

Wetland Reference Sites in the Lower Columbia River and Estuary: Data Synthesis and Restoration Planning Applications

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Pacific Northwest
NATIONAL LABORATORY

Presentation Overview

- ▶ Introduction
- ▶ Key Research Findings from Data Synthesis
- ▶ Restoration Planning Applications of Reference Sites Analysis

Introduction



Problem Statement

Comprehensive, specific, and detailed habitat data from reference wetland ecosystems in the LCRE is needed to help inform restoration design for the CEERP.



- Vegetation elevation ranges
- Channel/bank elevation and shape
- Inundation requirements



Restoration Planning Questions

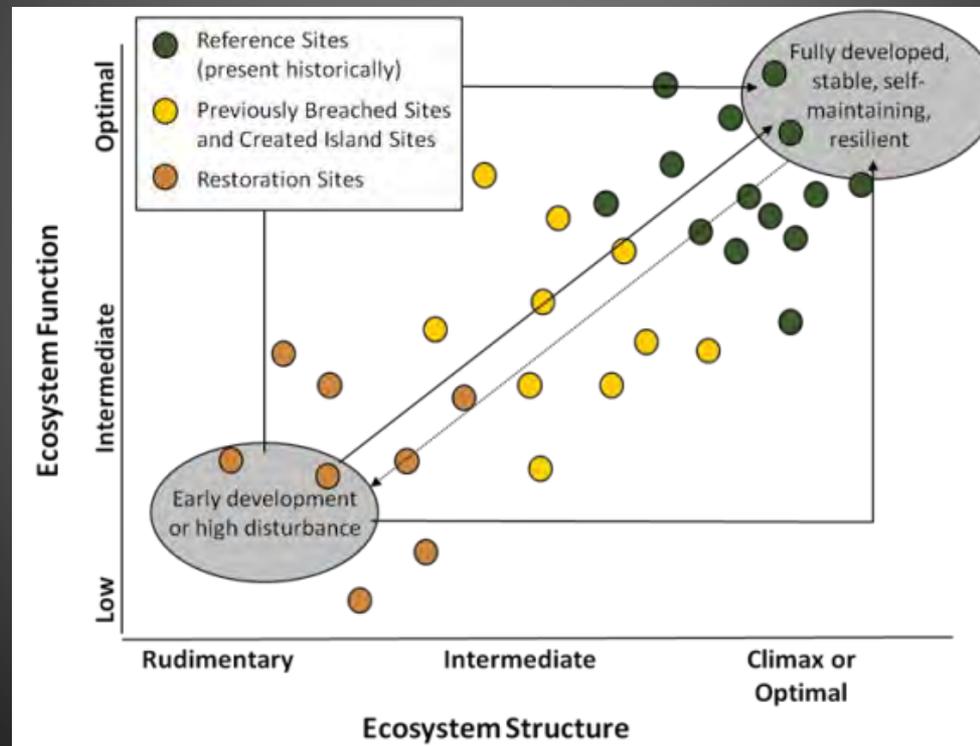
- ▶ How steep should the grade be?
- ▶ What elevation should the site be?
- ▶ What plant species could be expected to colonize?
- ▶ How can we avoid invasives, especially reed canary grass?

Goals

1. To characterize the environmental conditions required to restore and create tidal wetland plant communities in the LCRE.
2. To compare tidal wetland plant communities in the LCRE based on known anthropogenic and naturally occurring disturbances in their histories.

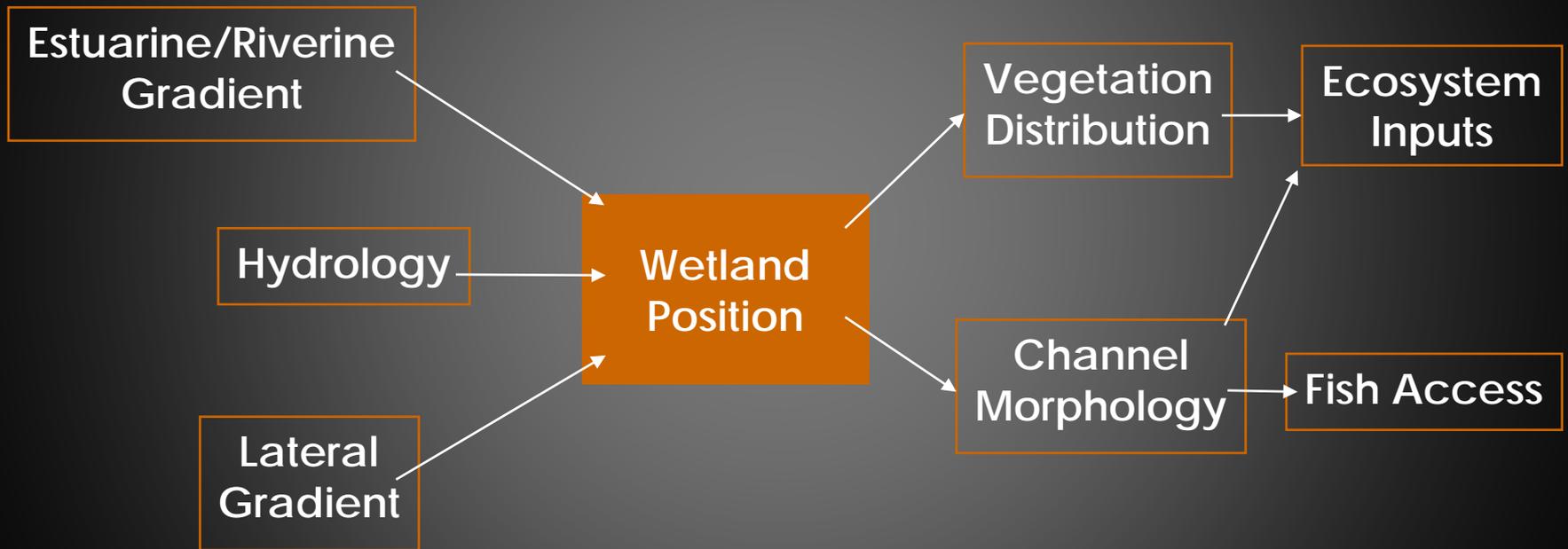
Definition

Reference Wetland - is generally defined as a site with environmental conditions similar to those desired at the restoration site and as little disturbed by human activity as possible.



Thom, RM, HL Diefenderfer, JE Adkins, C Judd, MG Anderson, KE Buenau, AB Borde, and GE Johnson. 2011. Guidelines, processes and tools for coastal ecosystem restoration, with examples from the United States. *Plankton Benthos Research* 5(supl):185-201.

