Trajectories of Ecosystem Recovery in Oligohaline Tidal Wetland Reconnection Restoration Projects

Sarah Kidd
Alan J. Yeakley
Portland State University
Columbia River Estuary Workshop
Astoria, OR - May 30, 2014

A little about me

- **Working in the LCRE since 2008**

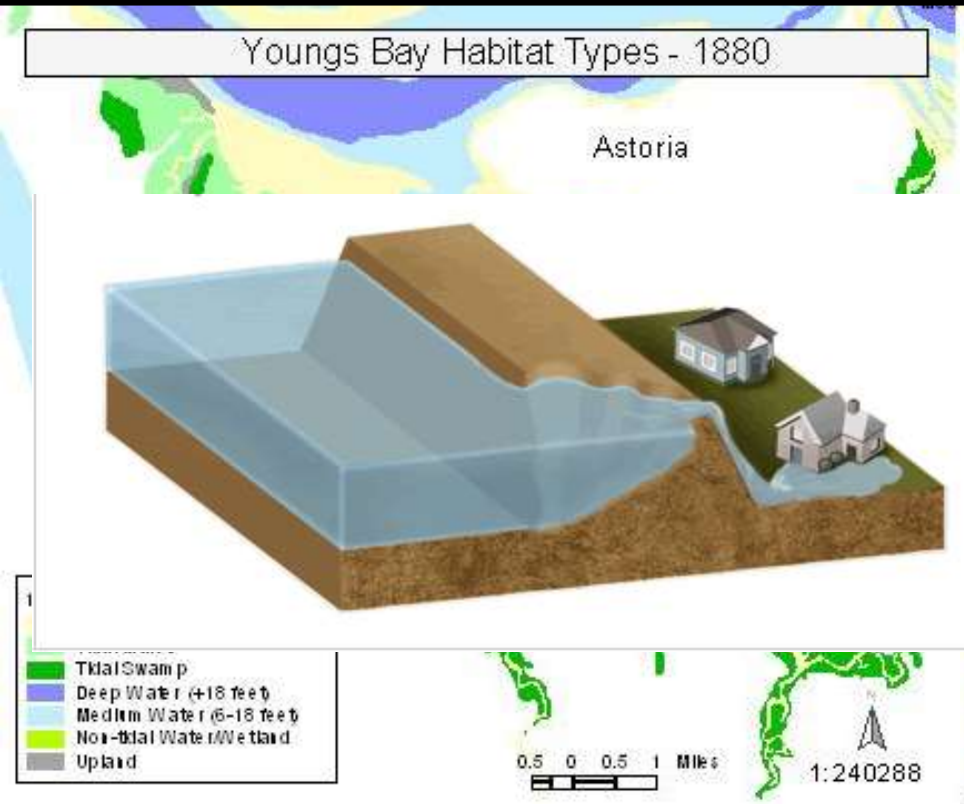
Portland State University, OR
M.S. Environmental Science 2011
Thesis: Riparian wetland response to livestock exclusion in the Lower Columbia River Basin

