Diversity



### Avg site elevation (m, NAVD88)



### Avg site elevation (m, CRD)



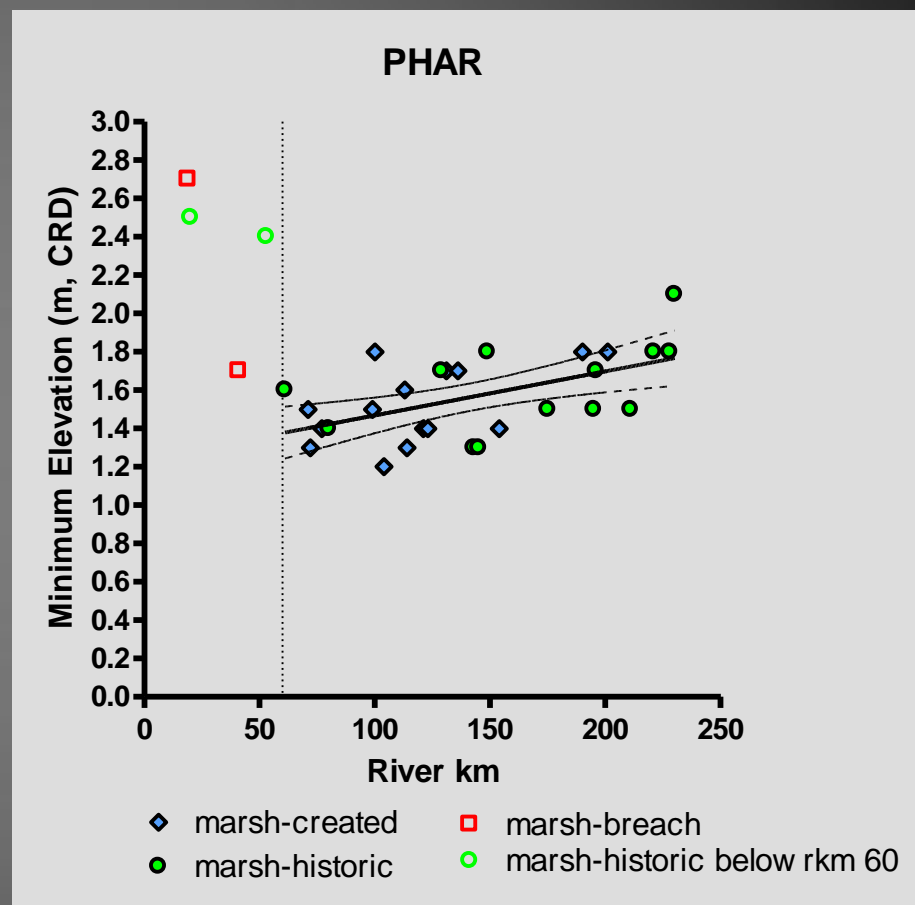
# Elevation

▶ Average minimum elevation where PHAR was the maximum cover species ranged from 1.4 to 1.7 m, CRD with 95% CI of 1.2 to 1.8 CRD