Tidal Wetland Conceptual Model



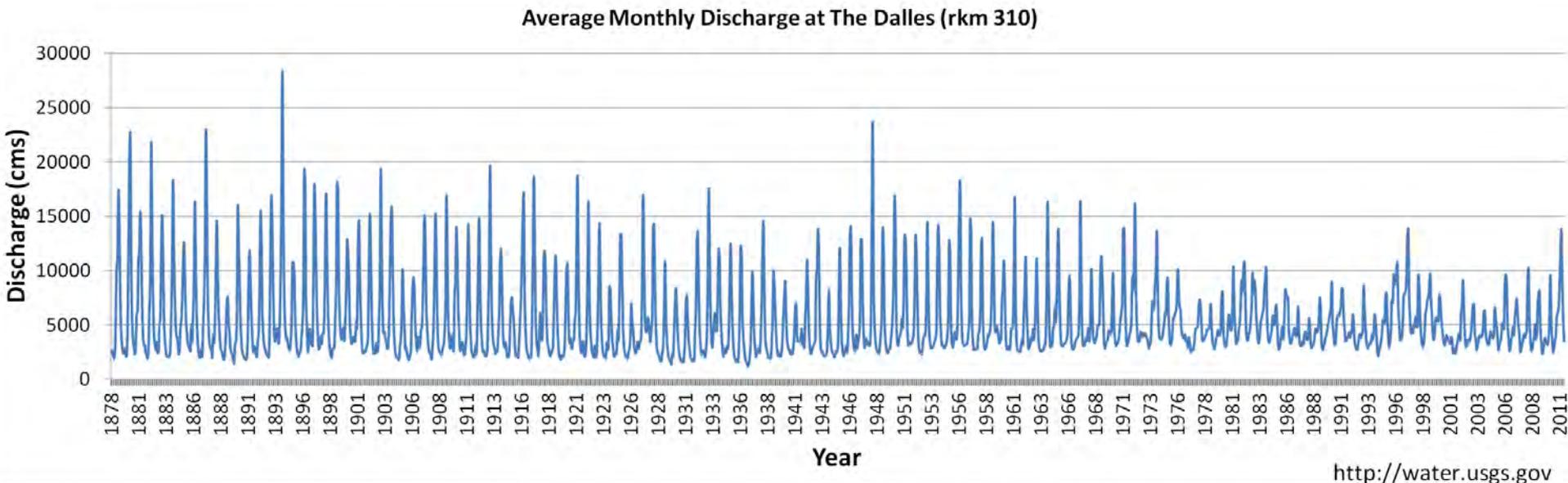
Research Questions: Ecosystem Structure

- ▶ 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



Research Questions: Disturbance History

- ▶ How have the changes in flow, altered sediment processes, and other anthropogenic influences affected reference wetlands:
 - Wetland establishment
 - Succession
 - Inundation patterns
 - Vegetation



Key Research Findings from Data Synthesis

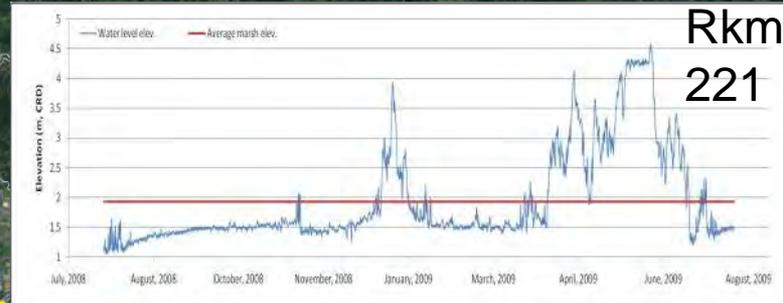
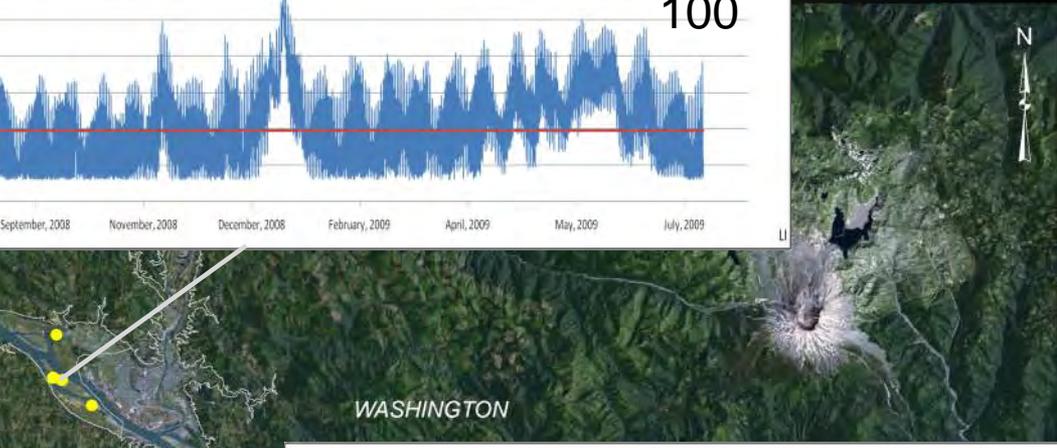
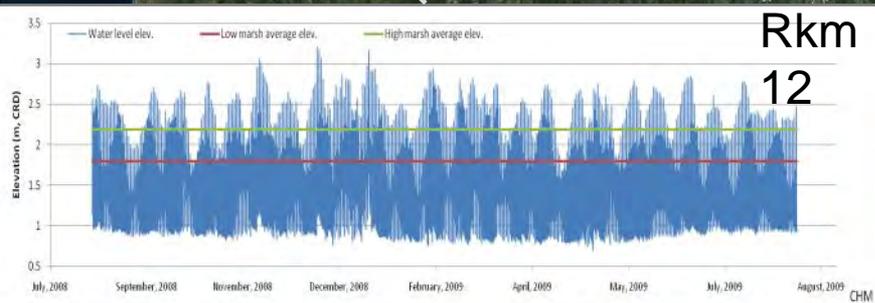
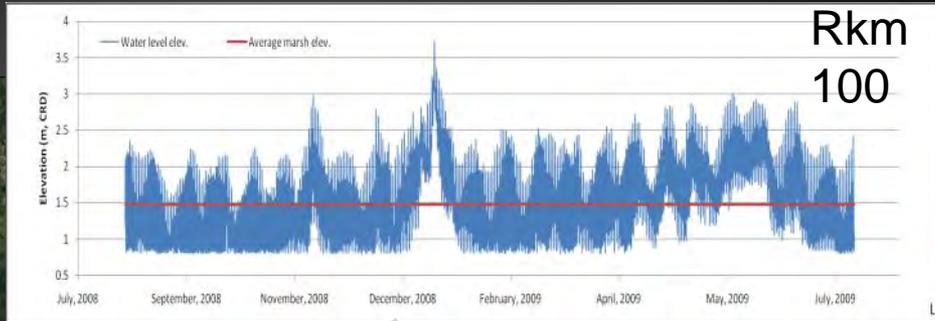


