# Wetland Inundation Patterns and Vegetation Communities in the Lower Columbia River and Estuary

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# Overview

- Background
- Conceptual Model
- Vegetation Patterns
- Inundation Patterns
  - Temporal variability
  - Spatial variability
- Why it matters

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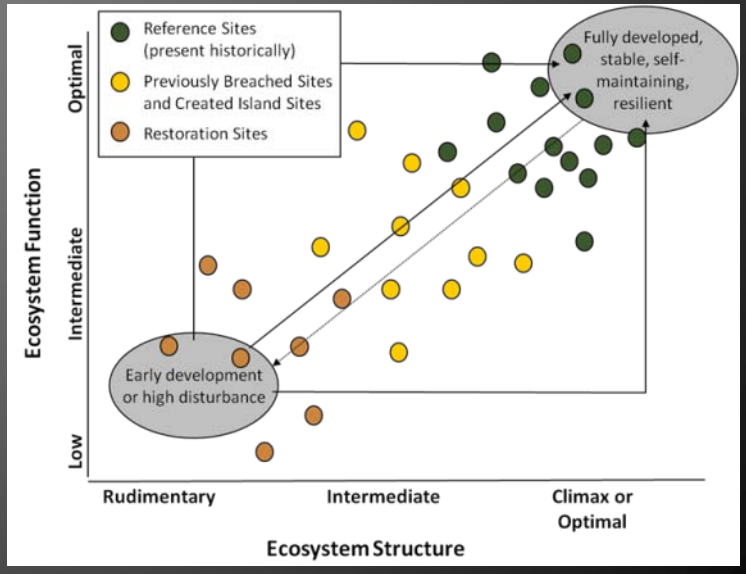
# Purpose of Research

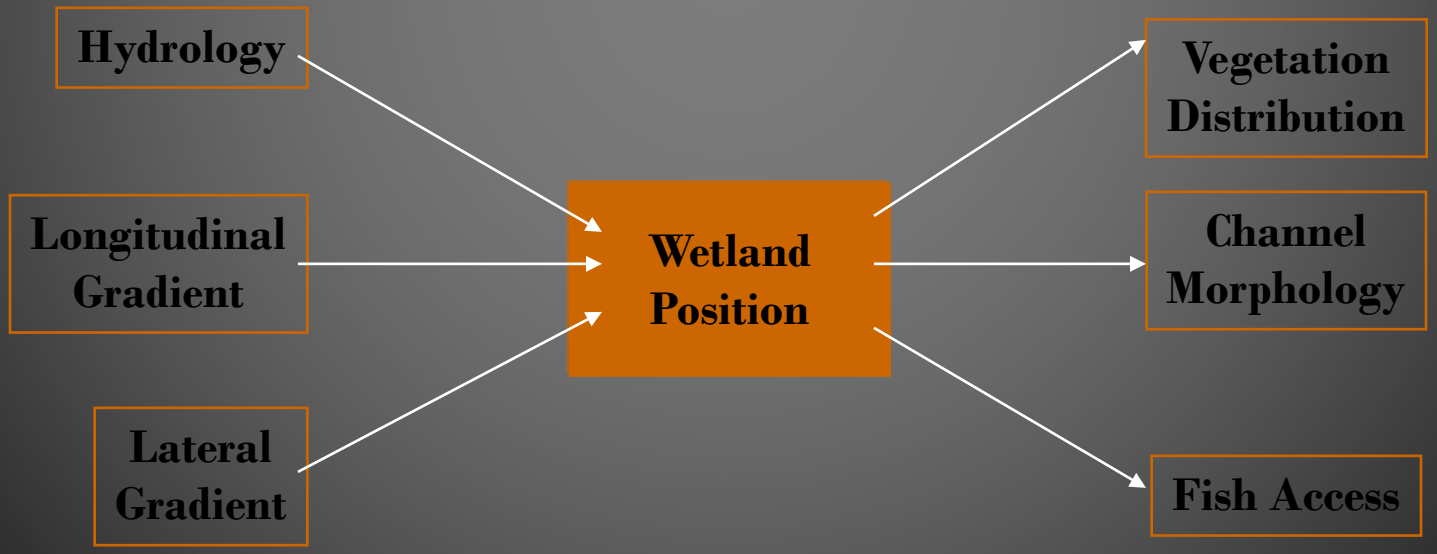
- Goal
  - To better understand habitat structure and to improve restoration success by evaluating reference conditions.


- Objectives
  - Evaluate status and trends of the estuary ecosystem
  - 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)
  - Wetland type
  - Inter-annual variability