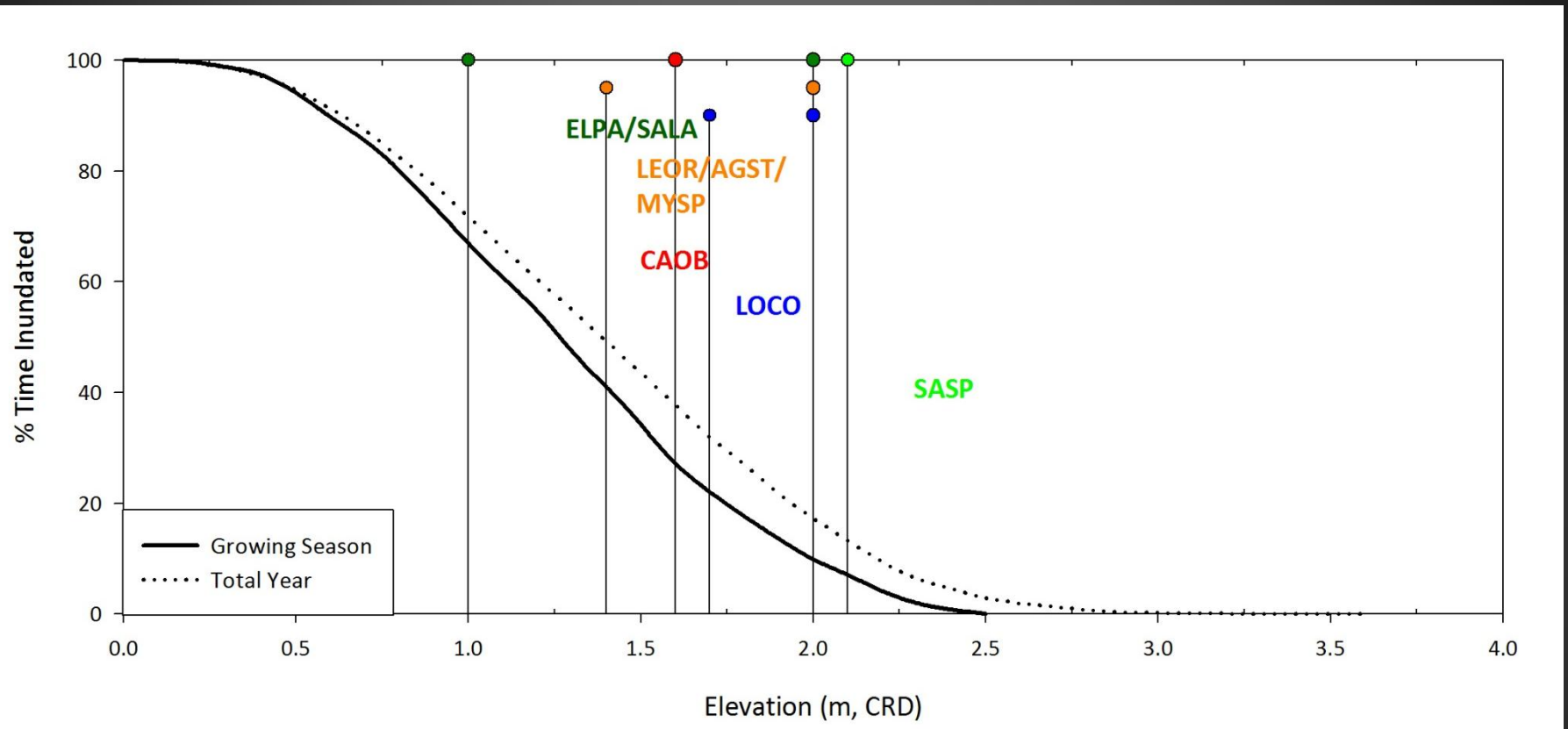
▶ Below 1.5 m, CRD

- *Eleocharis*
- *Sagittaria*

were the species most often observed with maximum cover



# Inundation



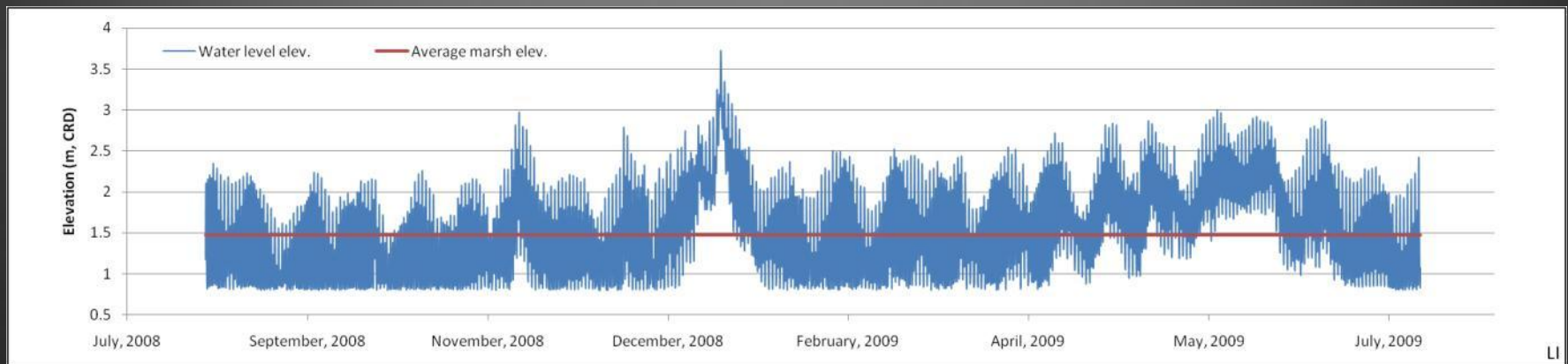
Borde, AB, SA Zimmerman, RM Kaufmann, HL Diefenderfer, NK Sather, and RM Thom. 2011. *Lower Columbia River and Estuary Restoration Reference Site Study: 2010 Final Report and Site Summaries*. PNWD-4262.

# Inundation

## Sum Exceedance Value

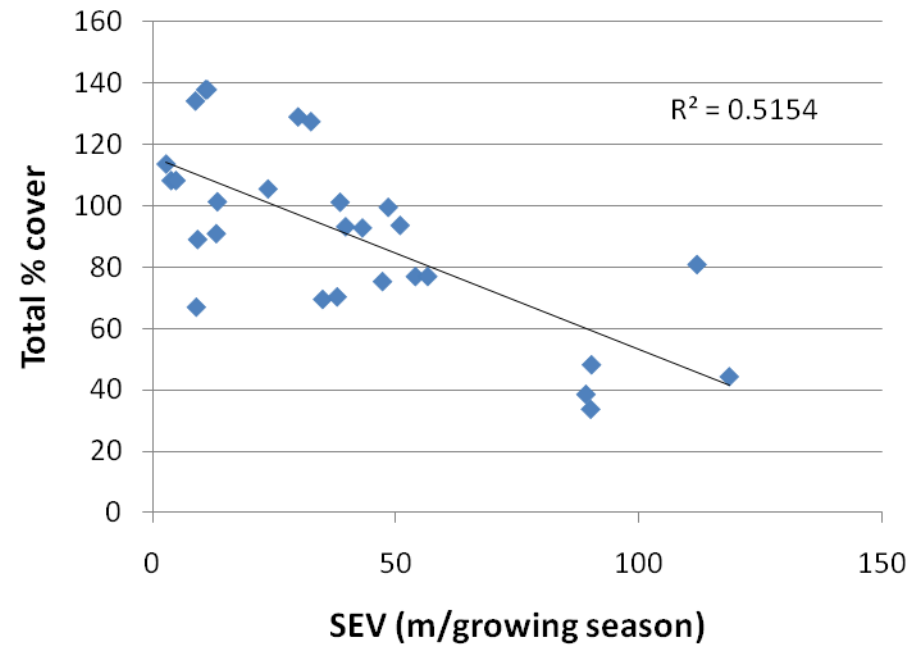
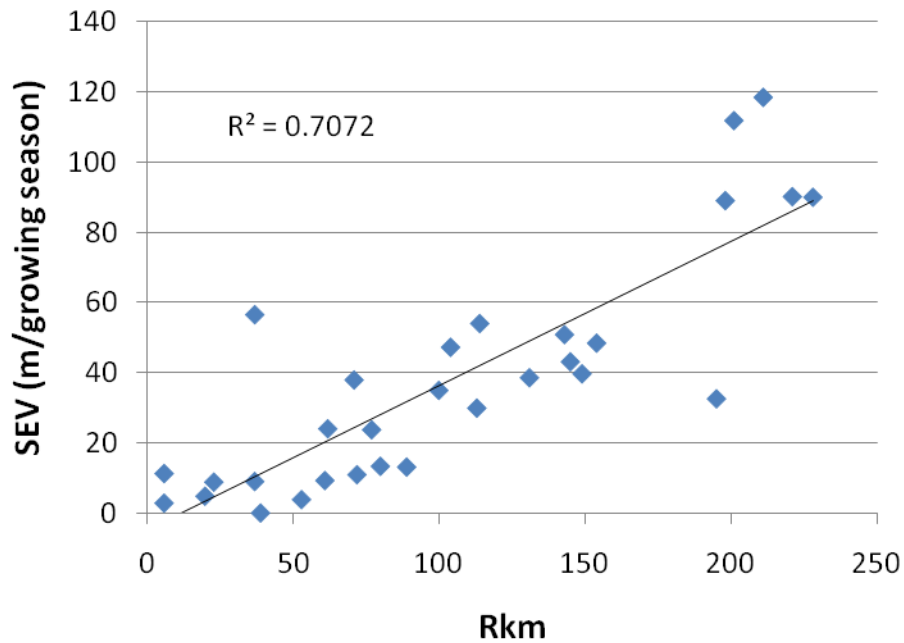
$$SEV = \sum_{i=1}^n (d_{\text{elev}})$$