Data Synthesis

- ▶ 5 projects
 - Reference Site Study (LCEP/BPA)
 - Ecosystem Monitoring (LCEP/BPA)
 - Cumulative Effects (USACE)
 - Tidal Freshwater Research (Multi-Scale Study) (BPA/USACE)
 - Salmon Benefits (USACE)
- ▶ 55 sites
- ▶ 35 km estuarine zone
- ▶ 200 km tidal freshwater zone
- ▶ Monitored between 2005 and 2011



Study Sites



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

0 3 6 12 18 24 Kilometers

OREGON

Vancouver

Portland

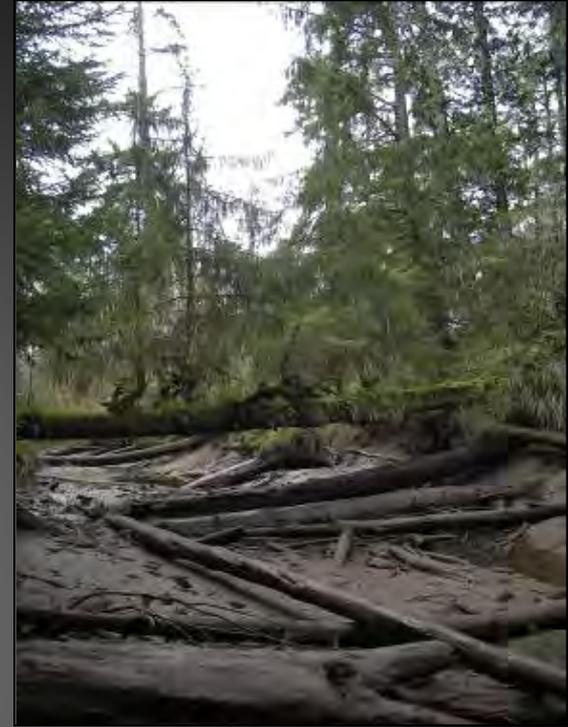
LCR Wetland Types



Brackish Marsh



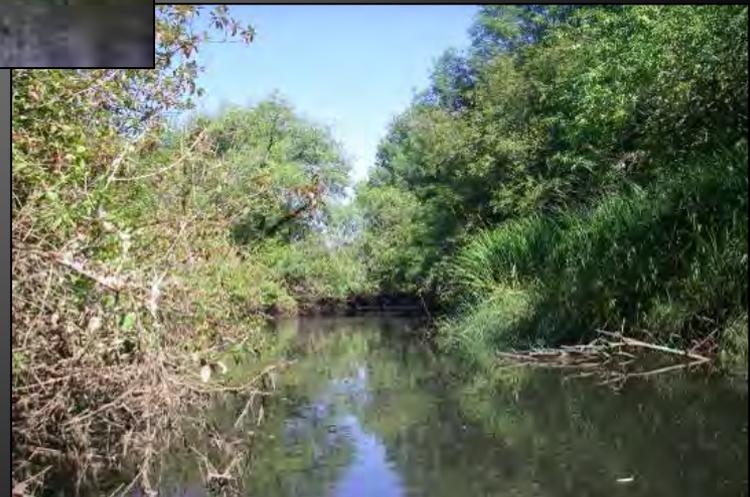
Shrub Wetland



Sitka Spruce Swamp



Tidal Freshwater Marsh



Riparian Forested Wetland

Metrics

- ▶ Vegetation percent cover surveys
- ▶ Vegetation community mapping
- ▶ Elevation collected with Real Time Kinematic (RTK) GPS, referenced to NAVD88
- ▶ Water level sensors were surveyed to evaluate hydrology relative to wetland morphology
- ▶ Sediment composition and accretion



