Elevation and Vegetation Relationships in the Lower Columbia River and Estuary

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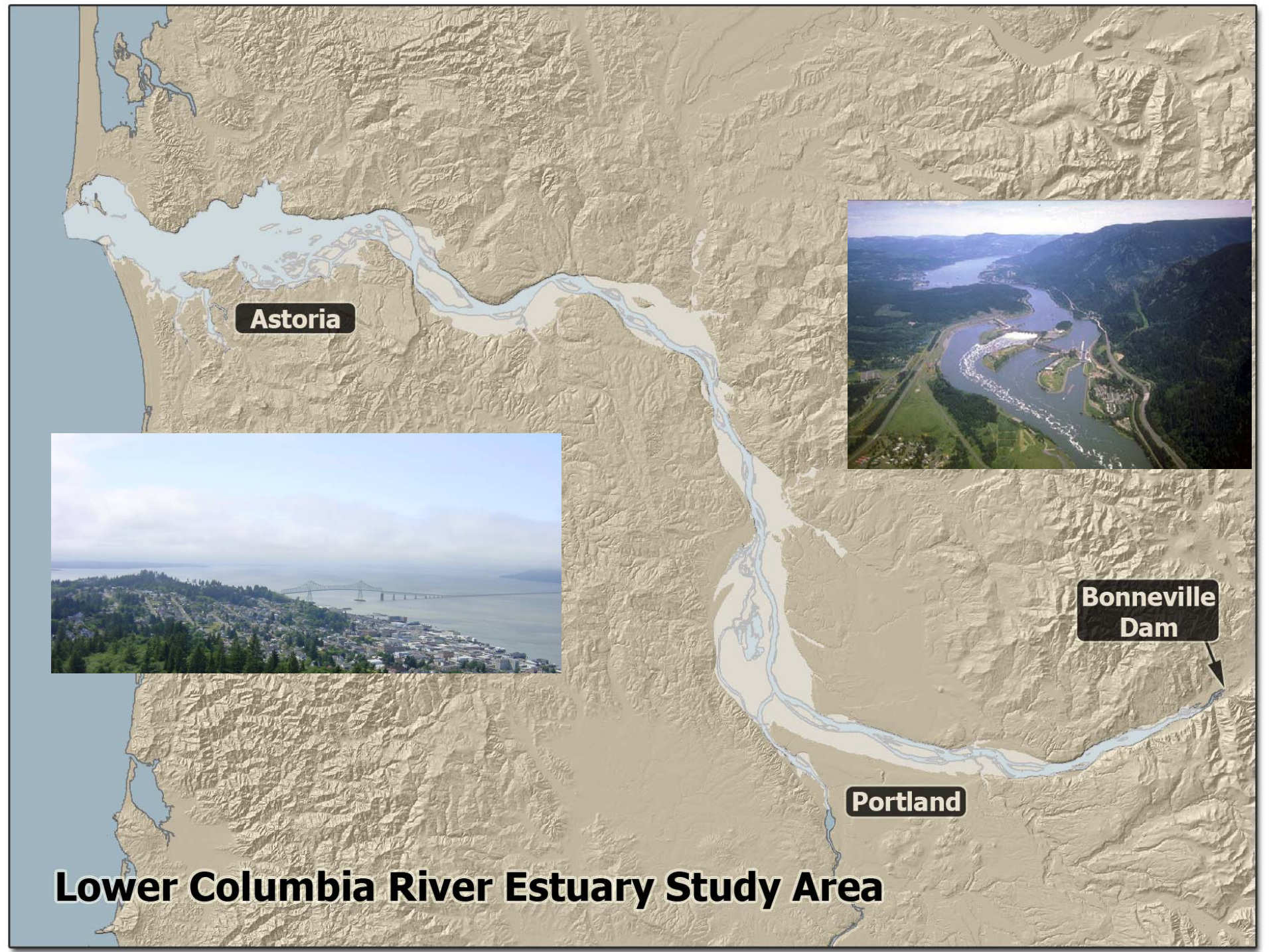
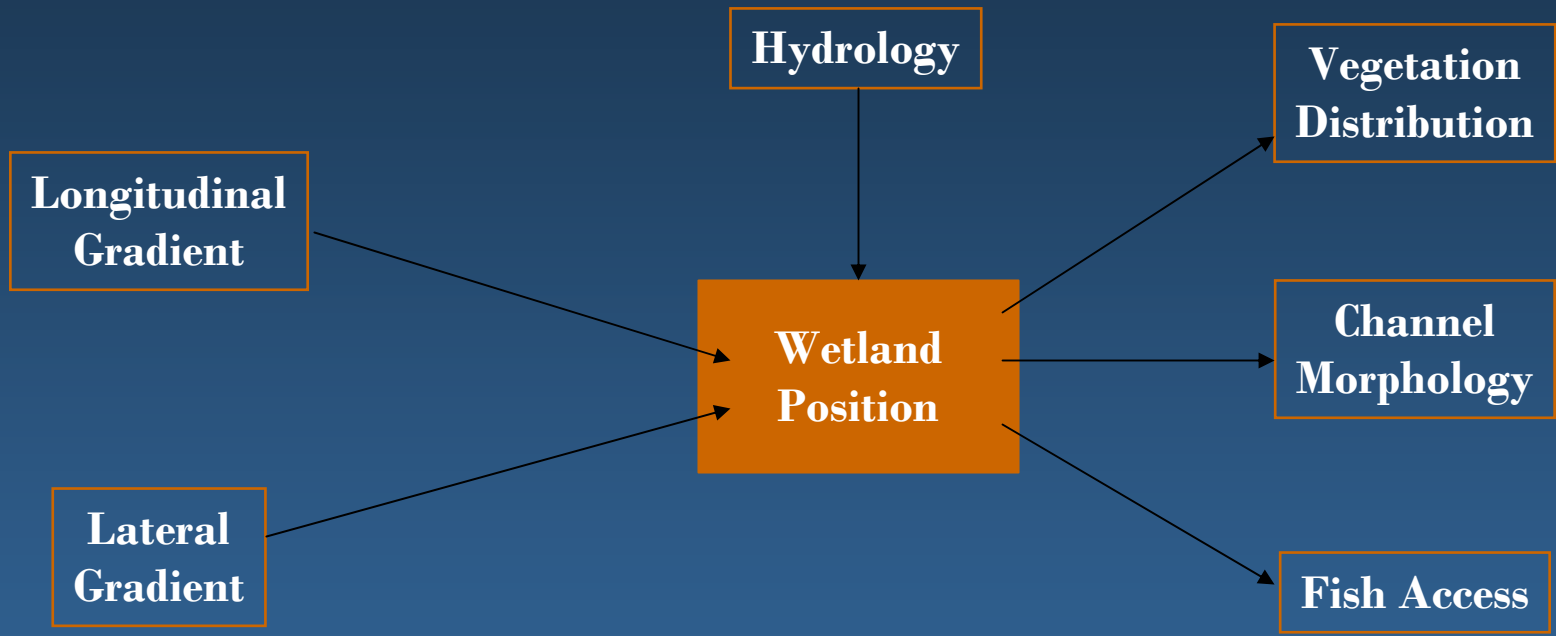
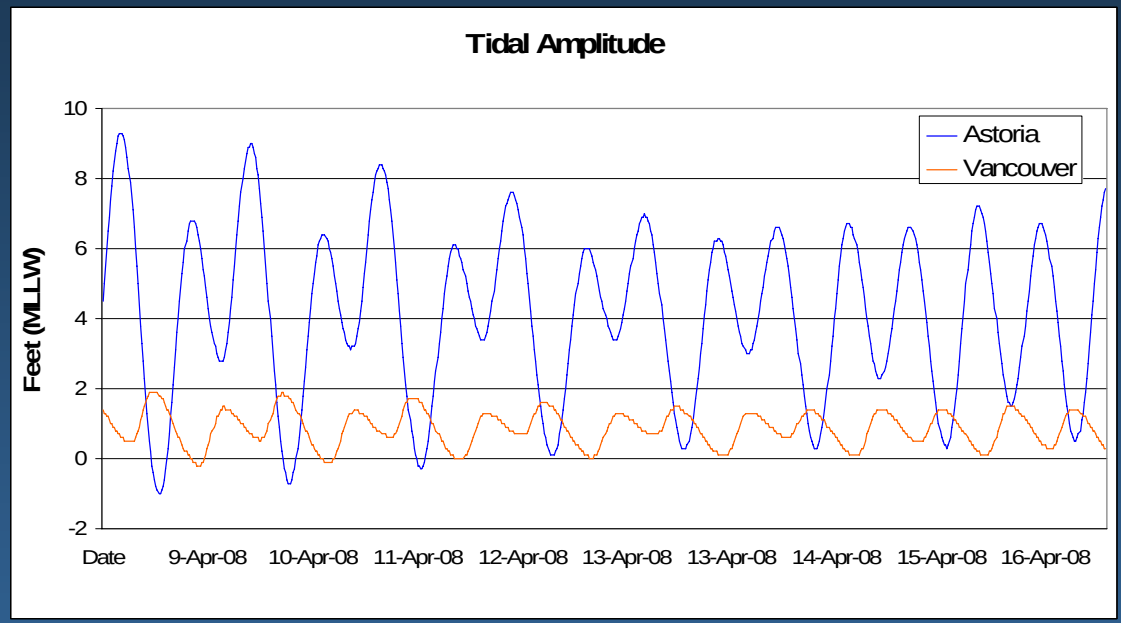