$d$  = daily water elevation  
above a marsh elevation



Gowing, D.J.G, EG Youngs, .I.C. Gilbert and G. Spoor (1998), Predicting the effect of change in water regime on plant communities. In H. Wheater and C. Kirby (Eds) *Hydrology in a Changing Environment, Vol 1*, Wiley, 473-484.

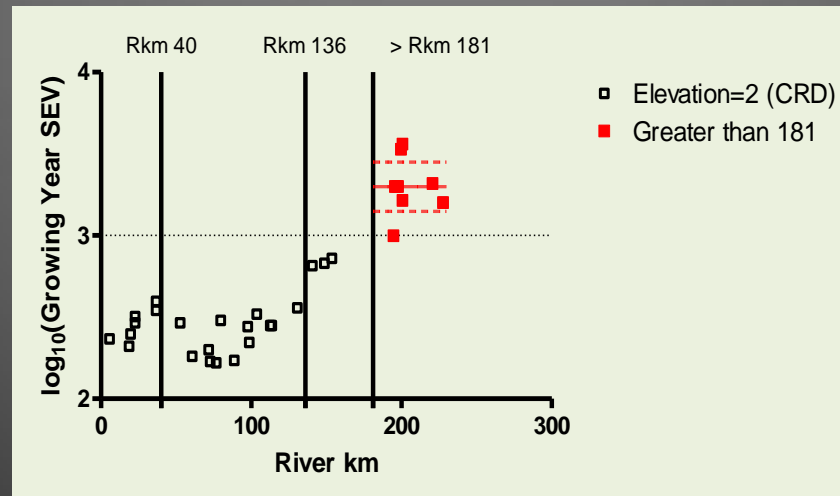
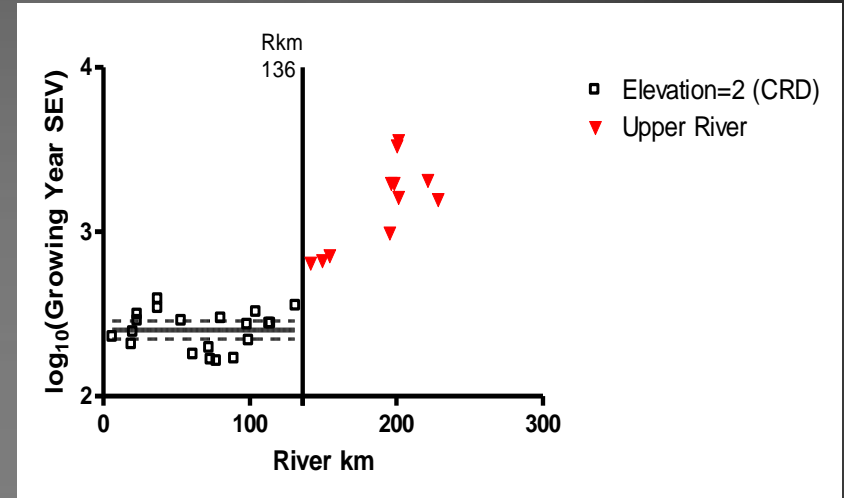
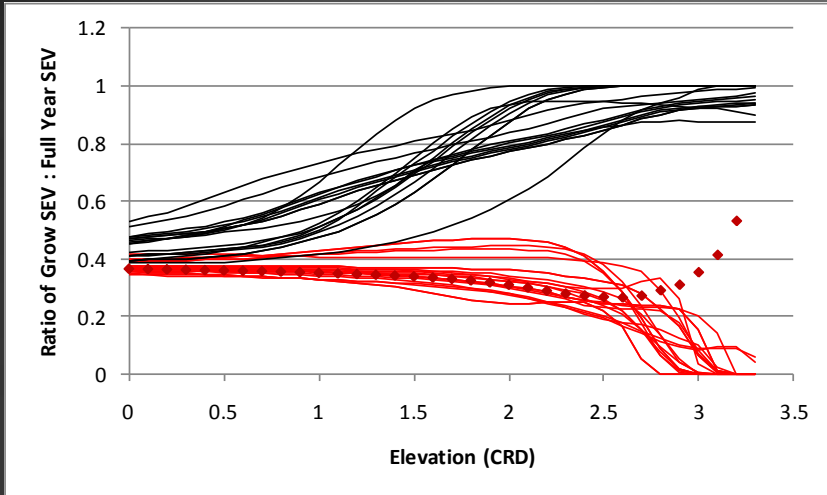
# Inundation