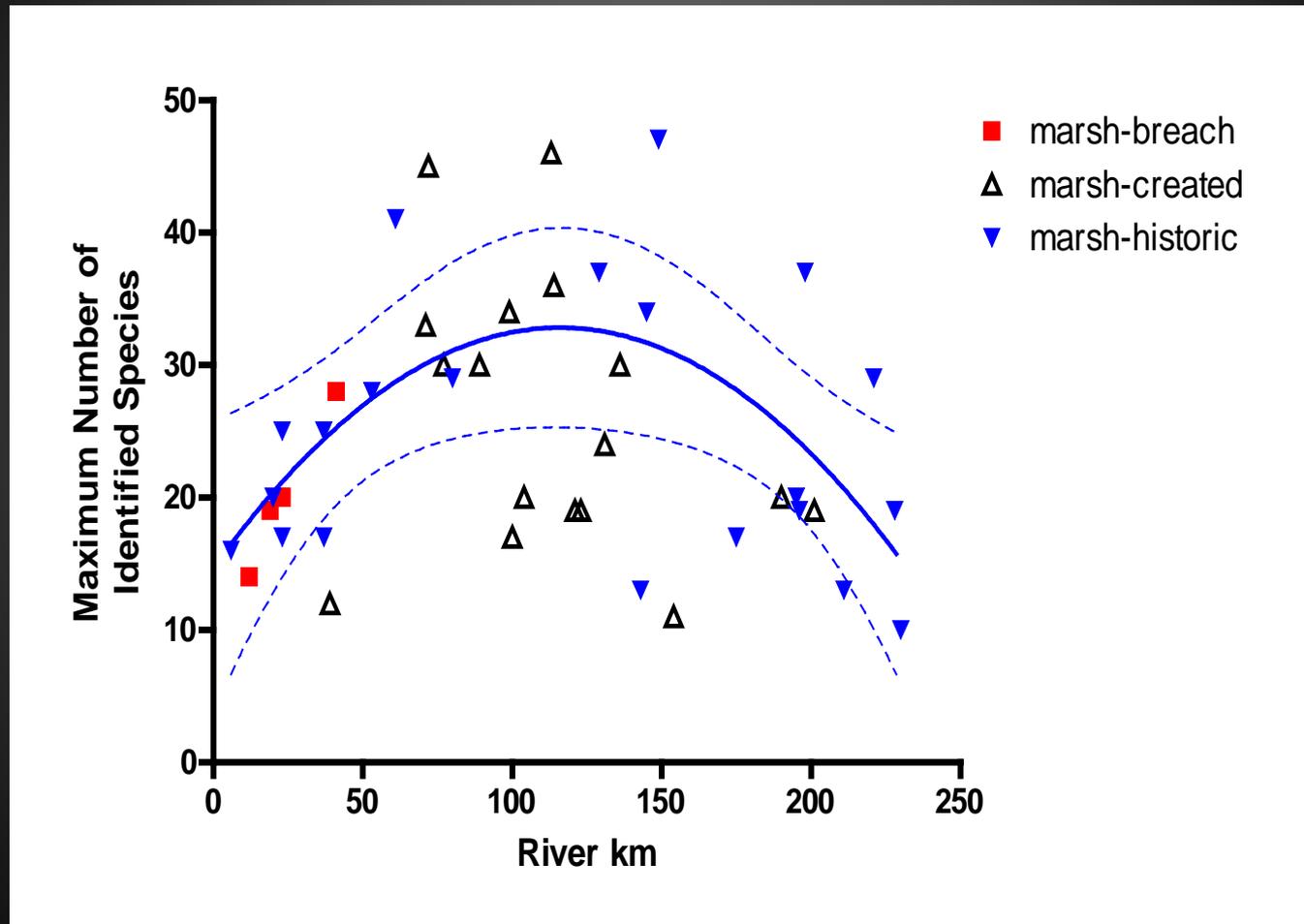
Overview of Marsh Vegetation Sampling

- ▶ 41 marsh sites
- ▶ 2784 quadrats sampled
- ▶ Reed canary grass occurred in 52% of the quadrats
- ▶ 172 taxa observed
- ▶ 7 taxa made up 68% of the cumulative cover

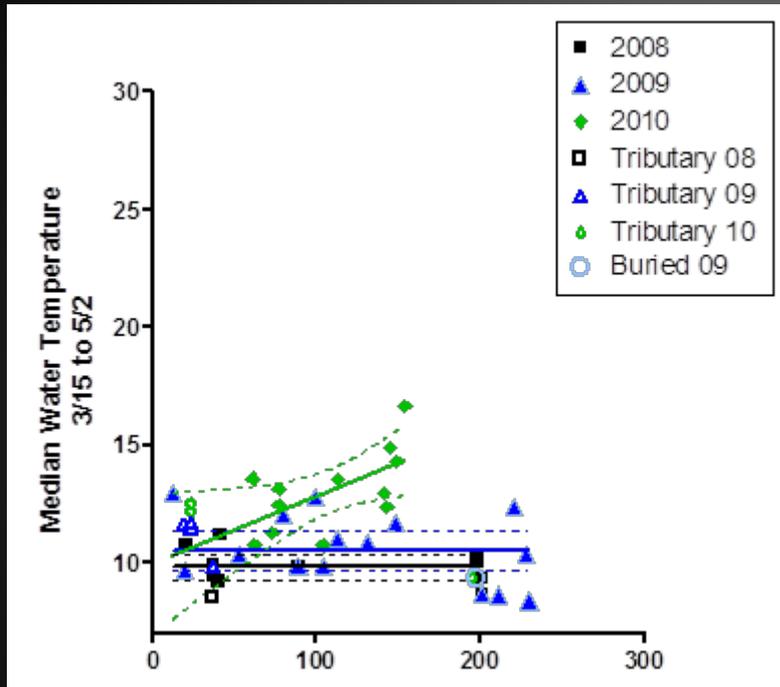
Common Name	Species Code	Percent Cover	Cumulative Cover
Reed canary-grass	PHAR	28%	28%
Common spikerush	ELPA	21%	49%
Wapato	SALA	10%	59%
Lyngby sedge	CALY	3%	62%
Canada waterweed	ELCA	2%	64%
False loosestrife	LUPA	2%	66%
Slough sedge	CAOB	2%	68%