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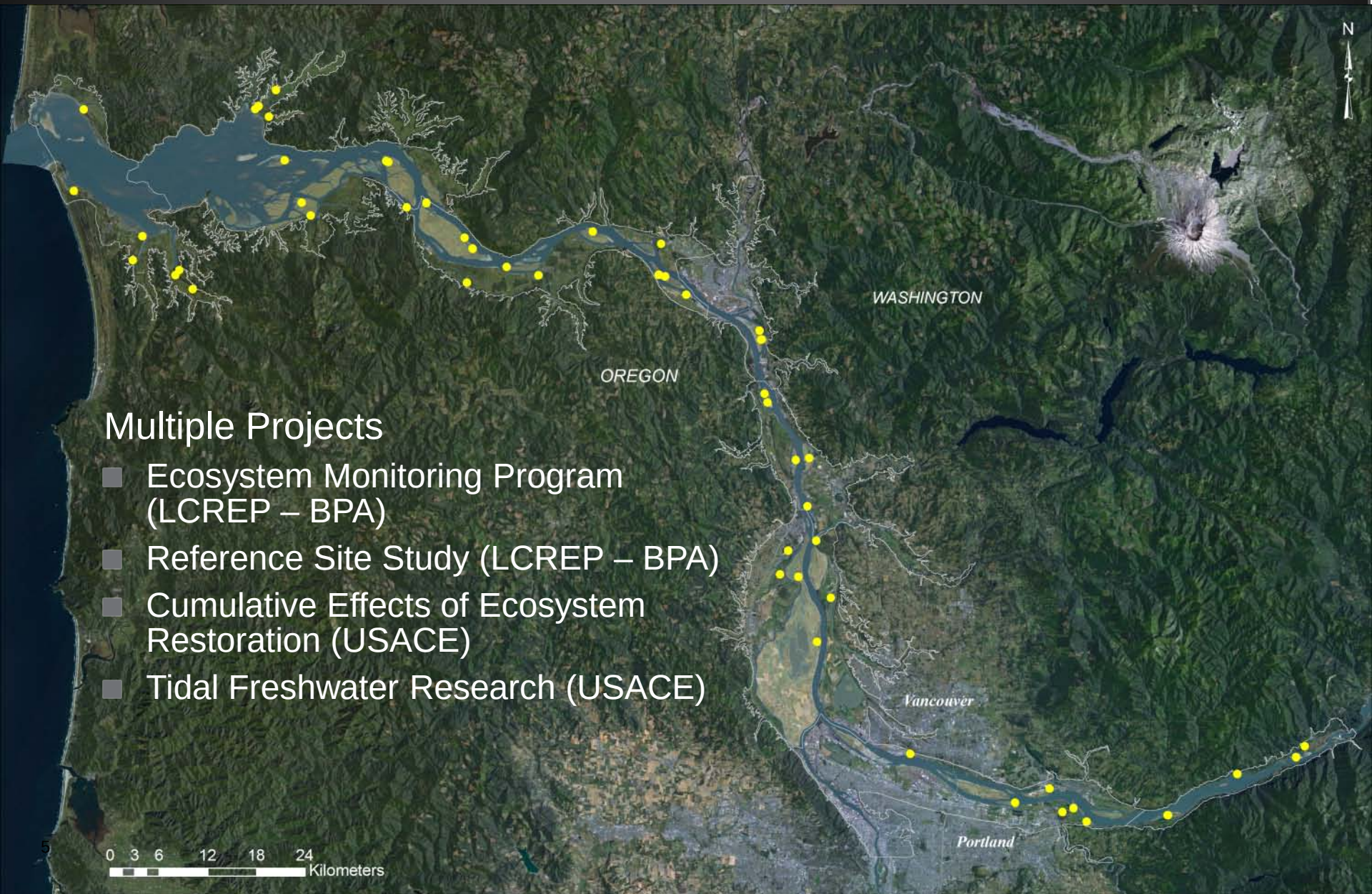
# Study Sites




Multiple Projects

- Ecosystem Monitoring Program (LCREP – BPA)
- Reference Site Study (LCREP – BPA)
- Cumulative Effects of Ecosystem Restoration (USACE)
- Tidal Freshwater Research (USACE)

# Wetland Types

Brackish Marsh

Tidal Freshwater Marsh

Sitka Spruce Swamp

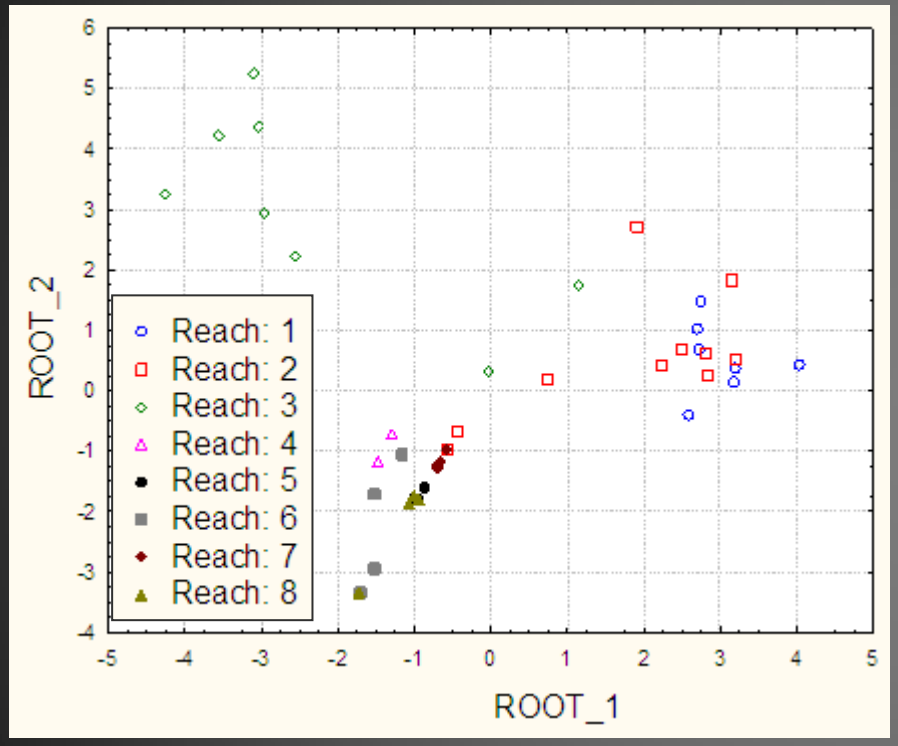
Scrub Shrub Wetland

Riparian Forested Wetland

# Metrics

- Conducted elevation surveys in conjunction with vegetation surveys
- Data collected along transects using systematic sampling with a random start
- 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

# Discriminant Function Analysis




1=A
2=B
3=C
4=D
5=E
6=F
7=G
8=H

Based on 44 sites,
30 plant species
(out of 220)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# Discriminant Function Analysis