Astoria
Bonneville Dam
Portland
Lower Columbia River Estuary Study Area

Conceptual Model



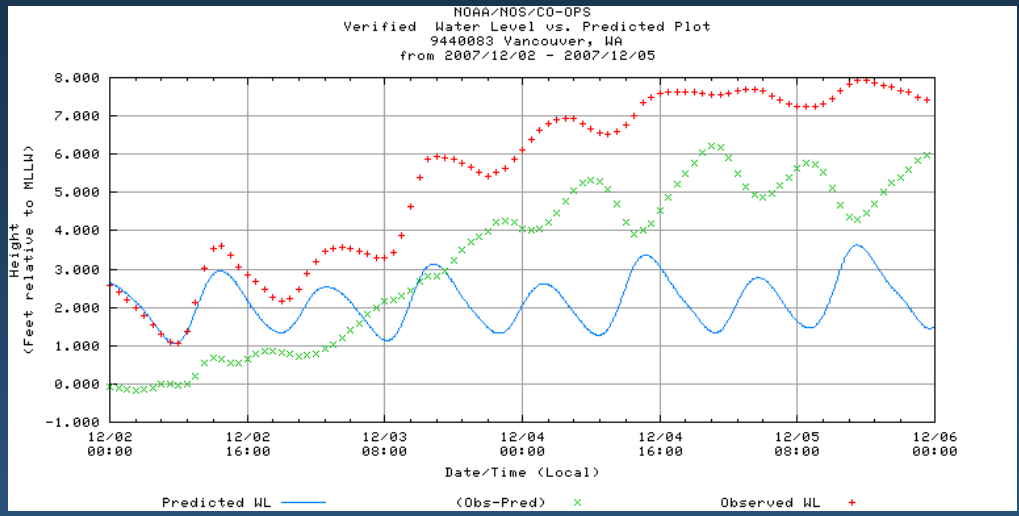
Factors Affecting Vegetation Distribution

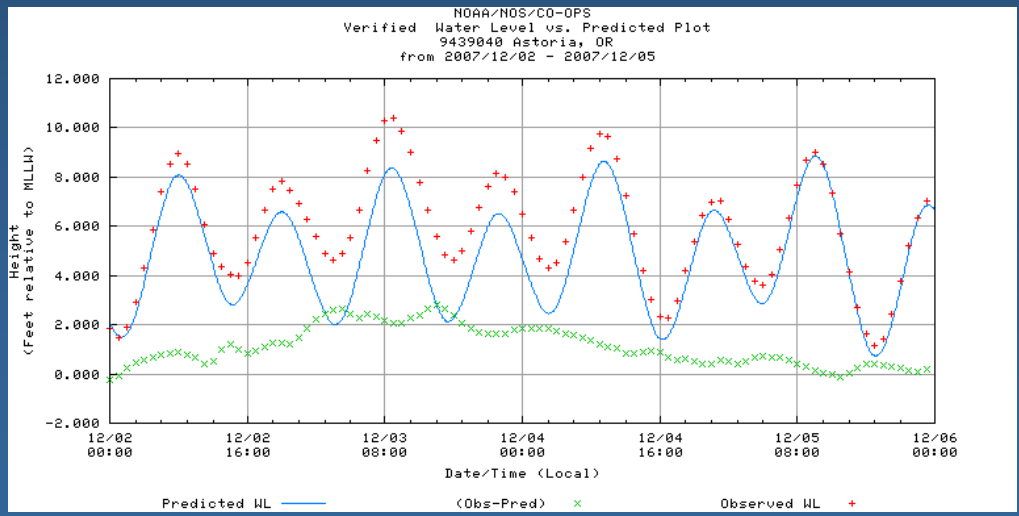
- Hydrology
  - Tides
    - Changes longitudinally