Inundation increases with Rkm

Total vegetated cover decreases with increasing inundation

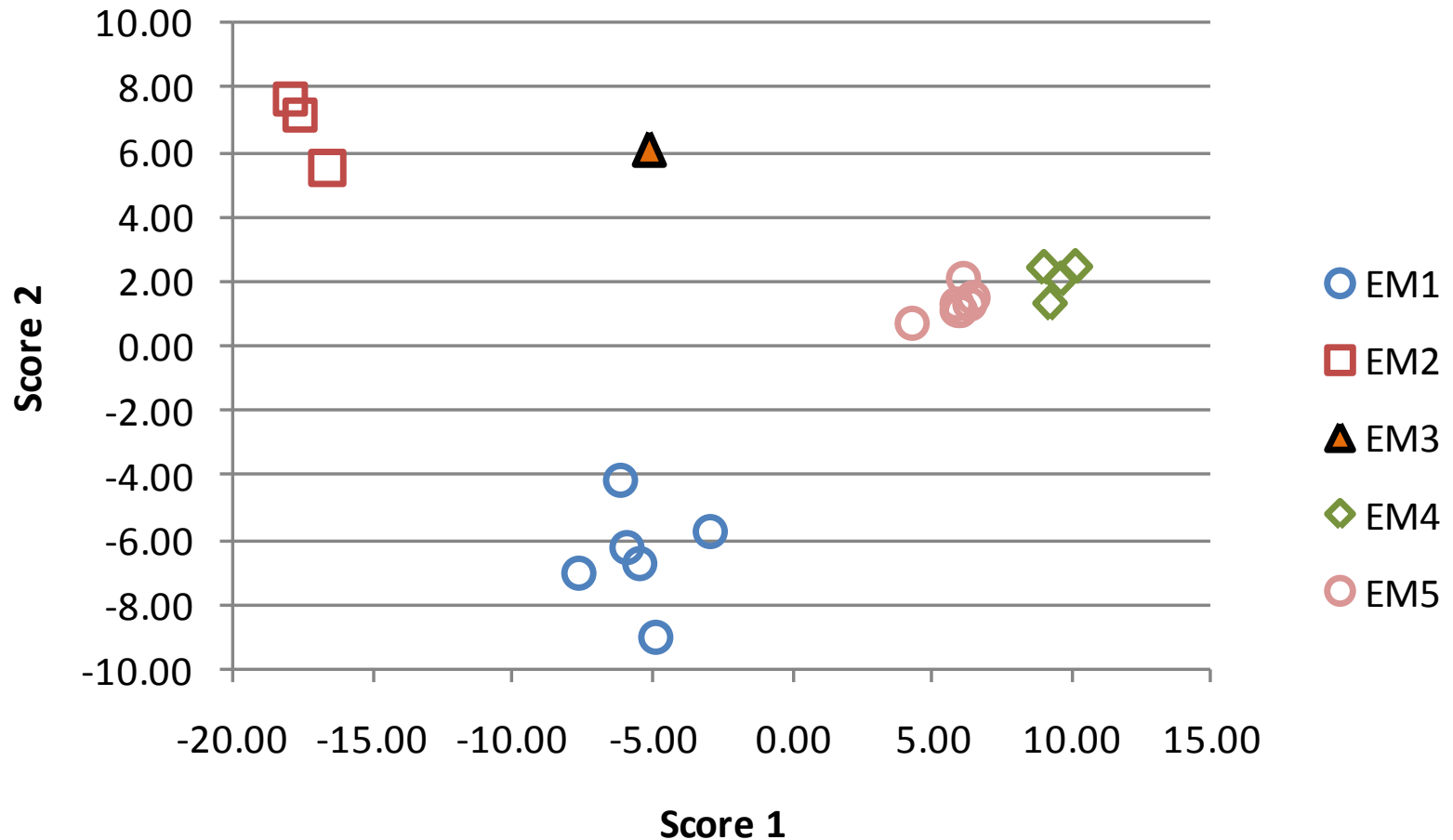
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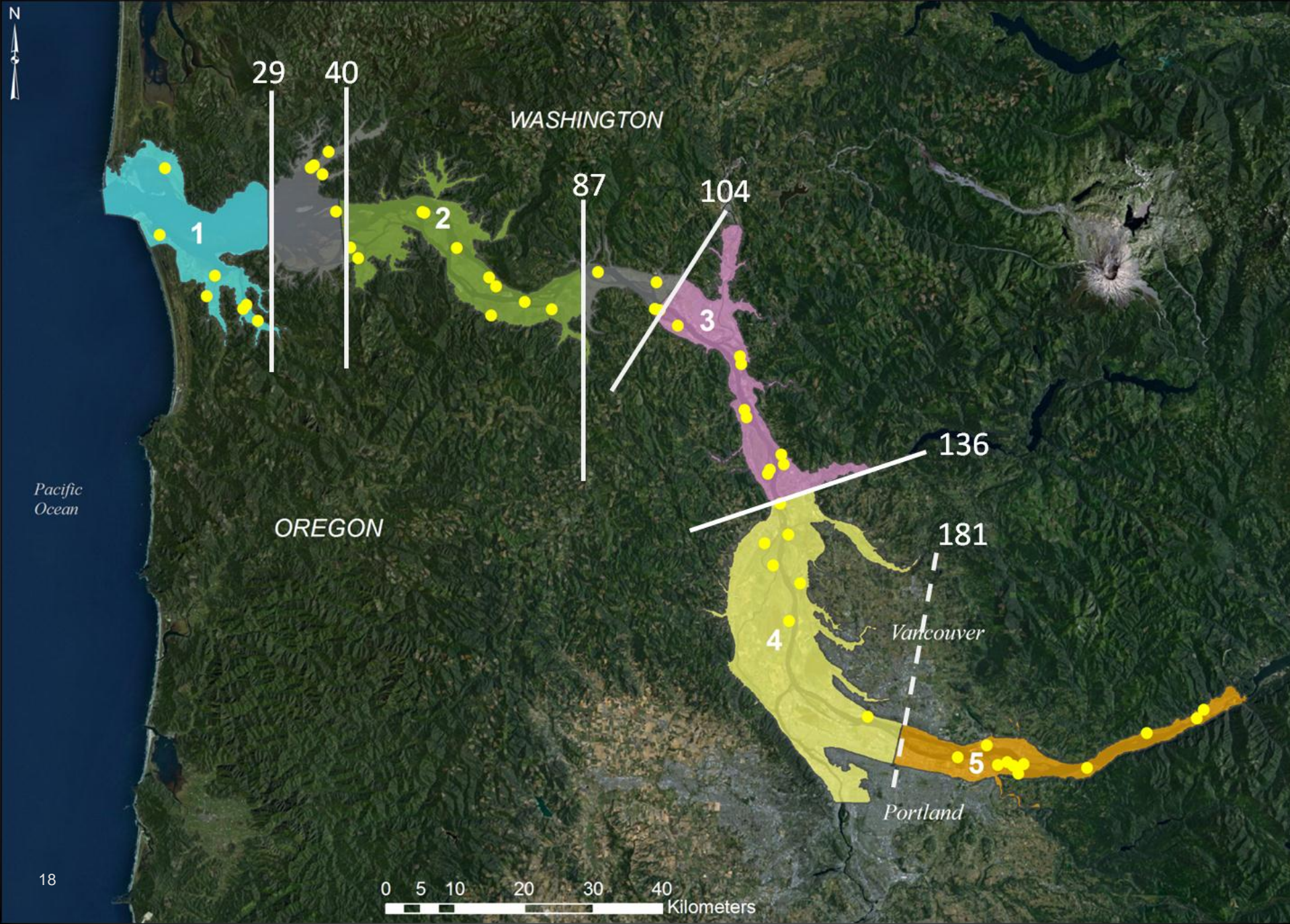