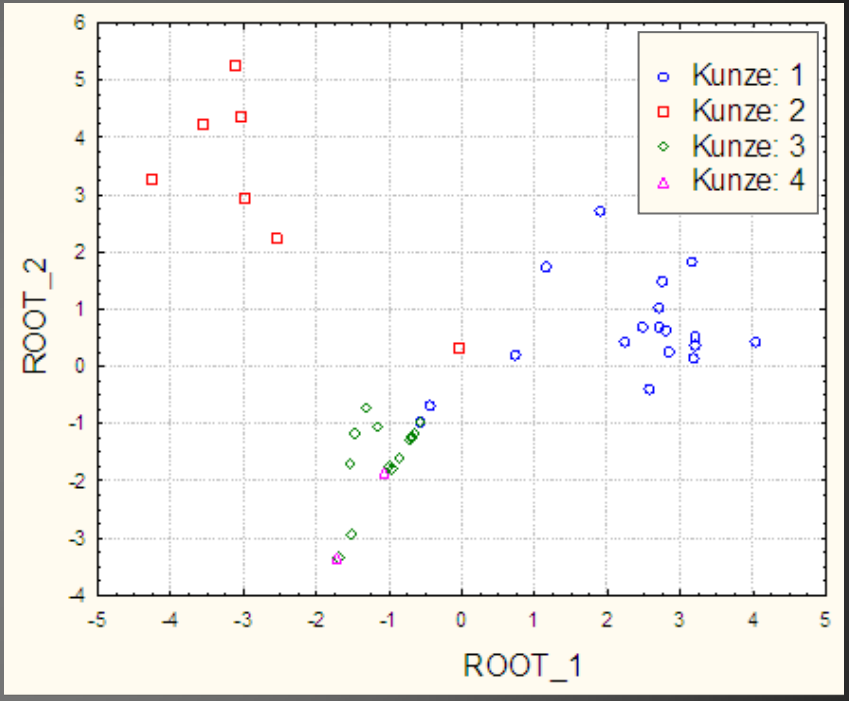
Kunze: 4 groups

1 = 0-64 rkm coastal surge plain wetlands

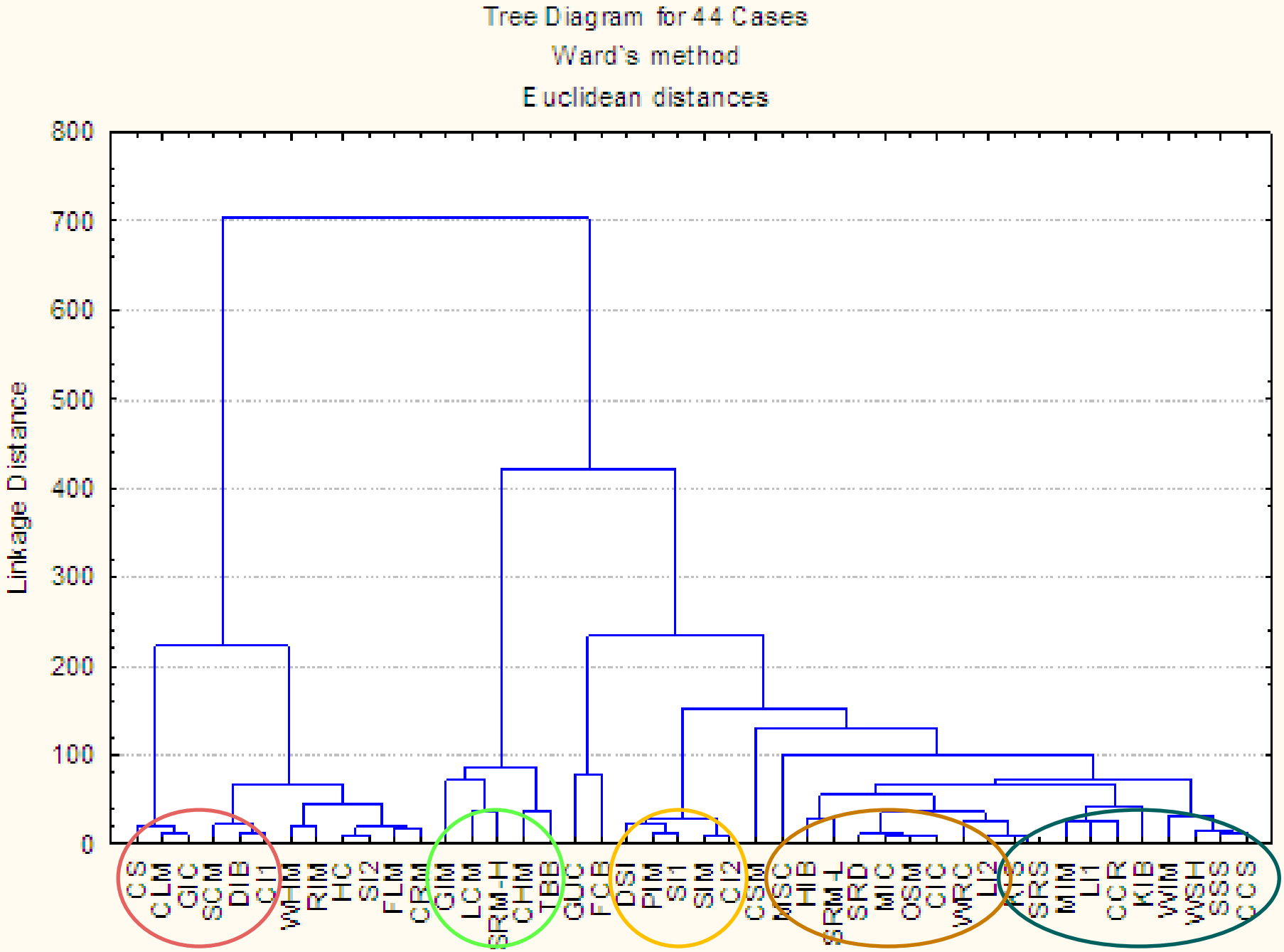
2 = 65-105 rkm (surge plain wetlands)

3 = 106-225 rkm (overflow plain wetlands)