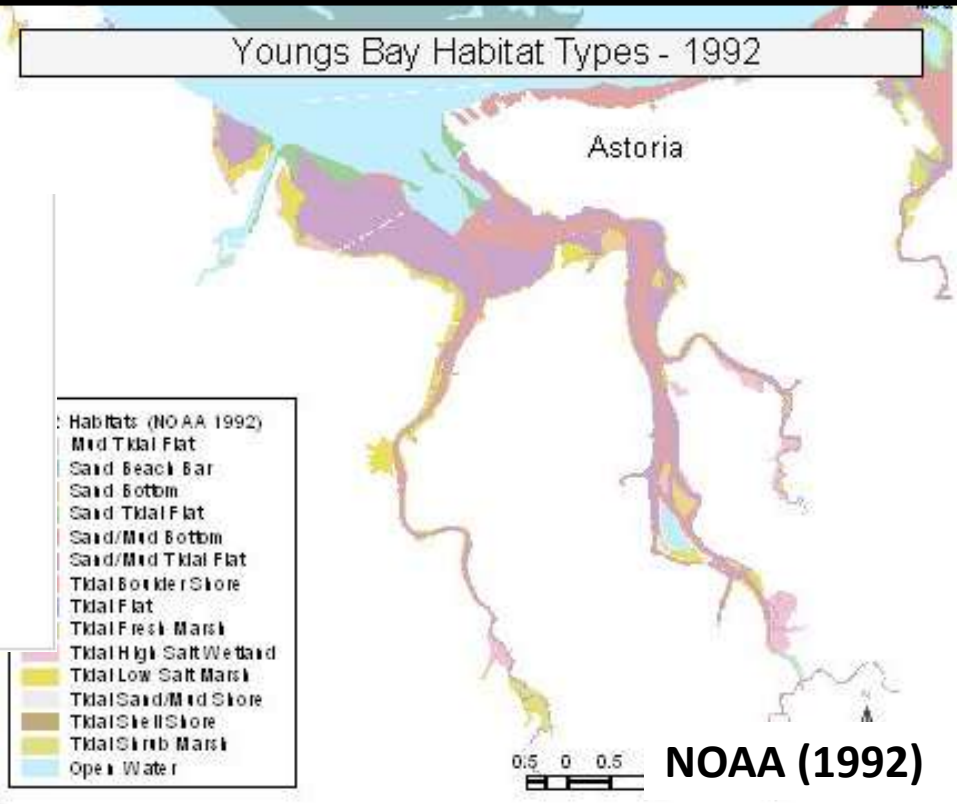
- **Currently 3rd yr PhD student**
- **Portland State University**
- **NSF Fellowships**
  - **IGERT - Ecosystem Service**
  - **GK12 - Science Inquiry**

Talk Outline

- Background: What, Where, How
- First Year Preliminary Results
- Future Research Direction

Young's Bay Watershed, Oregon - Land Conversion - 97% Loss of Tidal Wetlands





NOAA (1992)

How long does it take to restore:

Diked Pasture

Tidal Wetland

Objective: to identify the rate of ecosystem service recovery in tidally reconnected oligohaline (salinity 0.5-5 ppt) wetlands on historically diked agricultural lands in the Columbia River Estuary

How long does it take to restore:

Diked Pasture

Tidal Wetland

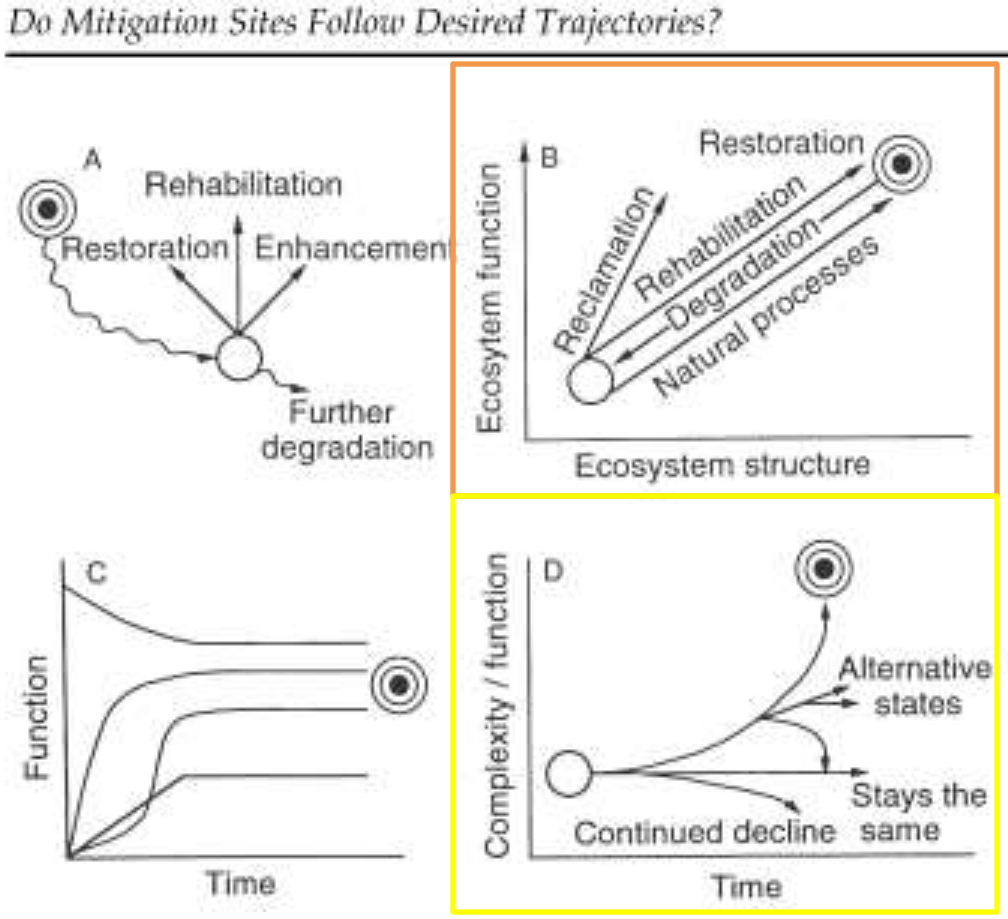
Legacy of restoration in Young's Bay allows for a space for time - chronosequence study of oligohaline tidal wetland restoration outcomes