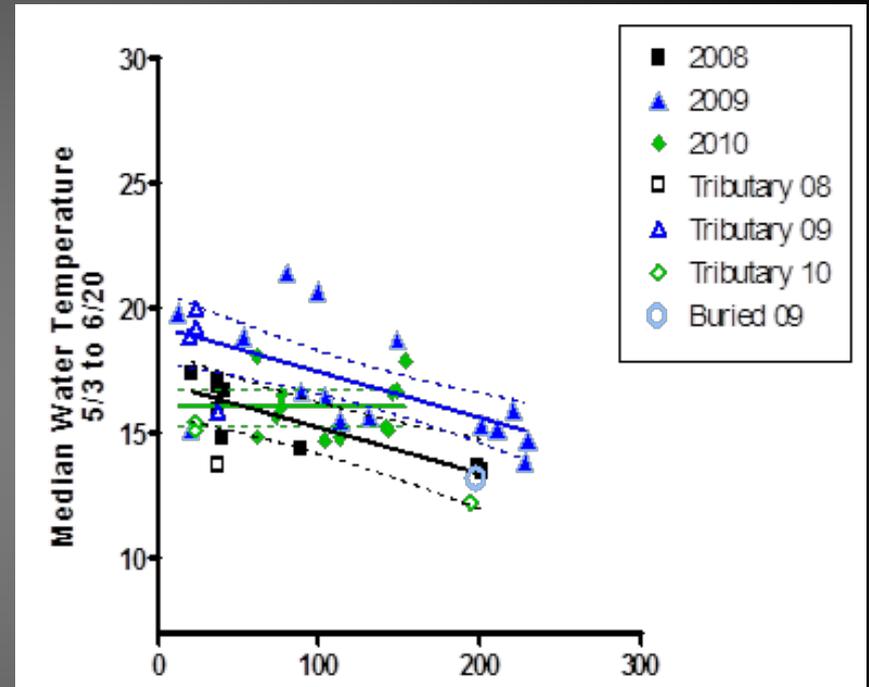
Plant Species Diversity



Water Temperature

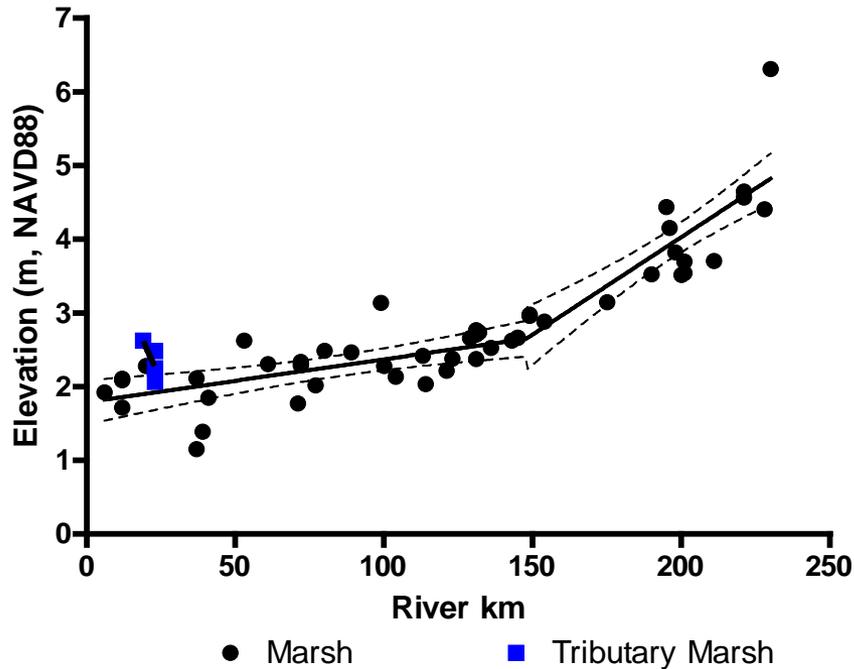


Spring



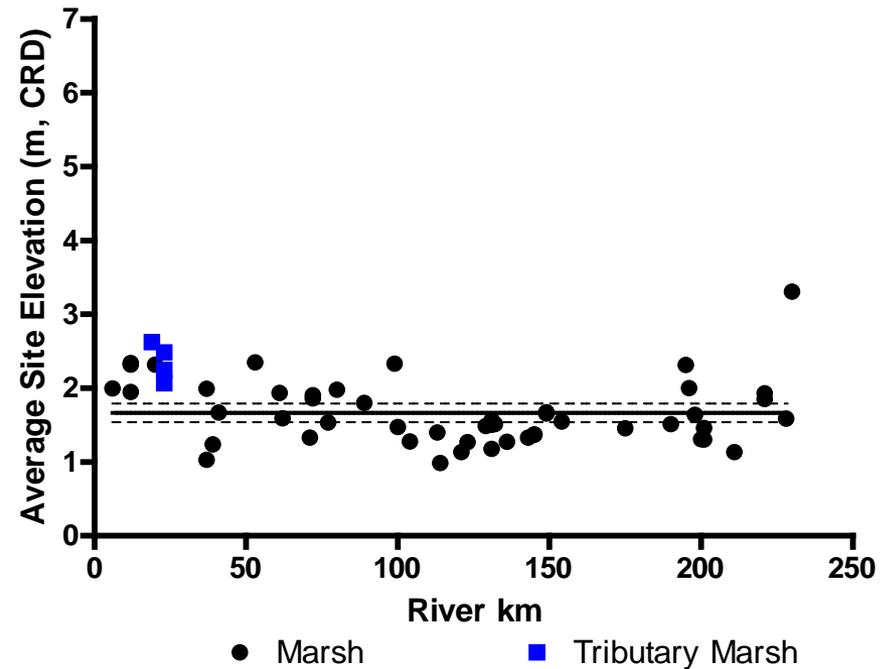
Early Summer

Elevation



NAVD88

North American Datum 1988

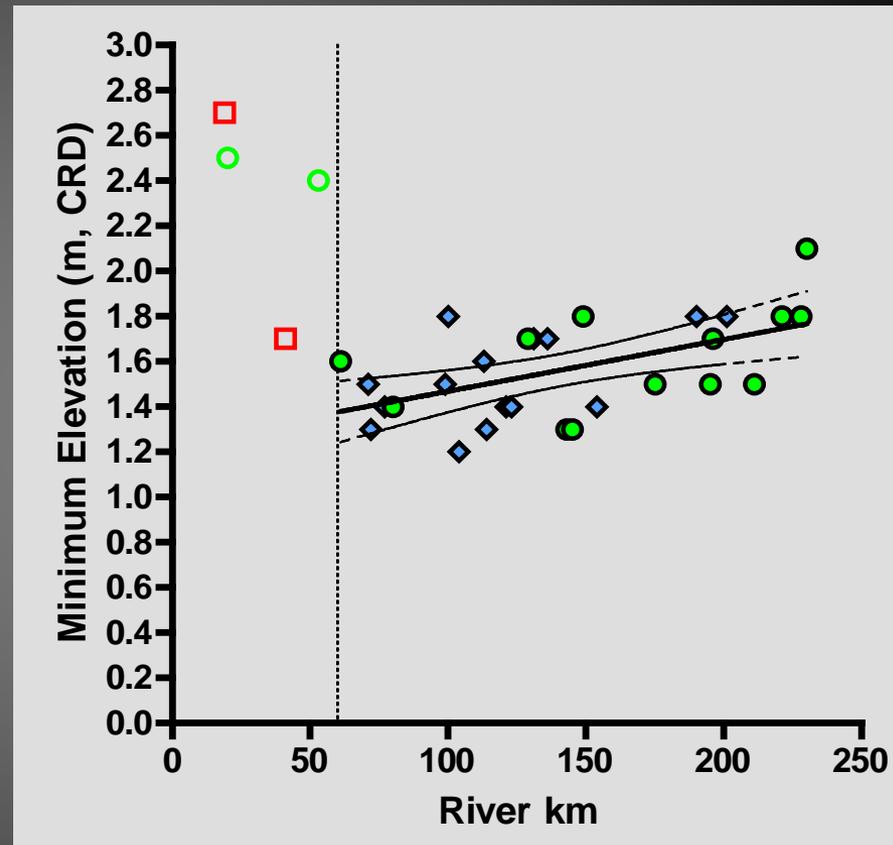


CRD

Columbia River Datum

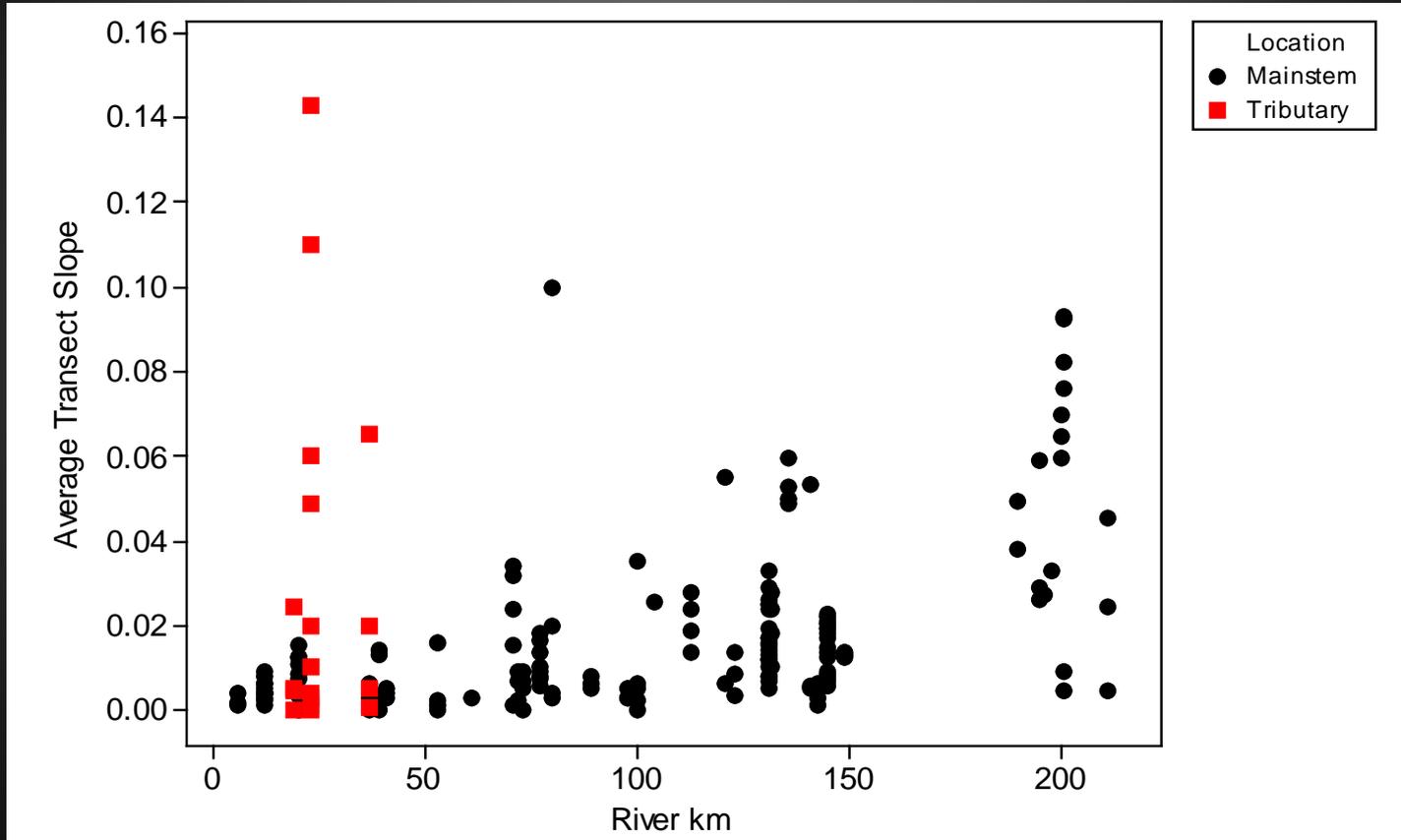