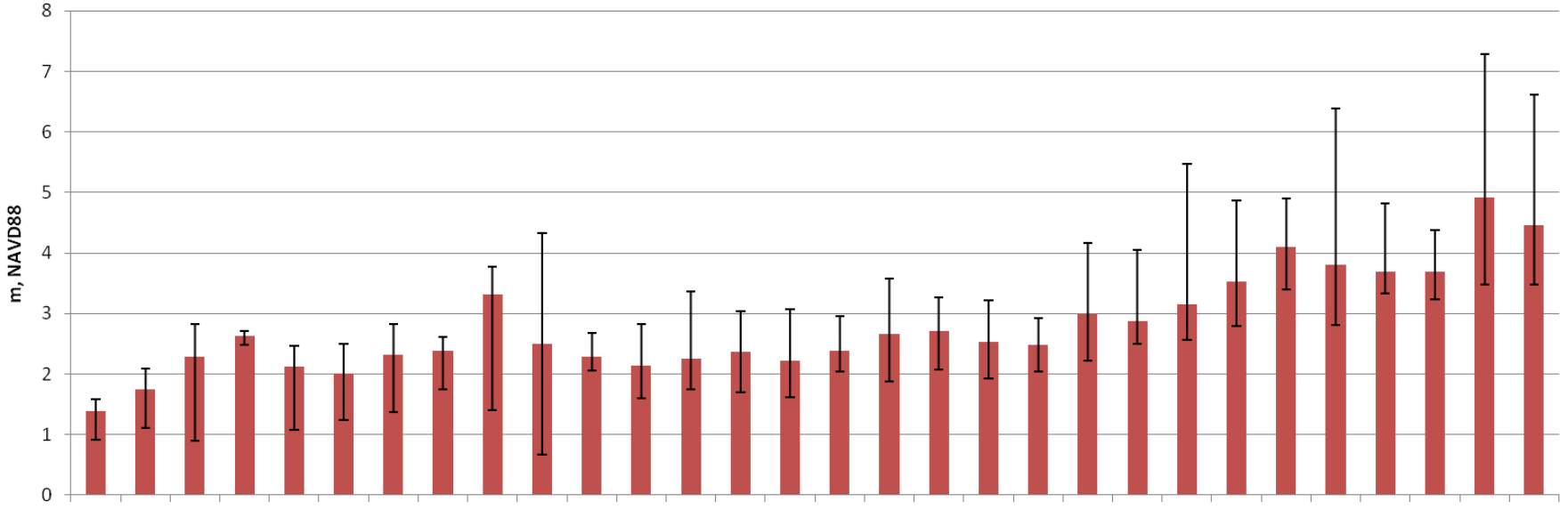
4 = 226-235 rkm (CR Gorge wetlands)



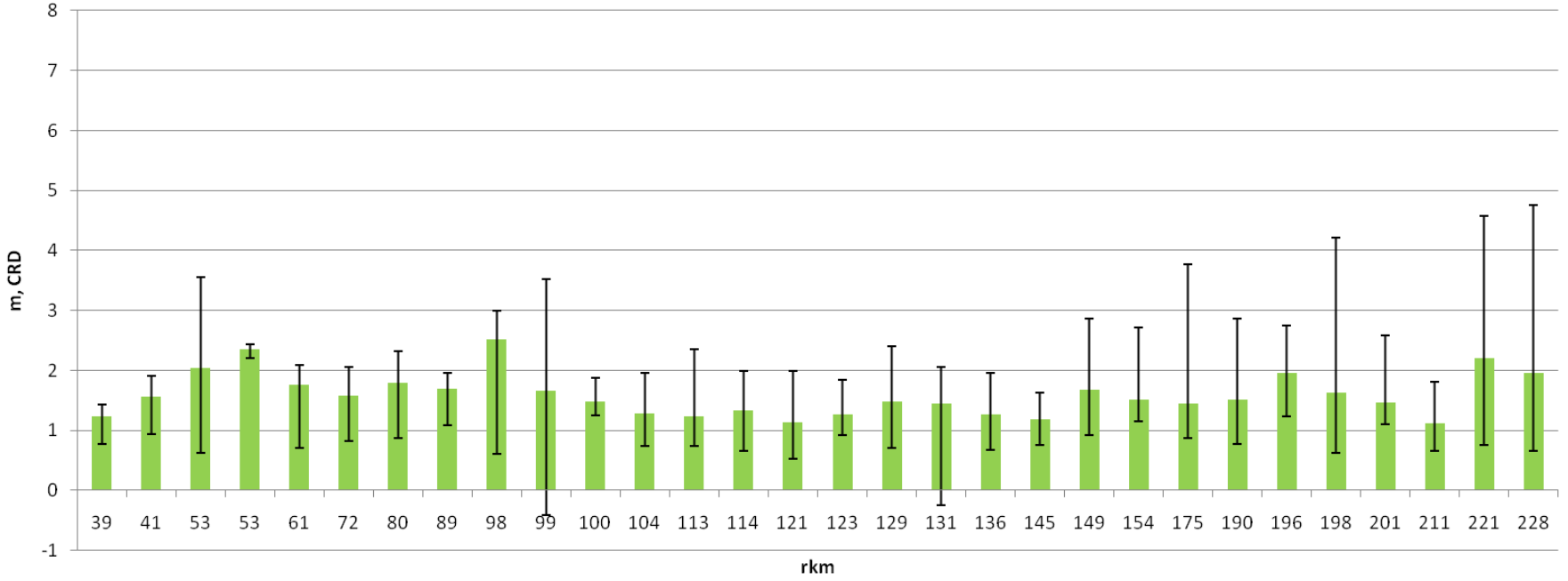

Kunze, LM. 1994. Preliminary Classification of Native, Low Elevation Vegetation in Western Washington. WADNR, Natural Heritage Program, Olympia, WA. *Based on*: Christy, JA and JA Putera. 1993. Lower Columbia River Natural Area Inventory. Report to the Nature Conservancy, Washington Field Office, Seattle, WA.