Map of Tidal Restoration Wetlands in Young's Bay Watershed

By Years of Tidal Reconnection

State of Tidal Wetland Restoration

Hypothesized Restoration Trajectories of Tidal Wetland Ecosystems



Zedler, J. B., and J. C. Callaway. 1999. "Tracking Wetland Restoration: Do Mitigation Sites Follow Desired Trajectories?" *Restoration Ecology* 7 (1): 69–73.

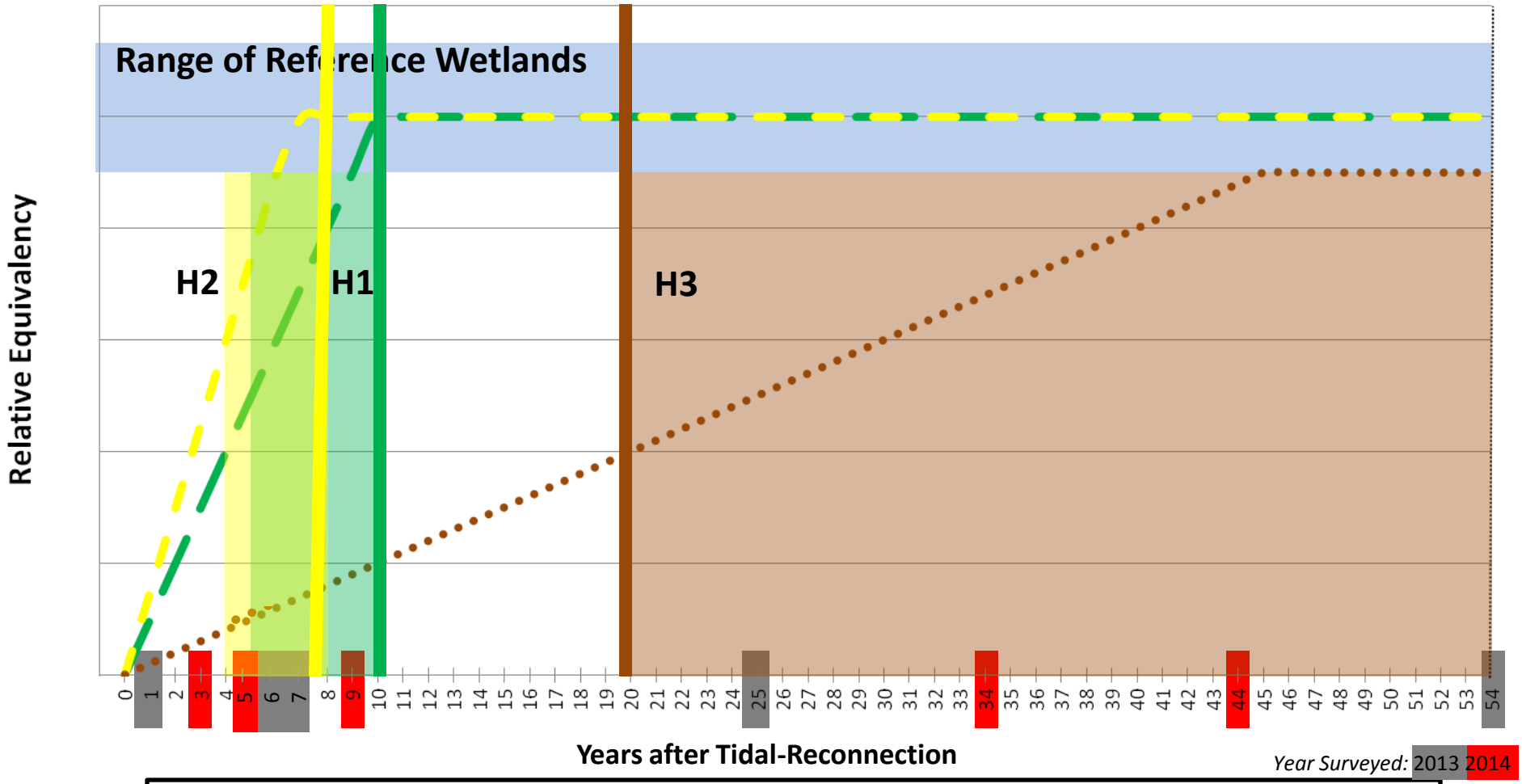
State of Tidal Wetland Restoration

Hypothesized Restoration Trajectories of Tidal Wetland Ecosystems

Primary Wetland Restoration Trajectory Studies:

Study Citation	United States Coastal Tidal Wetland Location
DeBerry and Perry 2012	East - Fresh
Craft et al. 2002	East-Brackish
Craft et al. 2003	East - Salt marsh
Warren et al. 2002	East - Salt marsh
Morgan and Short 2002	East - Salt marsh
Tanner et al. 2002	West - Fresh/Oligohaline
Gray et al. 2002	West- Brackish and Oligohaline
Simenstad and Feist 1996	West- Brackish and Oligohaline
Simenstad and Thom 1996	West - Salt marsh
Zedler and Callaway 1999	West - Salt marsh
Thom et al. 2002	West-Salt marsh
Matthews et al. 2009	Mid-west - Fresh (non-tidal)
Simenstad et al. 2006	Review of Studies
Spencer et al. 2012	Review of Studies