Elevation of Invasive Reed Canary-Grass

- ▶ Average minimum elevation 1.4 to 1.7 m, CRD
- ▶ Below 1.5 m, CRD
 - Spike rush (*Eleocharis palustris*)
 - Wapato (*Sagittaria latifolia*)

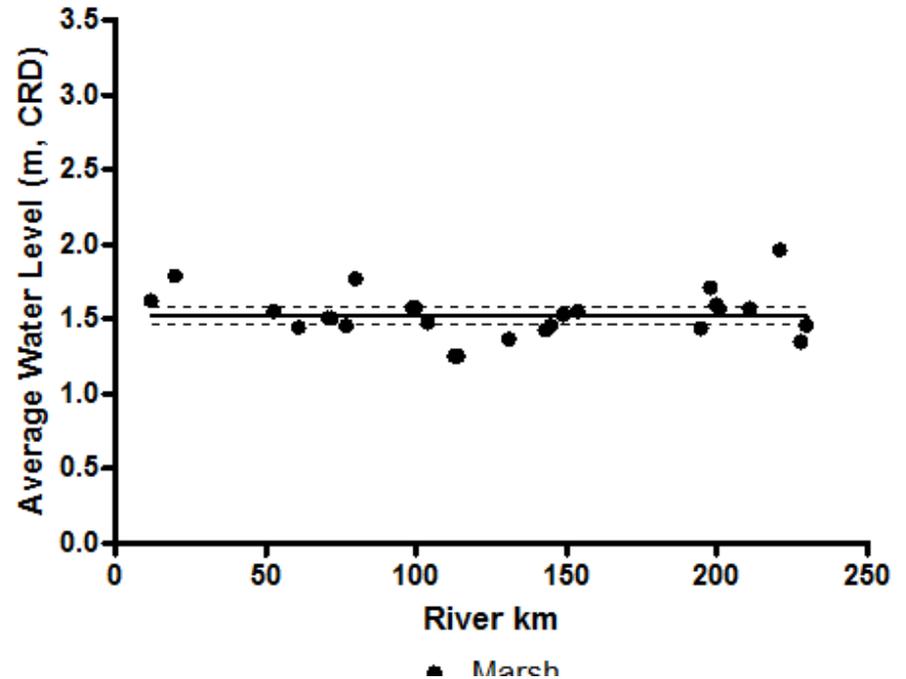
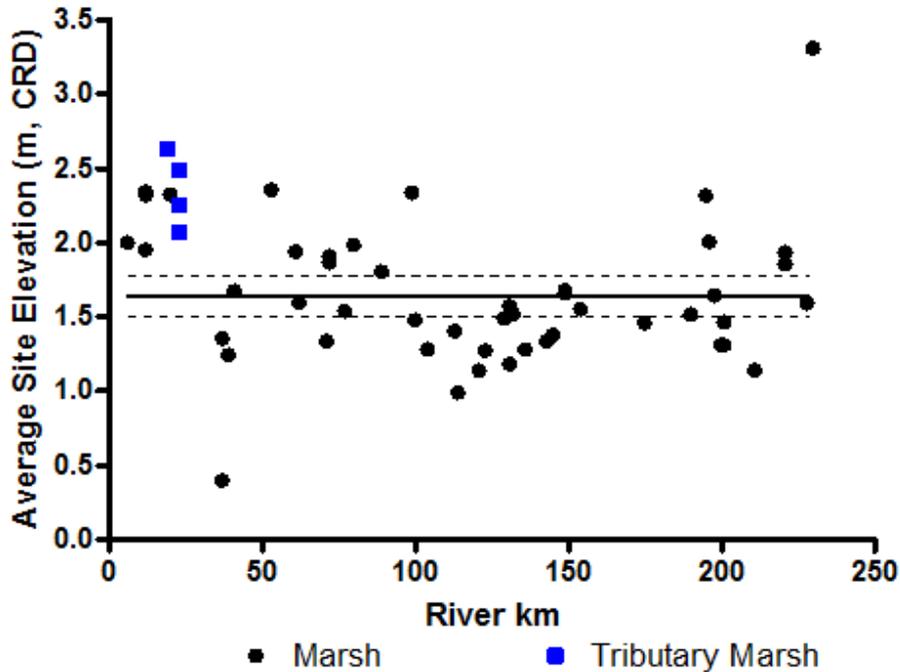


Sagar et al. In preparation. Ecosystem Monitoring 2011 Synthesis Report.