Tree Diagram for 44 Cases
Ward's method
Euclidean distances
Linkage Distance
800
700
600
500
400
300
200
100
0
CSM
CLM
CGM
CCM
CIB
CI1
WHM
RIM
HC2
HC1
FLM
CRM
CGM
LCM
SRM-H
CHM
TBB
CUC
FCB
DSI
PIM
SI1
SIM
CI2
CSM
MSC
HIB
SRM-L
SRC
MIC
OSM
OSC
WRC
LI2
KRC
SRC
MIM
LI1
CCR
KIB
WIM
WSH
SSC
SSC
CC

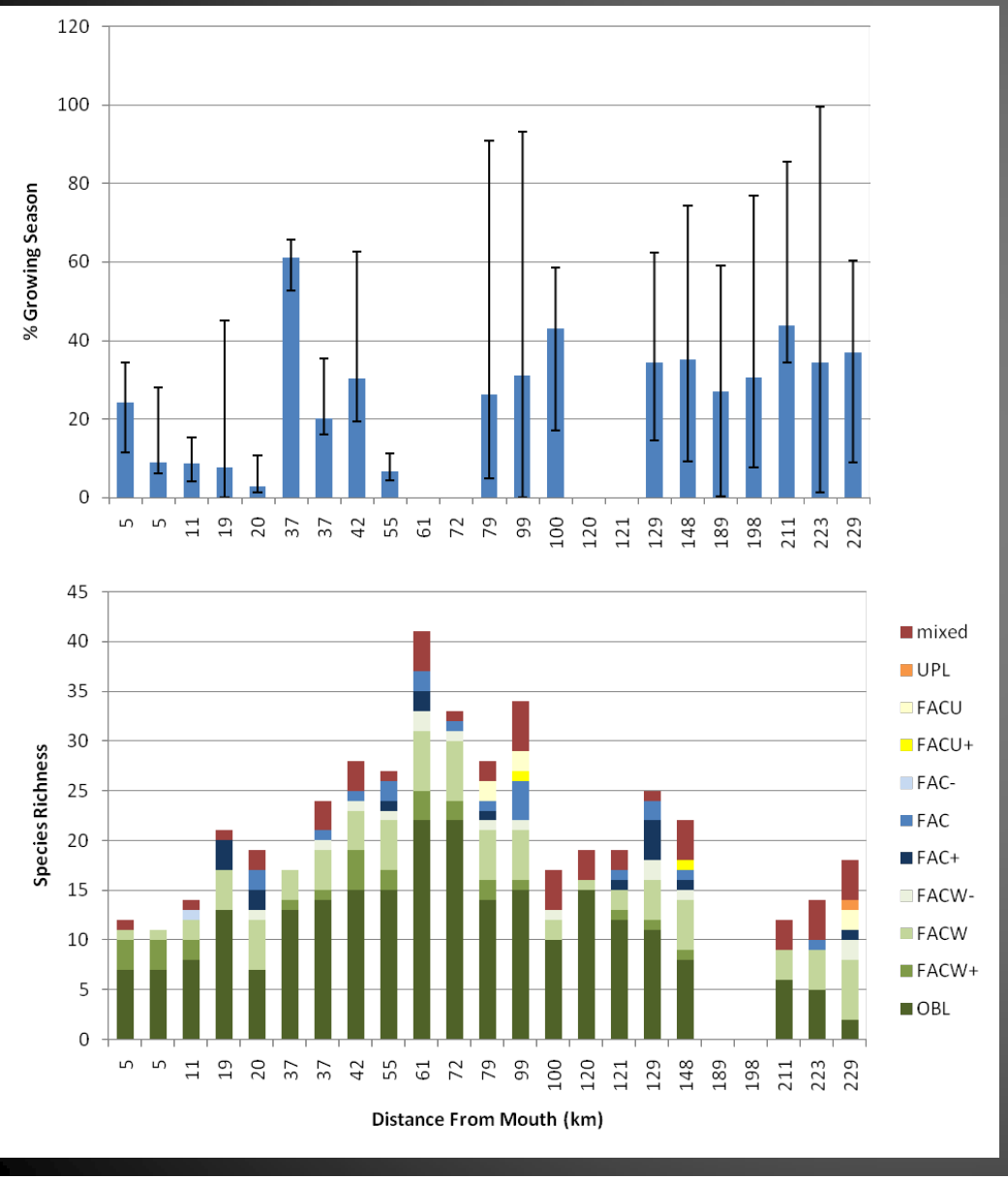
## Avg site elevation (m, NAVD88)