Factors Affecting Vegetation Distribution

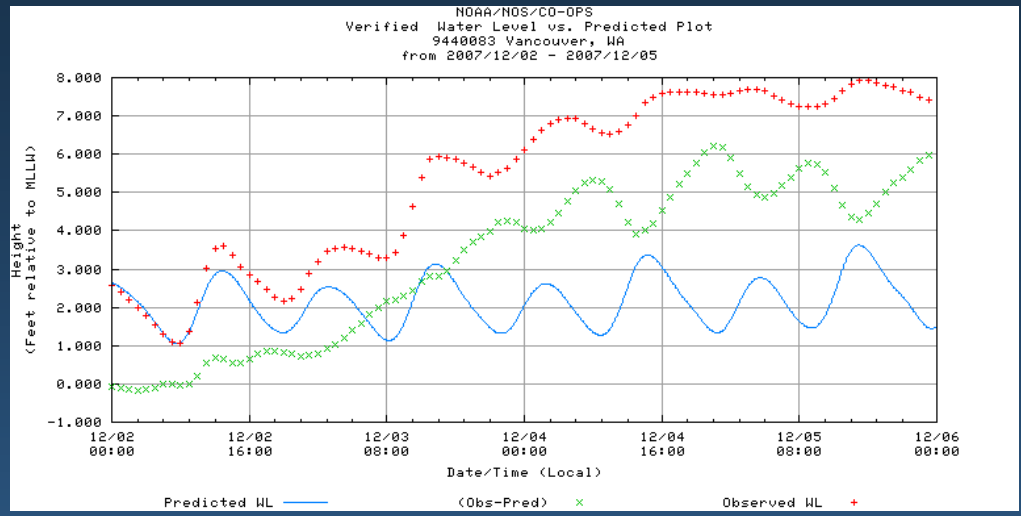
- Hydrology
  - River flows
    - Changes longitudinally