Hypothesized Restoration Trajectories of Tidal Wetland Ecosystems



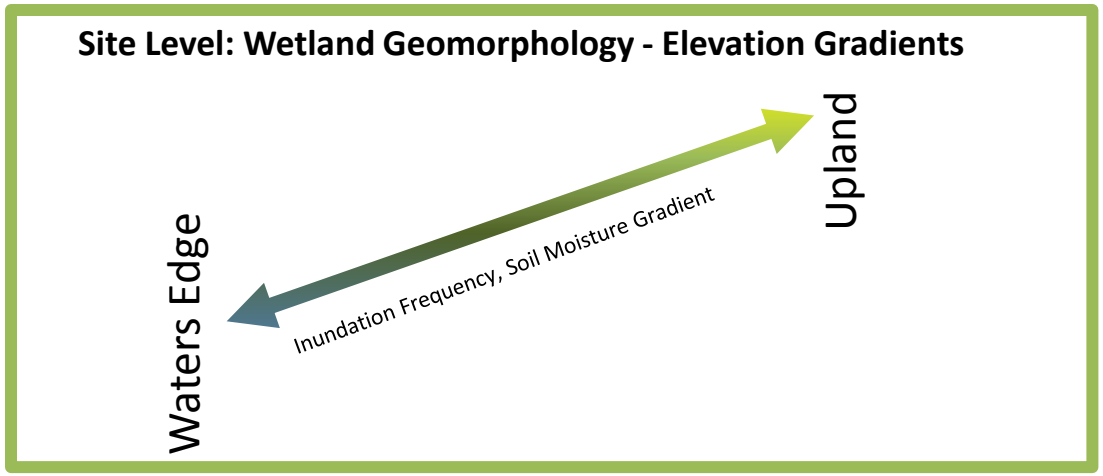
H1 **Plant Community Structure and Biodiversity:** Showing initial (0-5 years) shifts toward reference conditions, with near reference levels >10 years and older

H2 **Plant Biomass:** Showing increasing productivity (cover & height -biomass) with the age, reaching reference levels during the first 4-8 years

H3 **Soil development**: Showing surface soil bulk density and organic matter levels taking > 20 years to reach reference levels

Site Surveys - Methods

3 - 6, 100 m Transects were randomly established along the elevation gradient of each site (n=60 - 120 1m^2 quadrats per site)



Every 5 meters along each transect:

- ***Species cover, richness & height, topography-elevation***

Every 20-30 meters (n=12 per site):

- ***Biomass, soil OM and BD, sediment accretion***

Every site's main tidal channel:

- ***Hydrology & water conditions: water surface level elevations, temperature, salinity***

United State Geological Survey (USGS) tidal wetland monitoring and the Roegner et al. protocols (Roegner et al. 2009, USGS 2011).