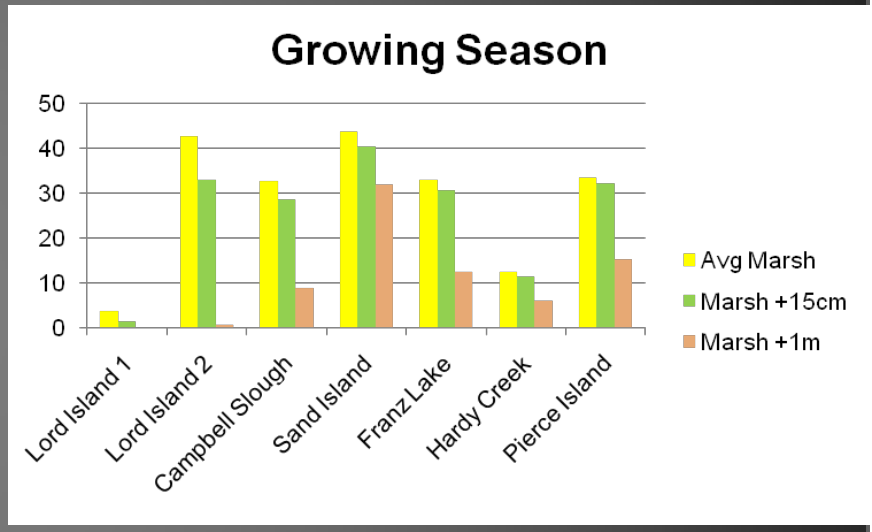



## Avg site elevation (m, CRD)



# Inundation

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# Inundation

- Sum Exceedance Value

# Temporal Variability

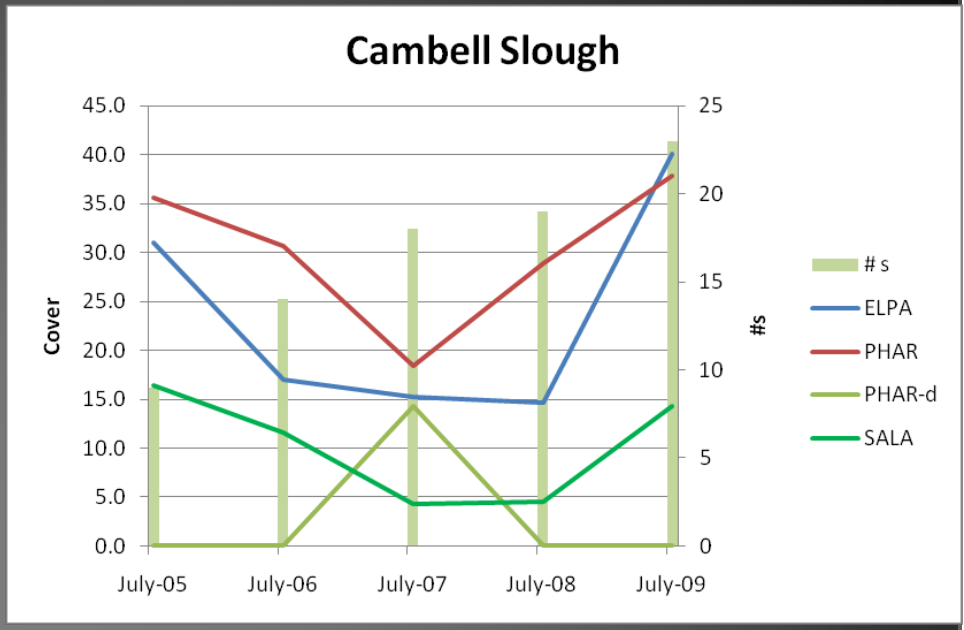
- 3 sites
- 2 in Reach F
  - Campbell Slough
  - Cunningham Lake
- 1 in Reach H
  - Franz Lake