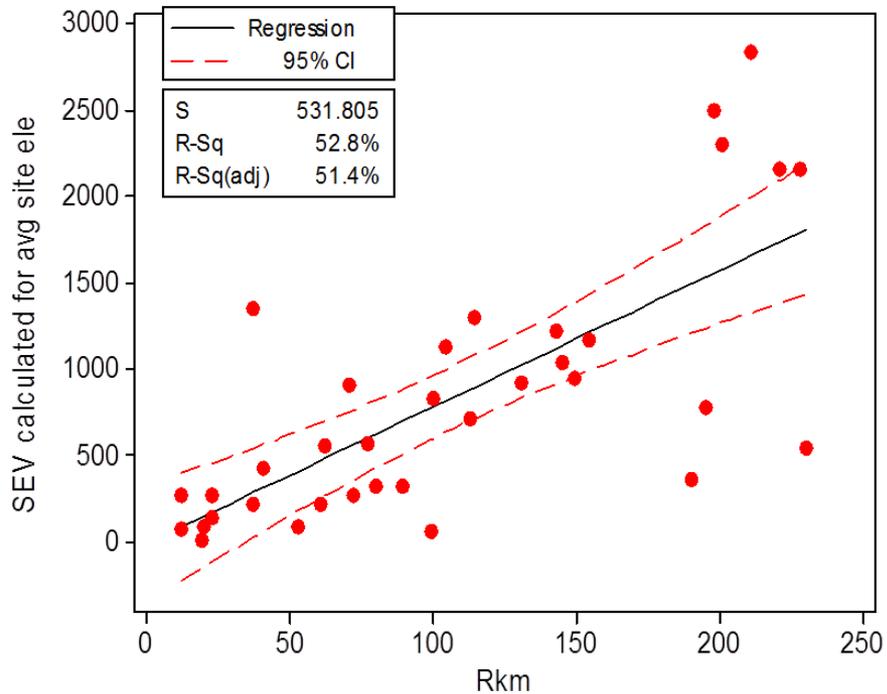
Slope



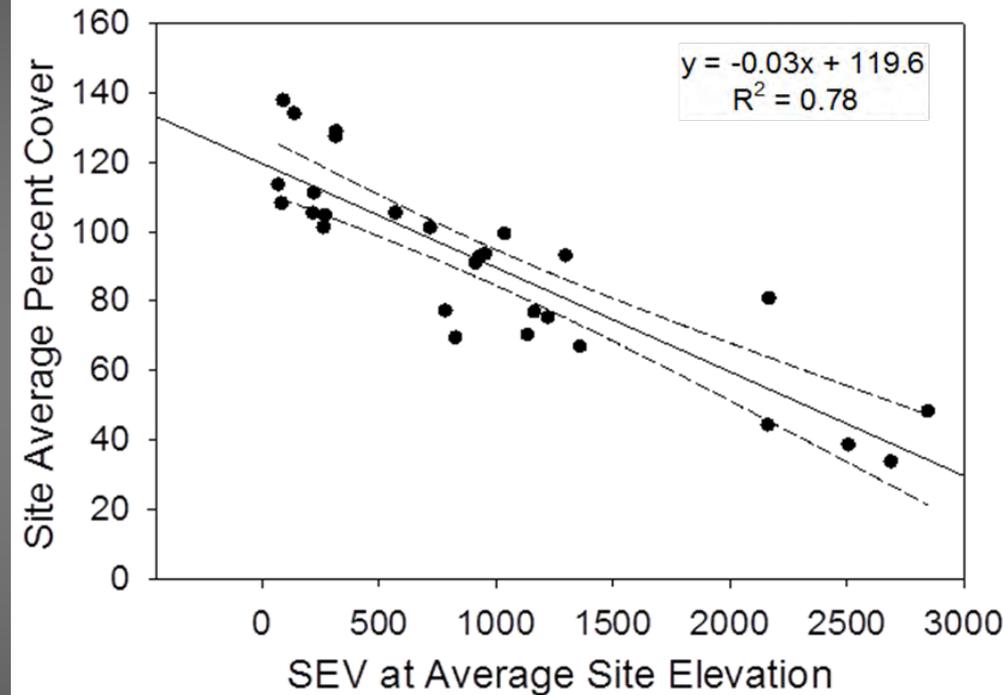
Wetland Elevation is Related to Water Surface Elevation