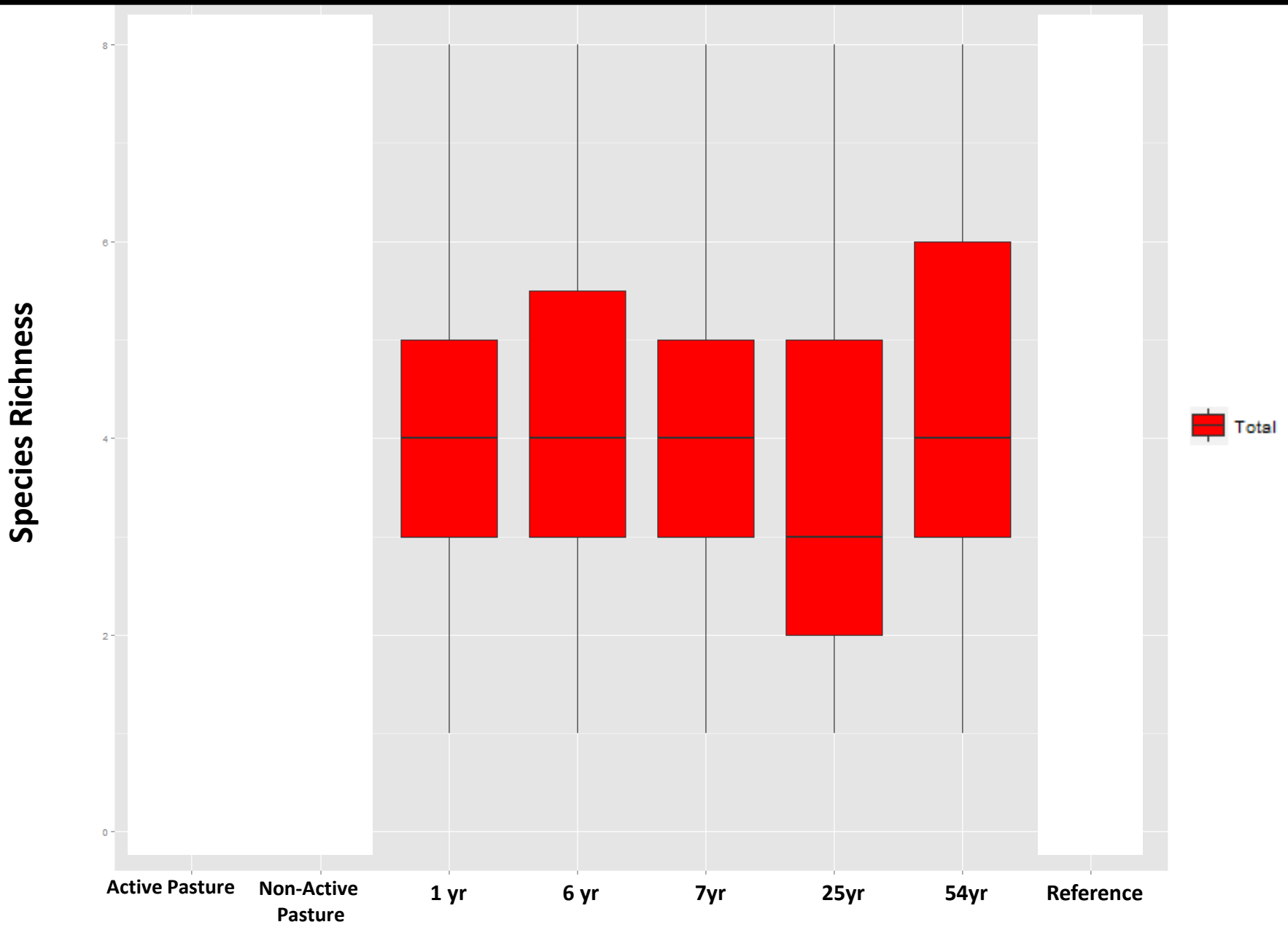




Many thanks to all the volunteer hours by Luke Murphy and Meredith Condon