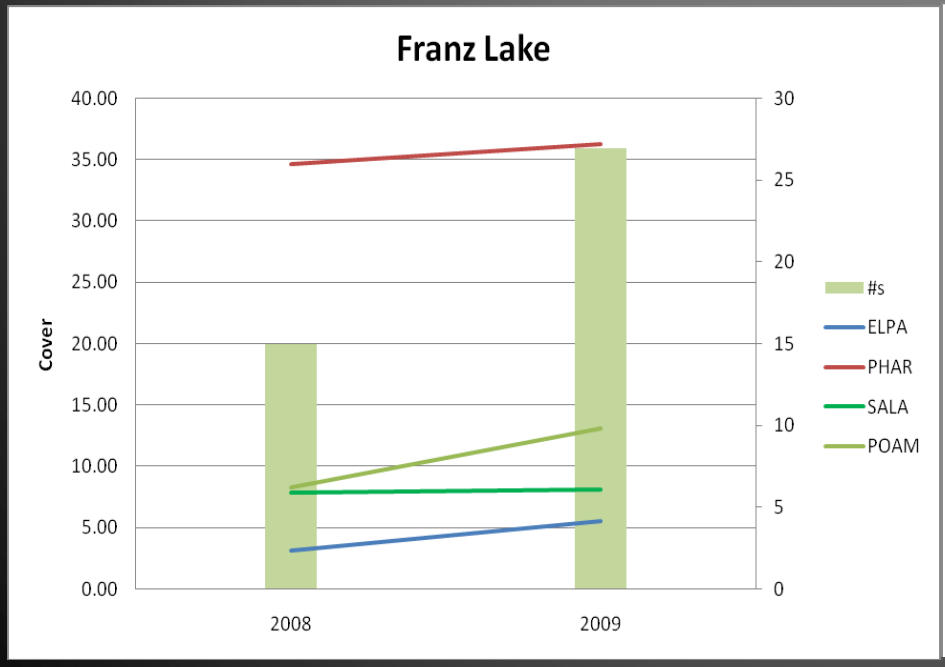
July 26, 2005

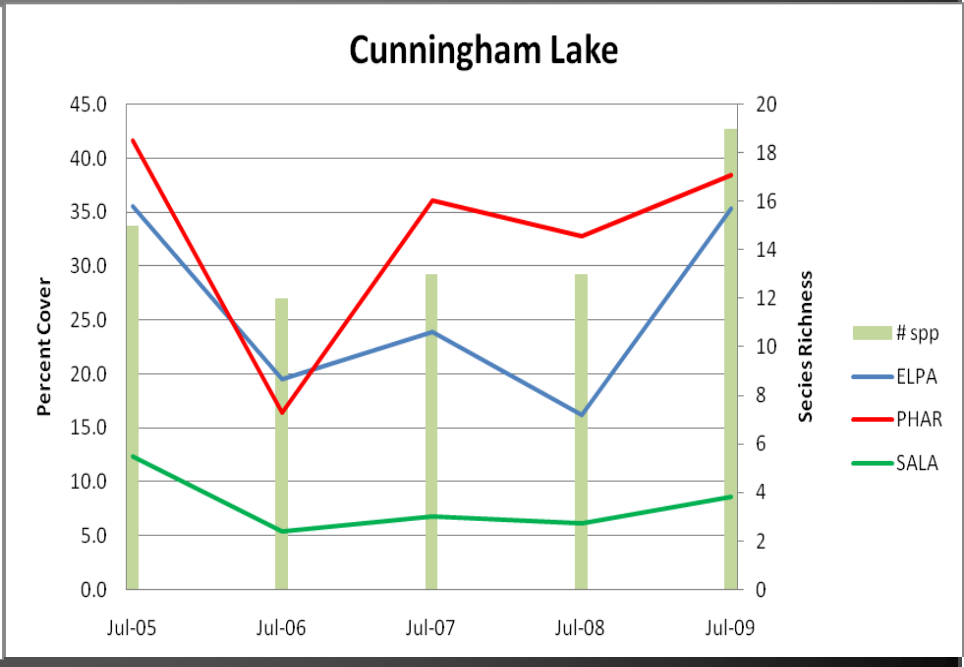
July 21, 2008

# Temporal Variability

- Dominant species don't change

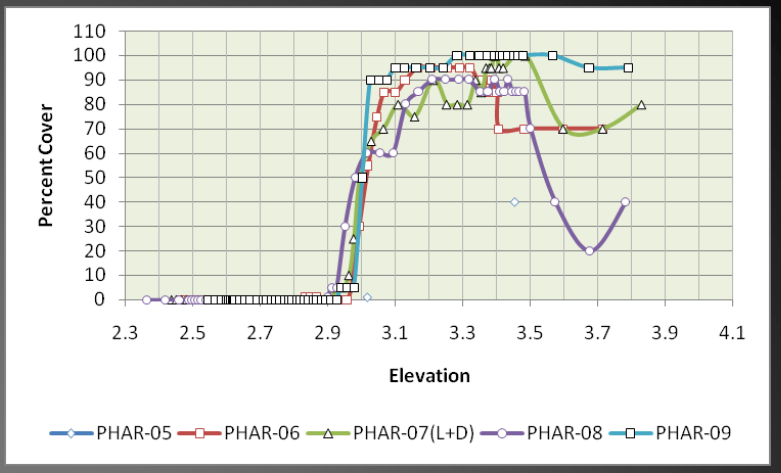


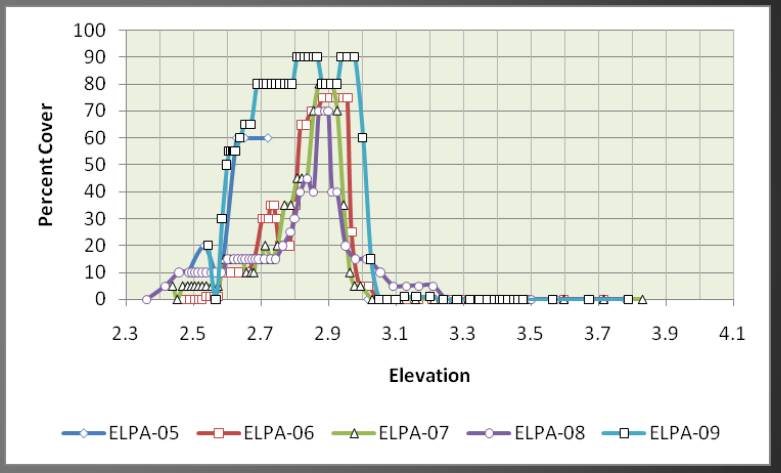



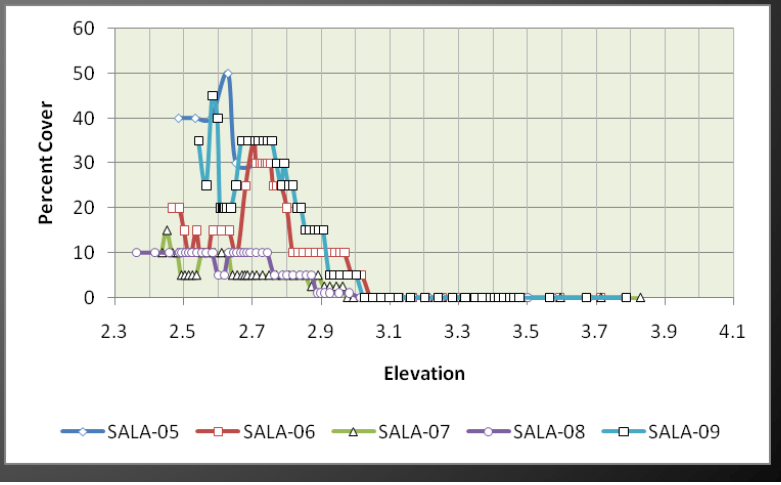



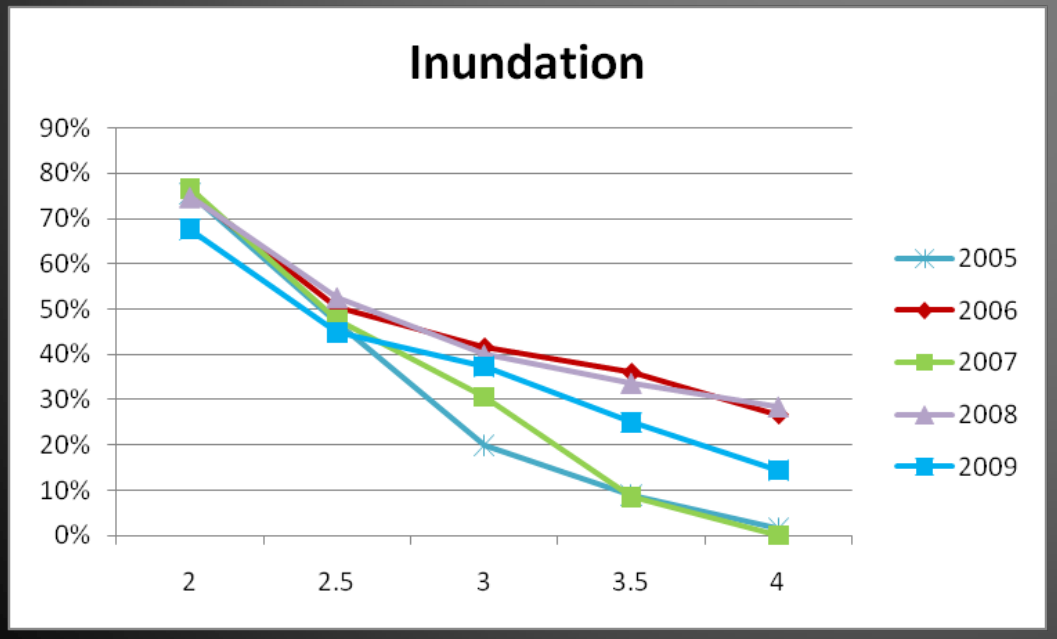
# Temporal Variability

- Boundaries between vegetation communities don't change
- Vegetation cover within communities does change