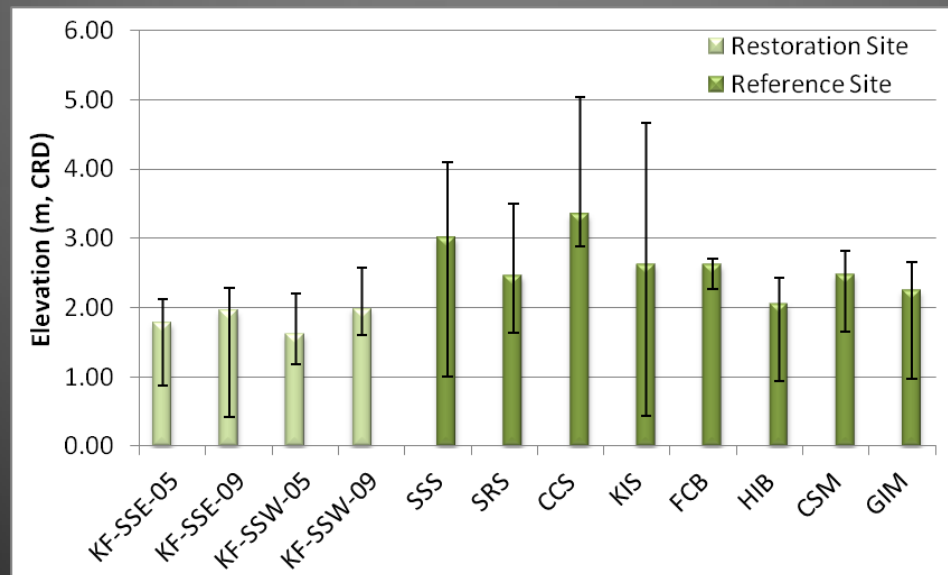
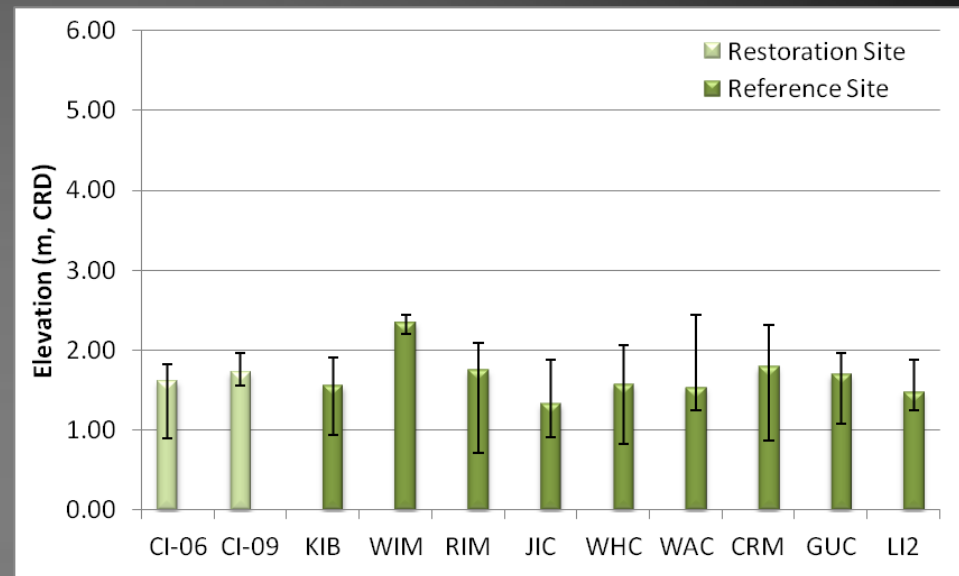
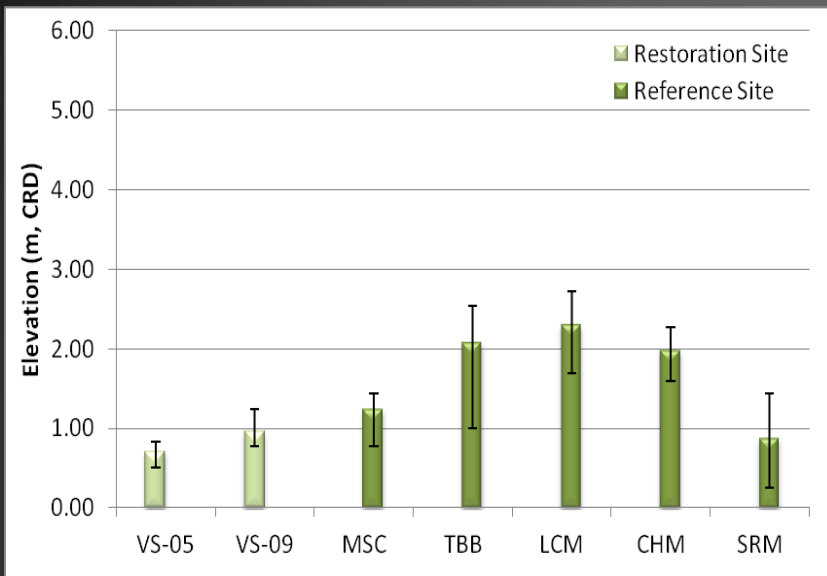
# Vegetation Distribution