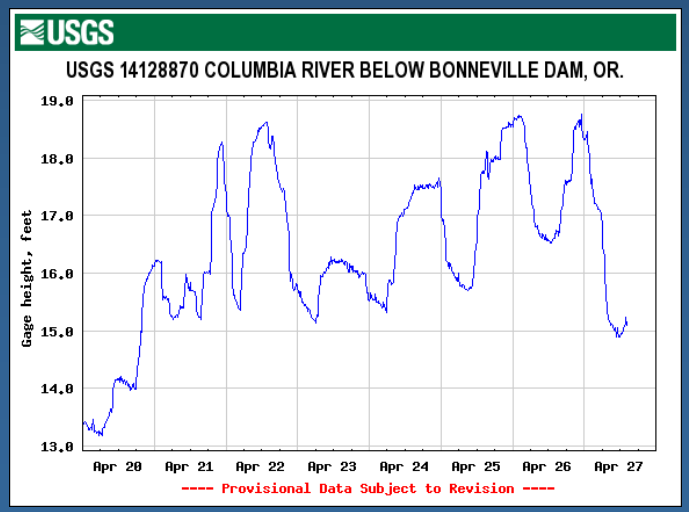


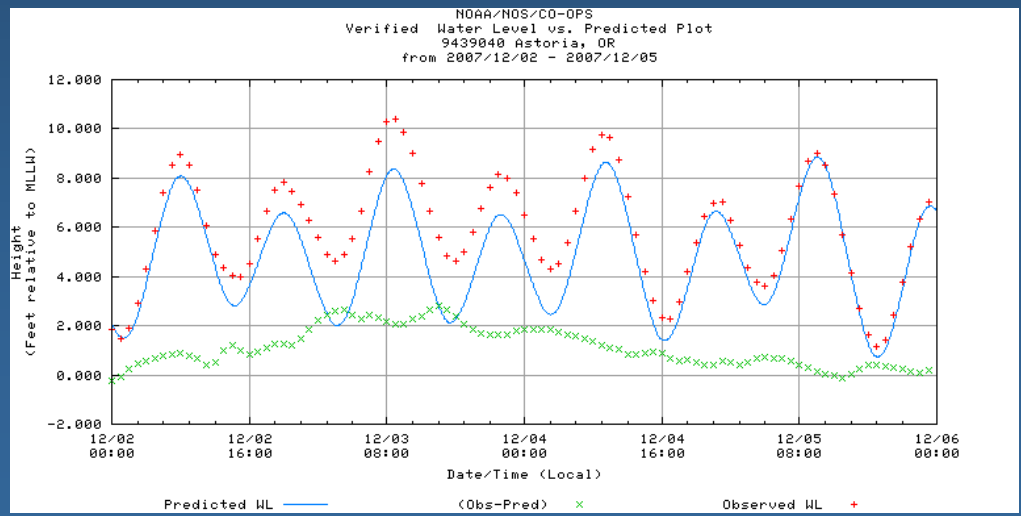


Factors Affecting Vegetation Elevation

- Hydrology
  - River flows
    - Changes longitudinally
    - Daily variability

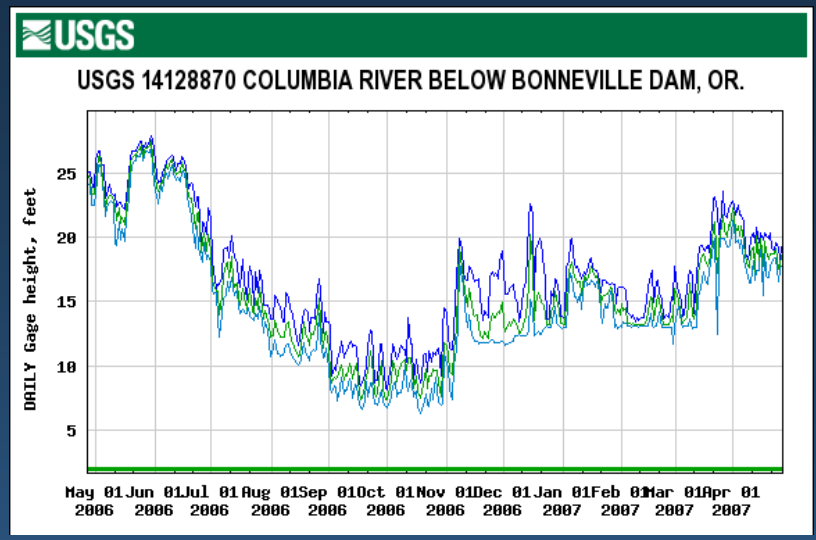


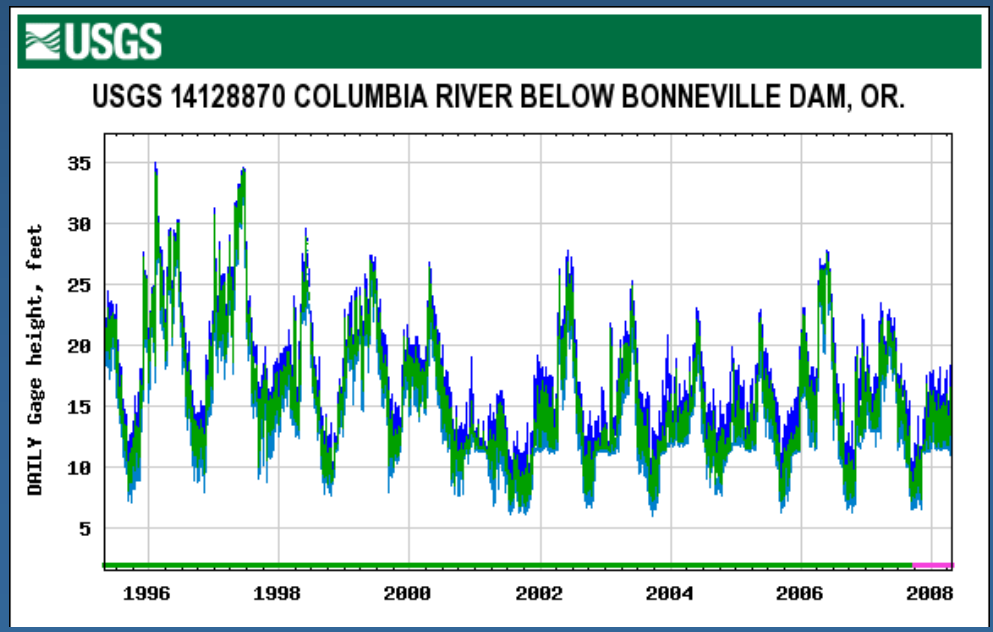




Factors Affecting Vegetation Elevation

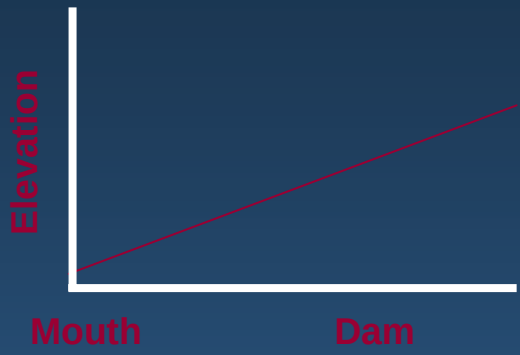
- Hydrology
  - River Flows
    - Seasonal variability
    - Annual variability

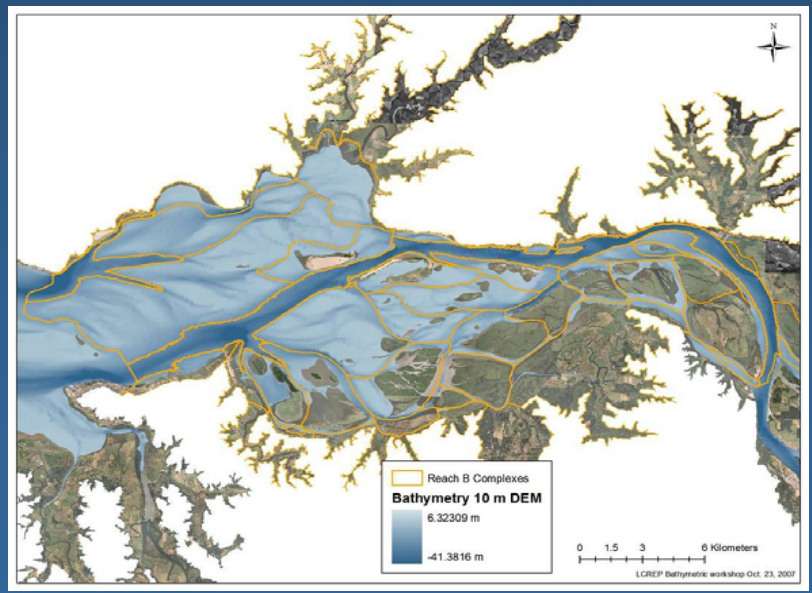




Factors Affecting Vegetation Elevation

- Elevation
  - From river mouth to dam