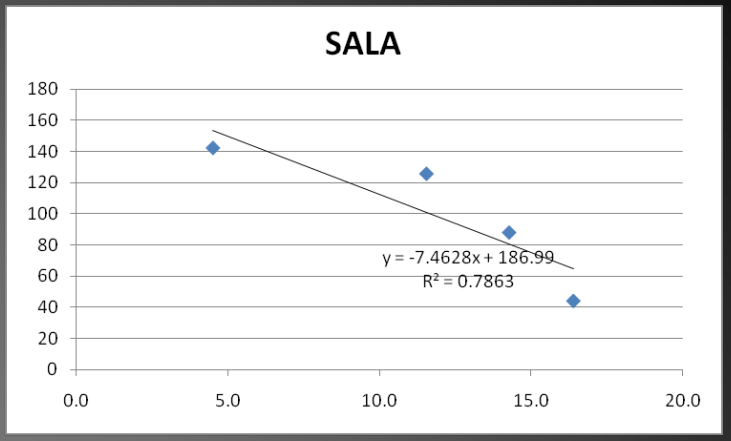



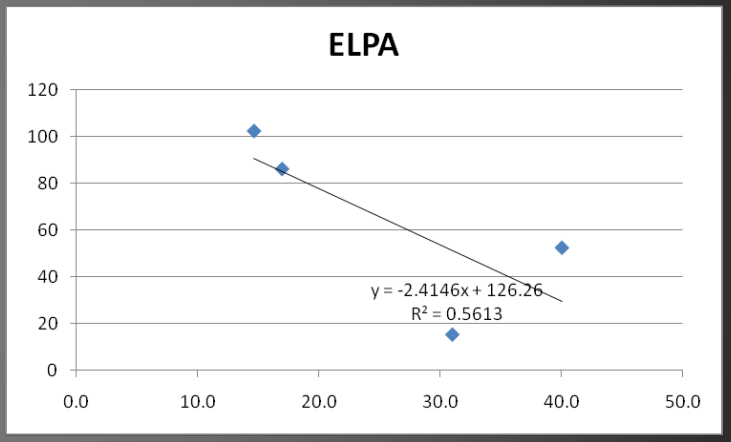



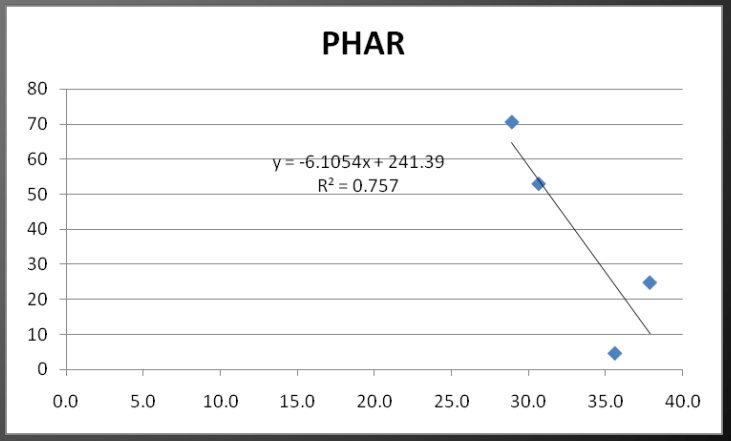
# Temporal Variability

- Sum Exceedance Value

$$SEV = \sum_{i=1}^{n} (d_{30})$$



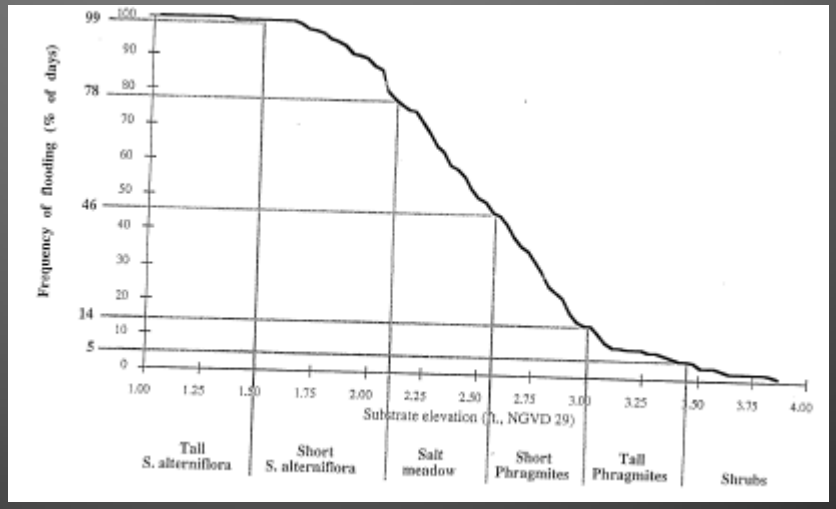

Gowing, D.J.G, EG Youngs, .I.C. Gilbert and G. Spoor (1998), Predicting the effect of change in water regime on plant communities. In H. Wheater and C. Kirby (Eds) *Hydrology in a Changing Environment, Vol 1, Wiley, 473-484.*

# Conclusions

- Elevations of emergent wetlands cover a very narrow band
- Inundation patterns vary throughout the estuary
- Cover changes in response to changing water levels
- Overall vegetation in reference wetlands is stable and resilient to some variation in water levels
- Information on elevation and inundation patterns is critical to successful restoration.

# Future Work

- Define elevation ranges for vegetation communities and inundation patterns for sites through out estuary
- Evaluate spatial variability in SEV through out estuary
- Calculate ranges of SEVs for individual species
- Determine thresholds for invasive species
- Disseminate information
  - Get feedback from restoration community (June SWG Meeting)



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