- ▶ Analysis based on 20 historic marsh sites
- ▶ 13 vegetation species (out of 220)
- ▶ Discriminant Function Analysis

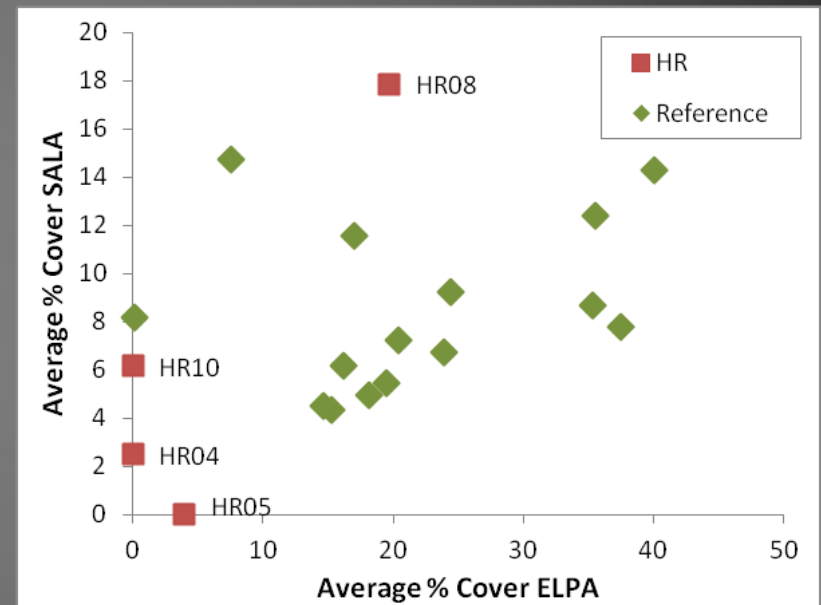
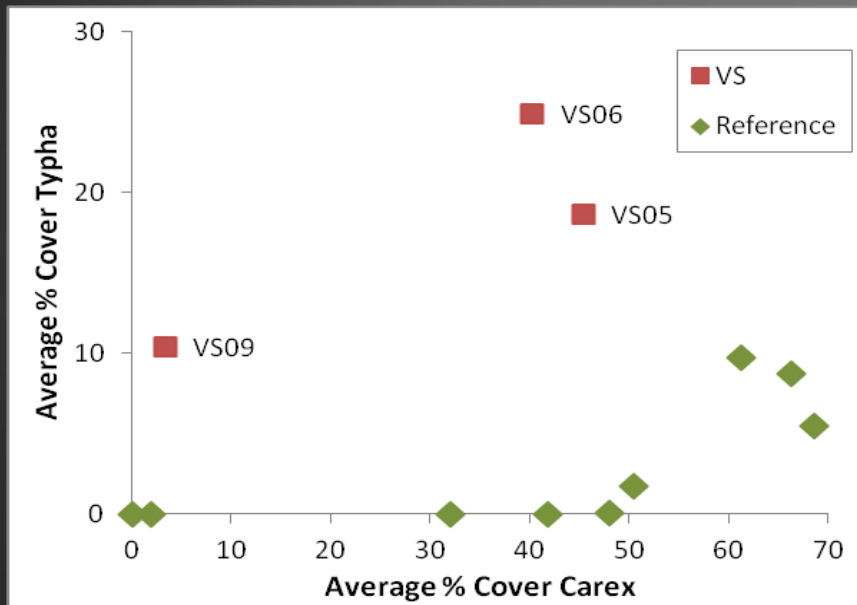