  - From main channel up the floodplain





Other Considerations

- Tidal Datum – Mean Lower Low Water (MLLW) based on data collected at tidal benchmarks over a 19-year period

- Fixed geodetic datums – based on fixed set of constants
  - North American Vertical Datum-1988 (NAVD88)
  - CRD – Columbia River Datum

Tidal benchmark information and datum correction information is available at: http://tidesandcurrents.noaa.gov/.

Other Considerations

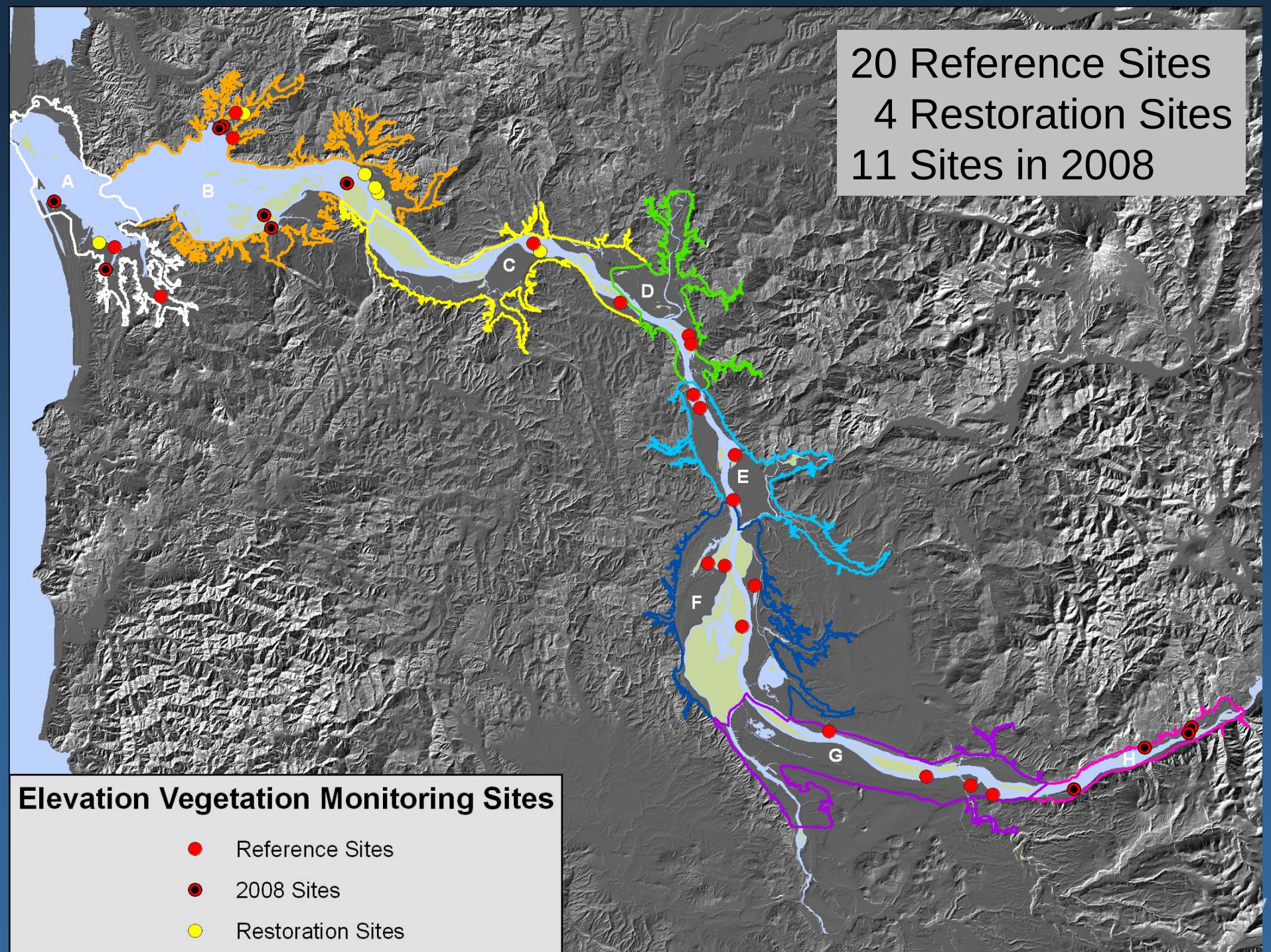
- Online Positioning User Service (OPUS) Derived Benchmarks
- Local Benchmarks