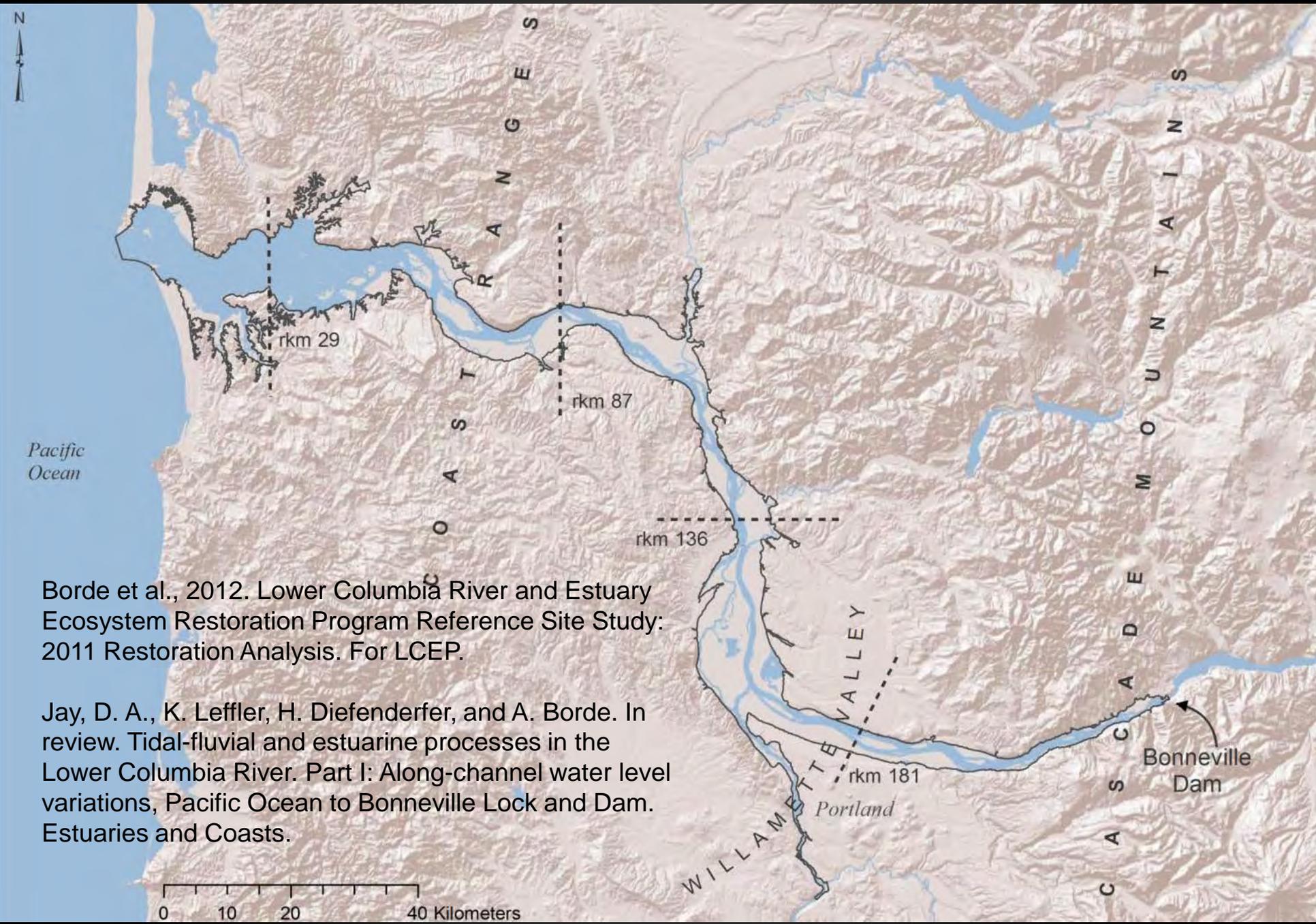
Spatial Analysis of Inundation



Inundation increases with Rkm



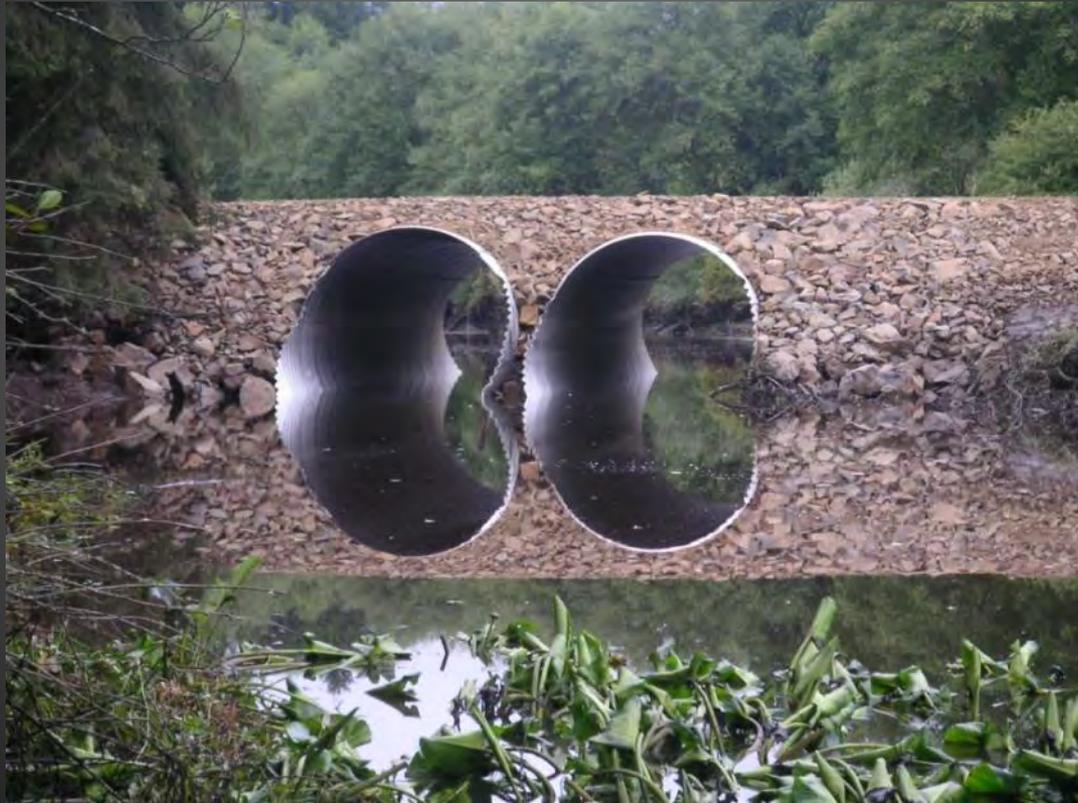
Total vegetated cover decreases with increasing inundation



Borde et al., 2012. Lower Columbia River and Estuary Ecosystem Restoration Program Reference Site Study: 2011 Restoration Analysis. For LCEP.

Jay, D. A., K. Leffler, H. Diefenderfer, and A. Borde. In review. Tidal-fluvial and estuarine processes in the Lower Columbia River. Part I: Along-channel water level variations, Pacific Ocean to Bonneville Lock and Dam. *Estuaries and Coasts*.

Restoration Planning Applications



Example

▶ Restoration site located at rkm 120 on the mainstem of the River. Target community is emergent marsh.

- Site would be located in EM zone 3
- The likely native species would be:

● <i>Elodea canadensis</i>	-0.1 – 1.1 m, CRD
● <i>Sagittaria latifolia</i>	0.5 – 1.5
● <i>Eleocharis palustris</i>	0.6 – 1.6
● <i>Schoenoplectus americanus</i>	0.9 – 1.0
● <i>Lilaeopsis occidentalis</i>	1.1 – 1.2
● <i>Leersia oryzoides</i>	1.3 – 1.5
● <i>Carex obnupta</i>	1.4 – 2.1

Example

- ▶ Restoration site located at rkm 120 on the mainstem of the River. Target community is emergent marsh.
 - The likely non-native species would be:
 - *Schoenoplectus triqueter* 0.9 – 1.2 m, CRD
 - *Iris pseudacorus* 1.1 – 1.7
 - *Phalaris arundinacea* 1.1 – 2.6
 - Additional species and their elevations can be found in report.

Example

- ▶ Restoration site located at rkm 120 on the mainstem of the River. Tide gate present and target community is emergent marsh.
 - If full connectivity is not expected (e.g., as with a tide gate) the expected SEV at the site elevations could be calculated to predict the vegetation community

<u>SEV (m/growing season)</u>	<u>Community</u>
< 700	high marsh
700 – 950	transitional
> 950	low marsh

Key Findings for Restoration Planning

- ▶ EM Zones are an effective way of partitioning the LCRE to improve restoration planning.
- ▶ Elevation is a good predictor of vegetation communities within an EM Zone.
- ▶ SEV is a better predictor is full connectivity is not expected.
- ▶ Variability in reference wetlands is caused by additional factors such as:
 - Landscape position (e.g., distance from the main channel)
 - Disturbance history



Data Gaps

- ▶ The age of wetland sites in the LCRE.
- ▶ The effect of natural and anthropogenic disturbances on:
 - Wetland succession
 - Non-native vegetation development
 - Channel formation
- ▶ The effect of reed canary grass and other non-native species on habitat quality for salmon
 - Quantity and quality of macro-detritus production
 - Differences in the prey community

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