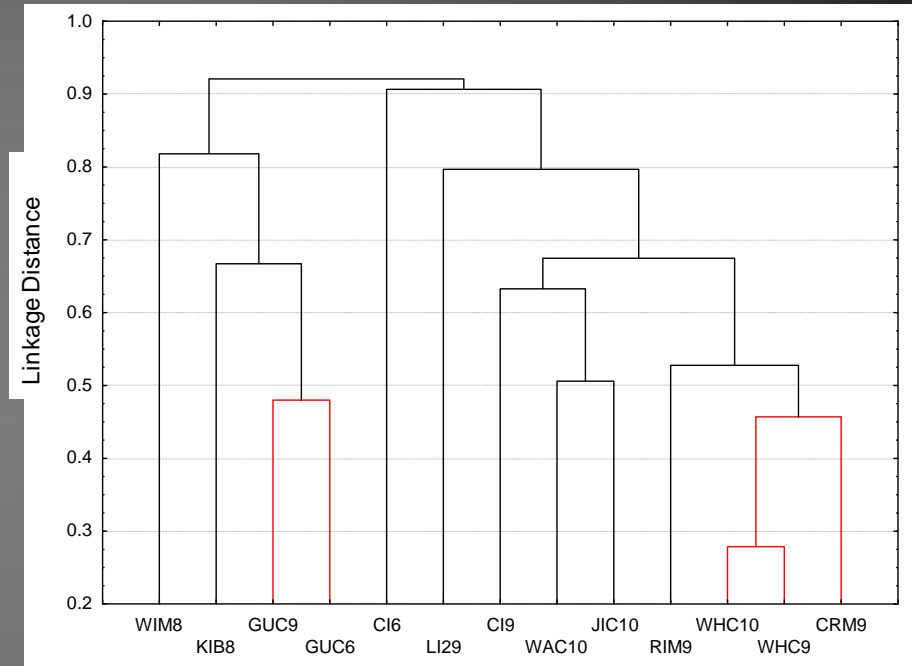
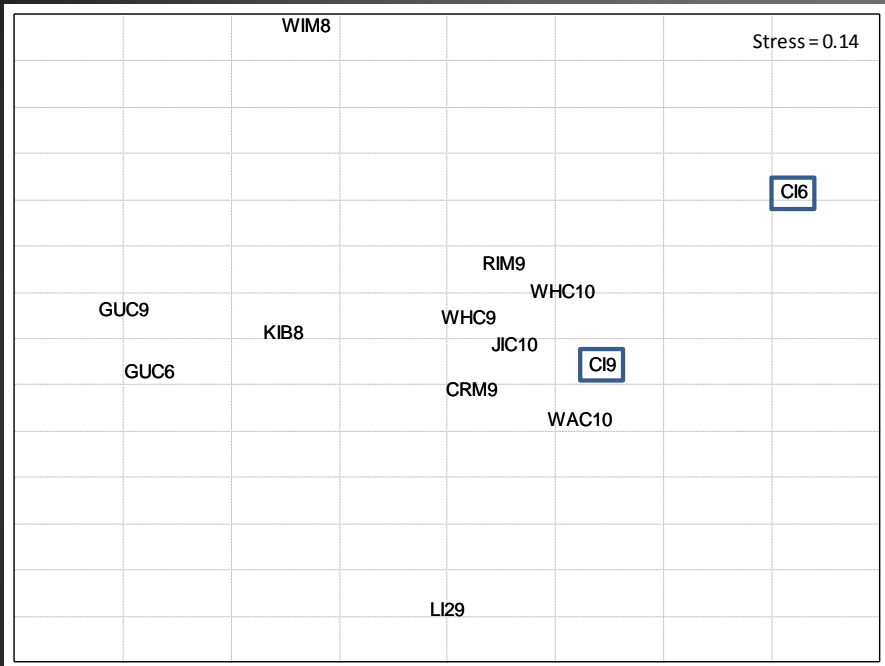
# Restoration Site Comparison



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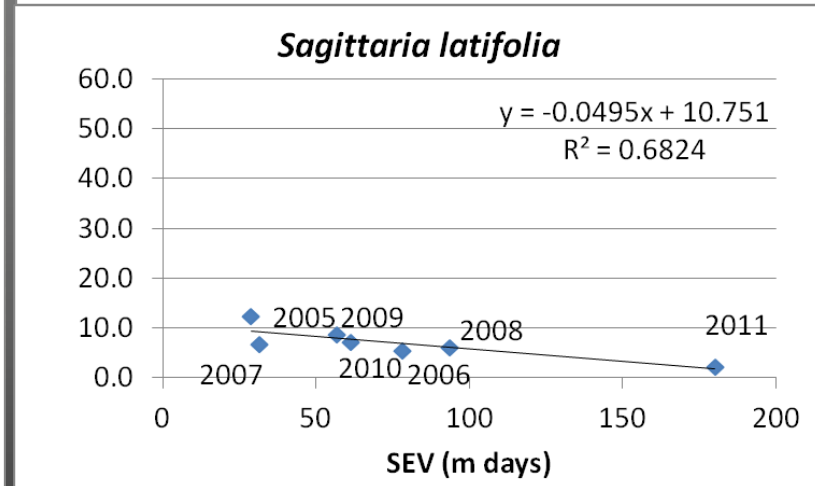
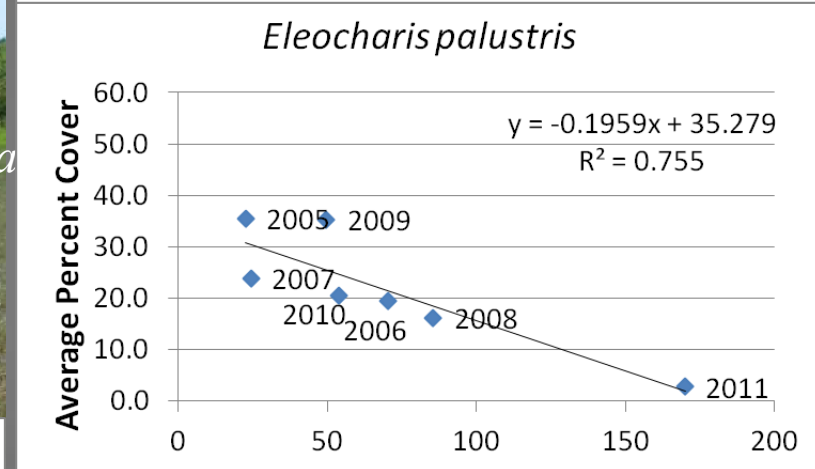
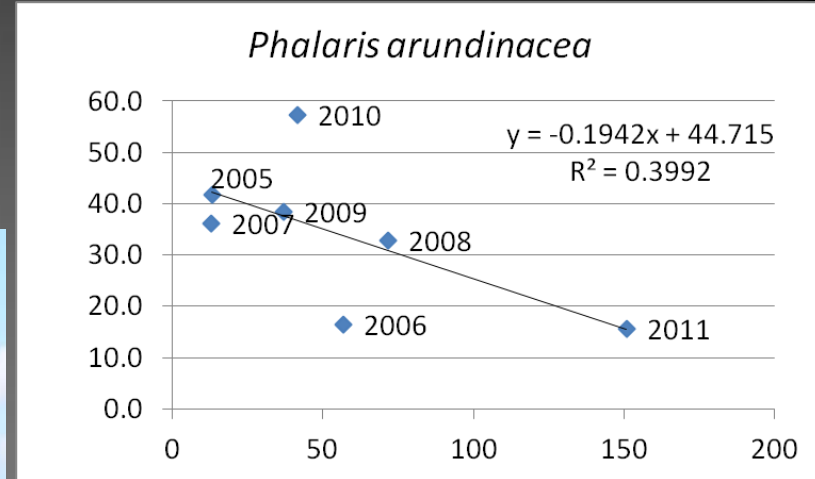
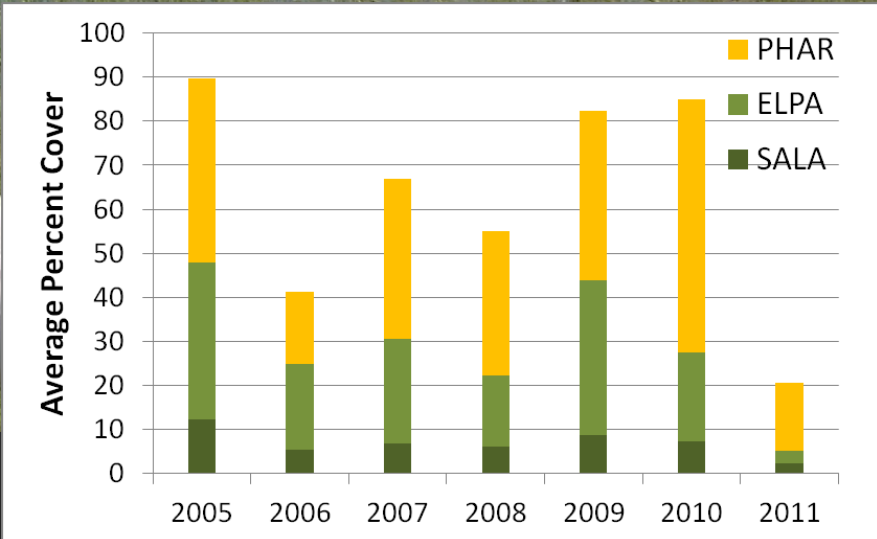