	Crims	Kandoll
Elevation Local BM (m-NAVD-88)	2.332	1.849
Elevation OPUS BM (m-NAVD-88)	2.269	1.684
Difference (m)	0.063	0.166

Study Sites

- Tidally influenced wetlands from the mouth to Bonneville Dam

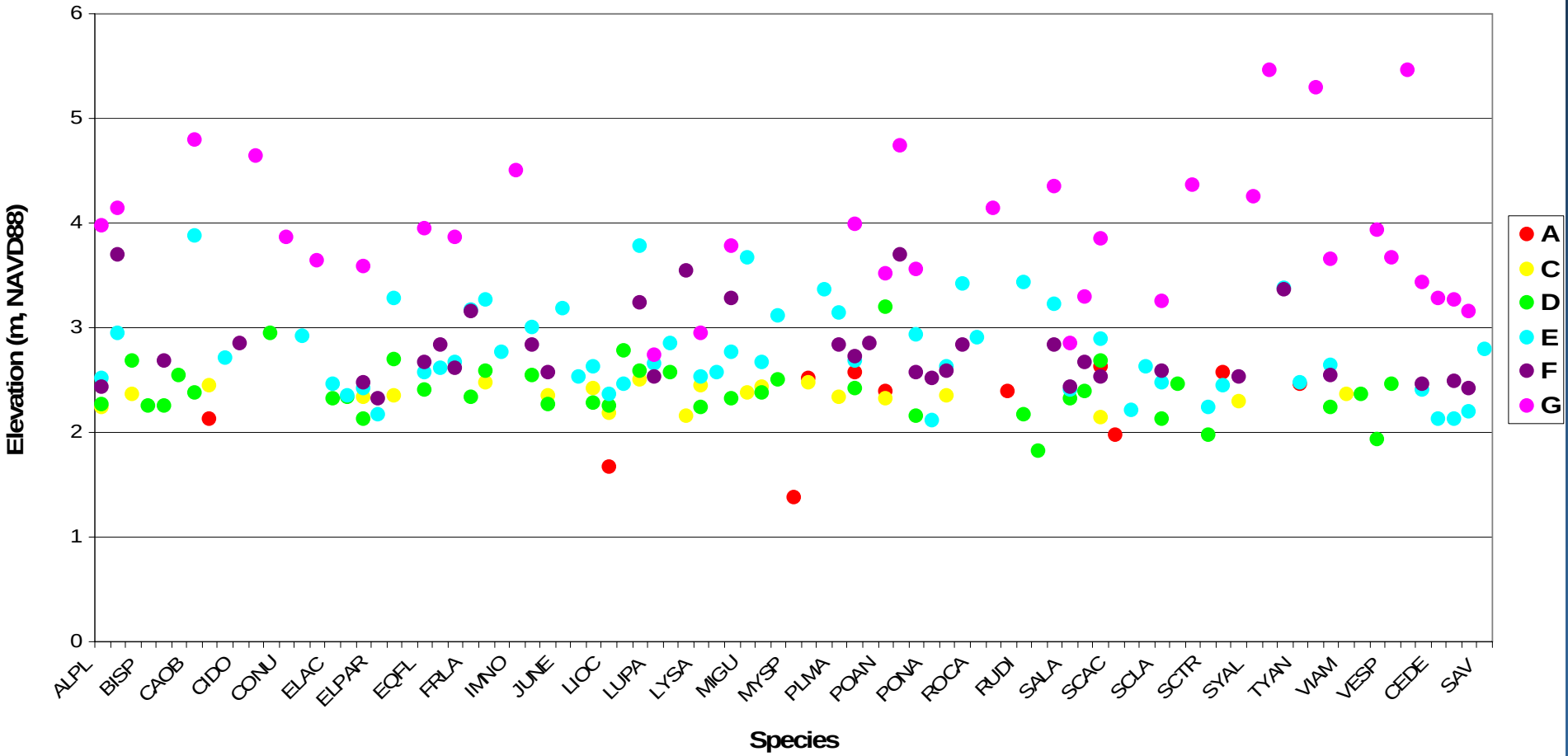
- Types
  - Forested wetlands or Swamps
  - Shrub/scrub
  - Emergent marshes


20 Reference Sites
4 Restoration Sites
11 Sites in 2008
A
B
C
D
E
F
G
H
Elevation Vegetation Monitoring Sites
Reference Sites
2008 Sites
Restoration Sites

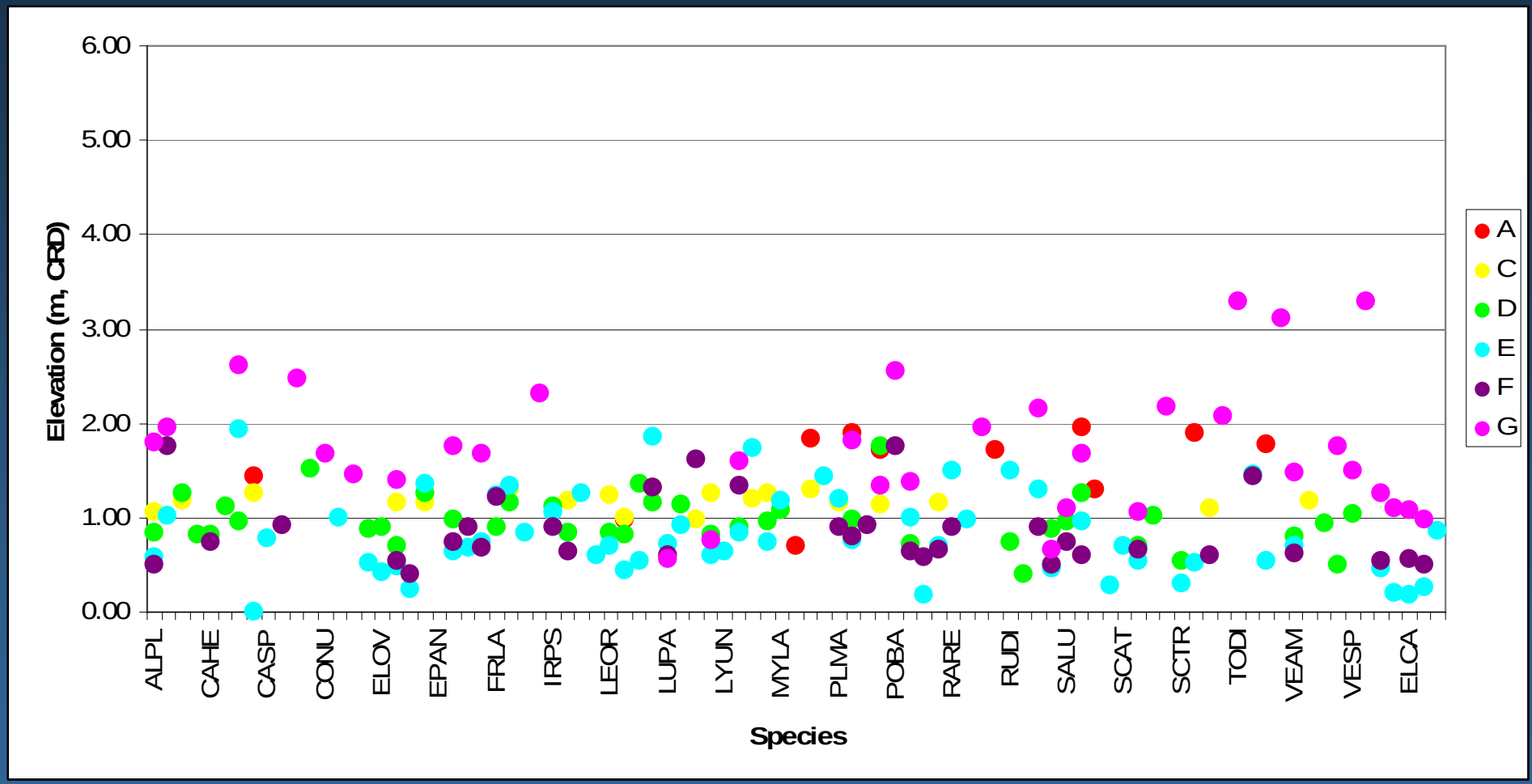
Methods

- 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 placed at a subset of sites to evaluate hydrology

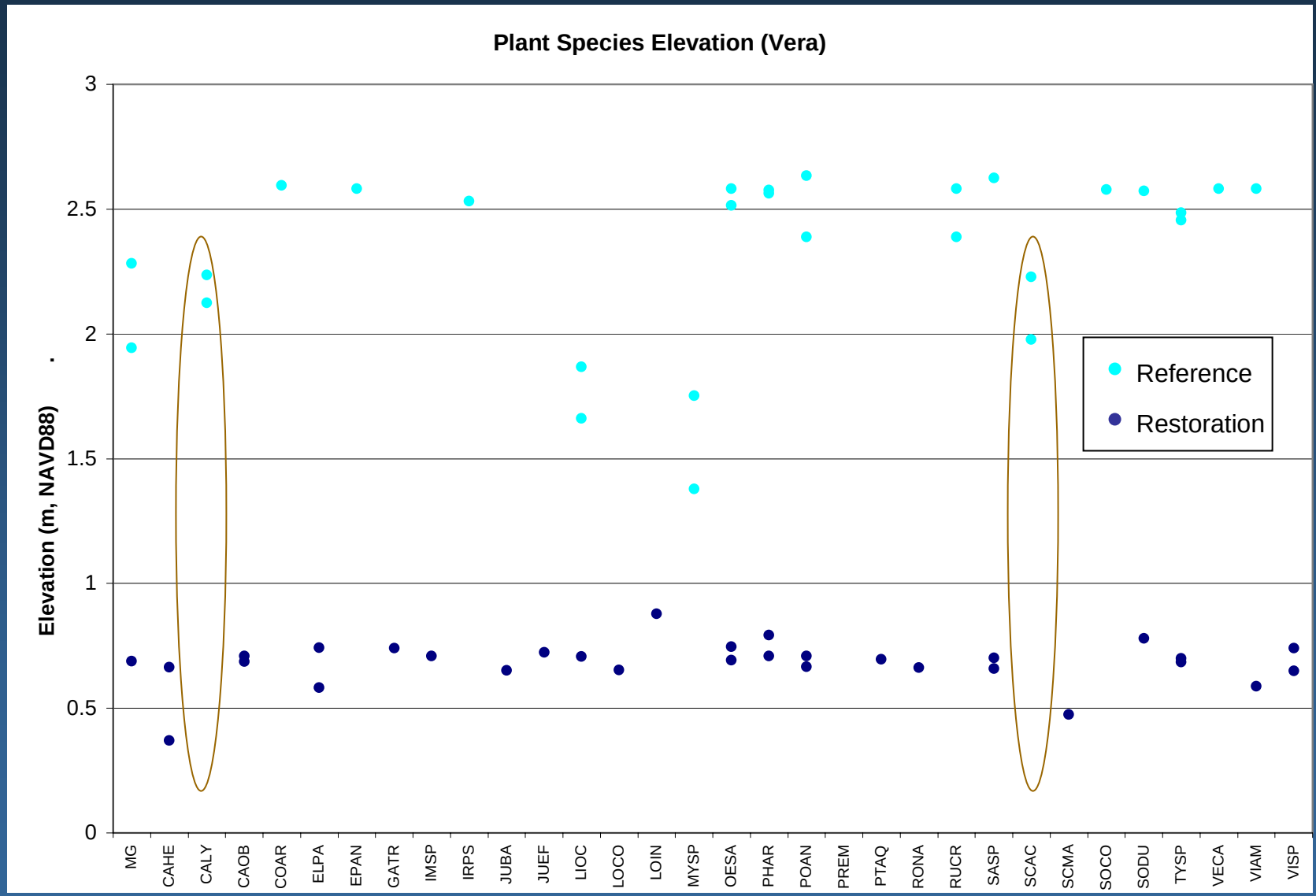
Average Species Elevations by Reach Relative to NAVD88