# Restoration Site Comparison



# Temporal Variability

Dominant species don't change



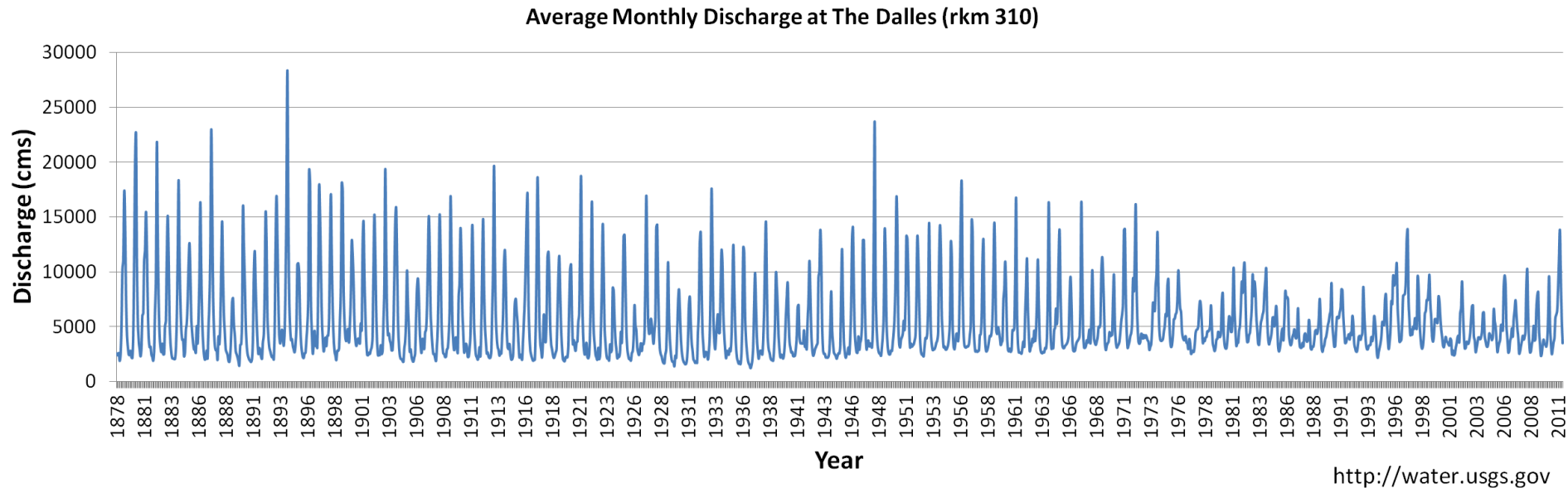
# Conclusions

- ▶ Elevations of emergent wetlands cover a very narrow elevation range within the estuary
- ▶ Inundation patterns vary throughout the estuary
- ▶ Cover and biomass changes in response to inundation
- ▶ Currently, vegetation in reference wetlands is stable and resilient to some variation in water level
- ▶ Response to climate variability is uncertain.



# Next Steps

- ▶ Examine how inundation patterns have changed in the past 130 years



- ▶ Evaluate climate change effects on inundation patterns and vegetation
- ▶ Calculate ranges of SEVs for individual species
- ▶ Historical analysis of site change to inform future restoration planning



# Acknowledgements

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