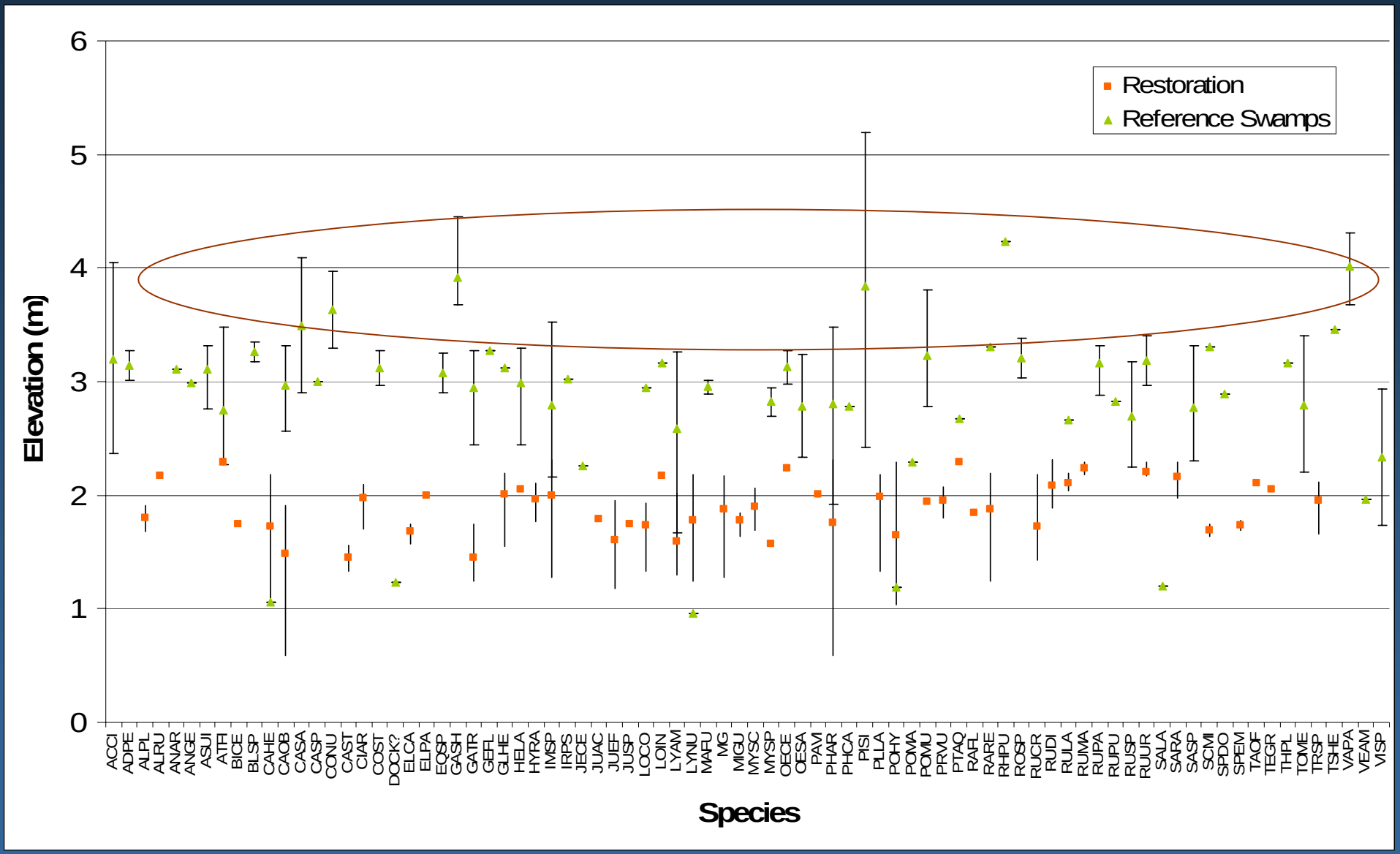


Average Species Elevations by Reach Relative to CRD



Restored Diked Area vs. Reference Area




Restoration
Reference Swamps
Elevation (m)
0
1
2
3
4
5
6
Species
ACCI
ADPE
ALPL
ALRU
ANAR
ANGE
ASUI
ATFI
BICE
BLSP
CAHE
CAOB
CASA
CASP
CONU
CAST
CIAR
COST
DOCK?
ELCA
ELPA
EQSP
GASH
GATR
GEFL
GLHE
HELA
HYRA
IMSP
IRPS
JECE
JUAC
JUEF
JUSP
LOCO
LOIN
LYAM
LYNU
MAFU
MG
MIGU
MYSC
MYSP
OECE
OESA
PAVI
PHAR
PHCA
PISI
PLLA
POHY
POMA
POMU
PRVU
PTAQ
RAFL
RARE
RHPU
ROSP
RUCR
RUDI
RULA
RUMA
RUPA
RUPU
RUSP
RUUR
SALA
SARA
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SCMI
SPDO
SPEM
TAOF
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TRSP
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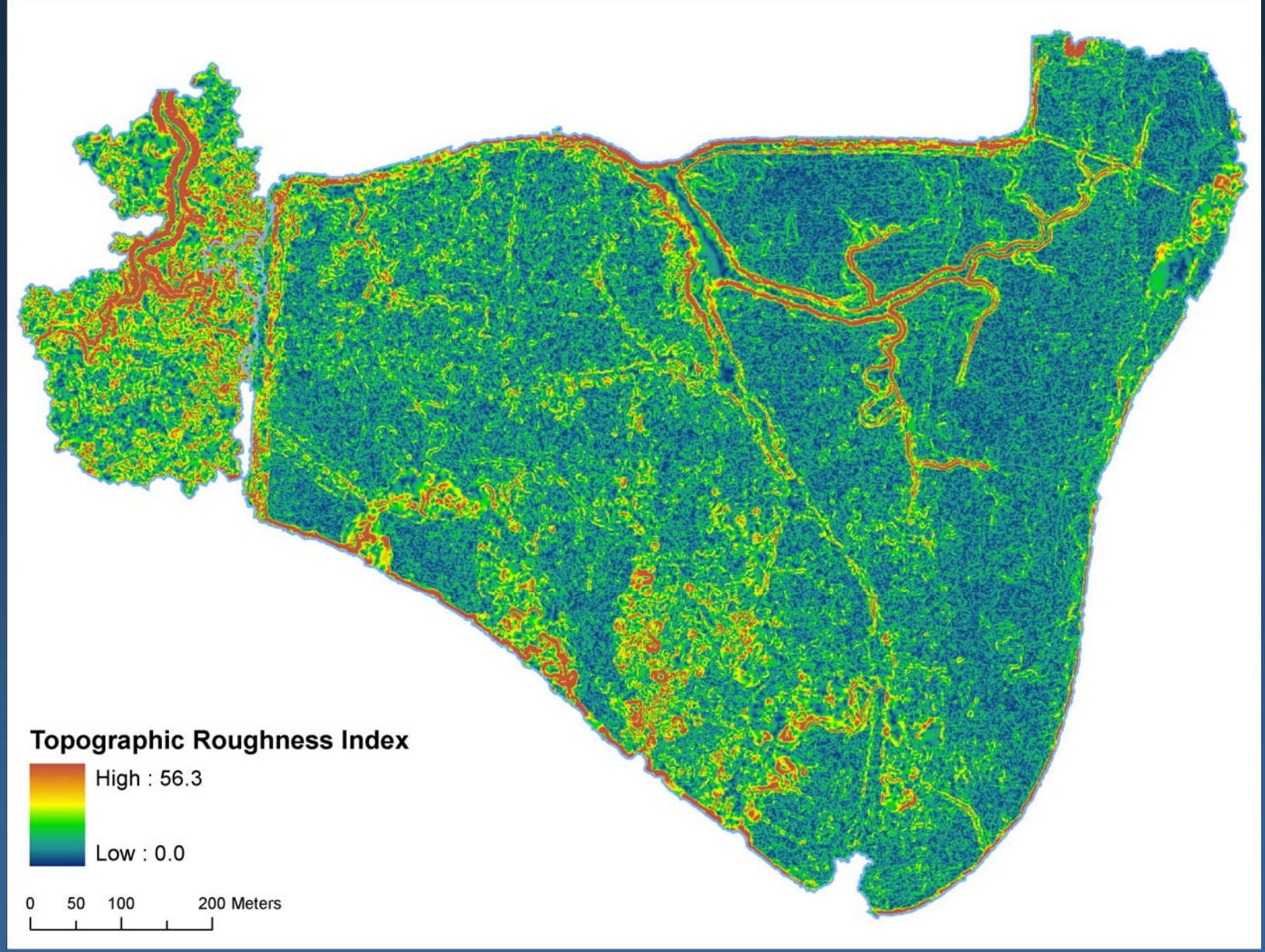
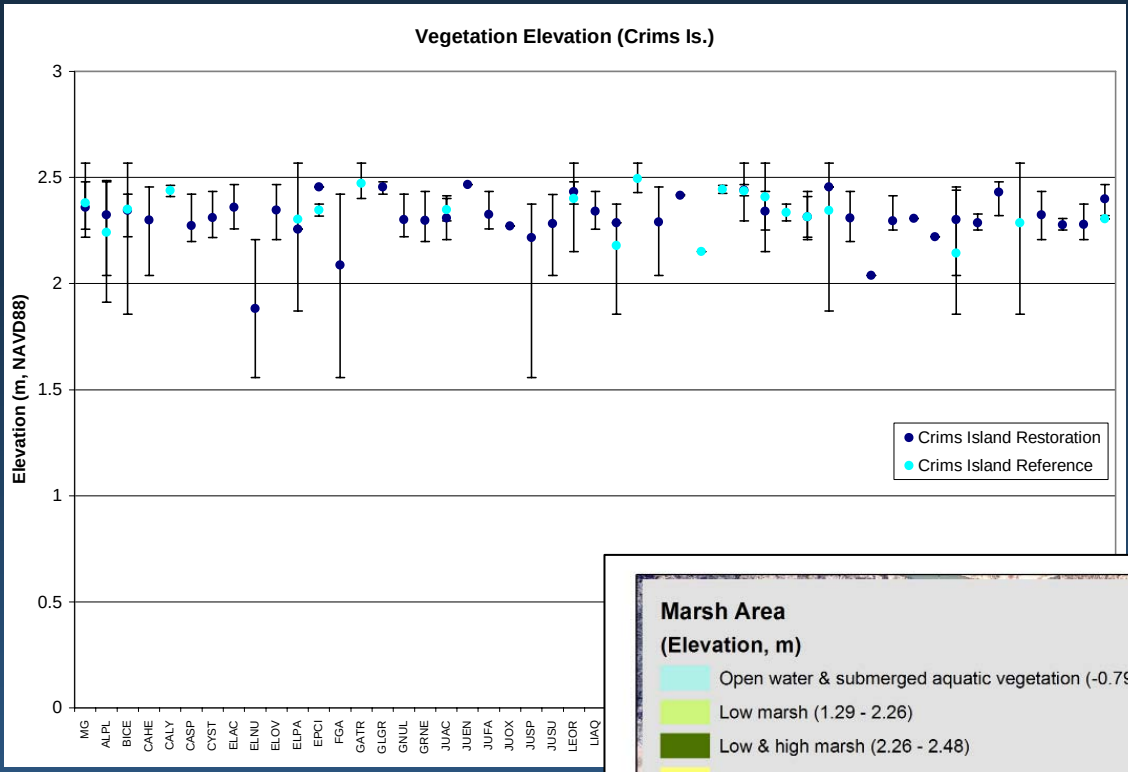
VAPA
VEAM
VISP



HL Diefenderfer, AM Coleman, AB Borde, IA Sinks. In Press. Hydraulic geometry and microtopography of tidal freshwater forested wetlands and implications for restoration, Columbia River, U.S.A. International Journal of Ecohydrology and Hydrobiology, December 2008.

Crims Island Restoration



Battelle

Implications for Restoration

Elevations of reference areas can provide information for restoration planning

- Swamps
  - Increase microtopography to replicate conditions in reference areas
- Marshes
  - Manage for invasive species (e.g. Reed canary grass)
- Created areas
  - Manipulate elevation to target elevations

Implications for Restoration

Elevation can explain some differences between restoration and reference areas

- Diked areas
  - Lower elevations
  - Reduced microtopography
- Created areas
  - Differences may not be due to elevation

Conclusions and Recommendations

- Important to collect data relative to known datum
  - NAVD88 allows comparison with other regions
  - CRD allow comparison within region
- Elevation linked with hydrology drives vegetation distribution and channel morphology
- Knowledge of vegetation elevations can improve restoration success
- Emerging dataset will improve as data continue to be collected and evaluated

Acknowledgements

Field assistants:

- Jimmie Cotton
- Jill Leary
- Nikki Sather
- Allan Whiting
- Dave Nicols

Funding and Support:

- LCREP
- USACE
- BPA


The End