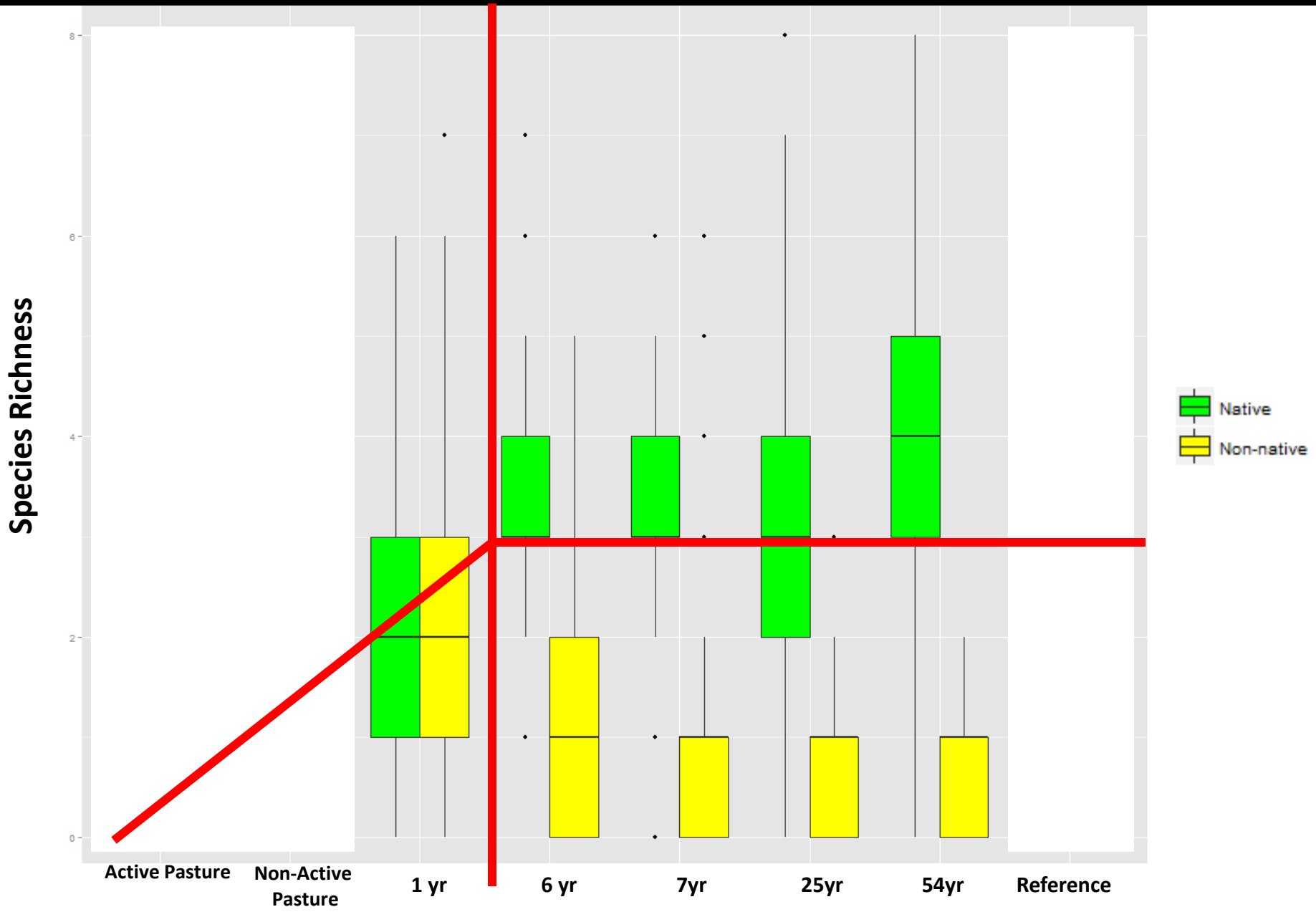
Plant Community Structure and Biodiversity

Total Species Richness



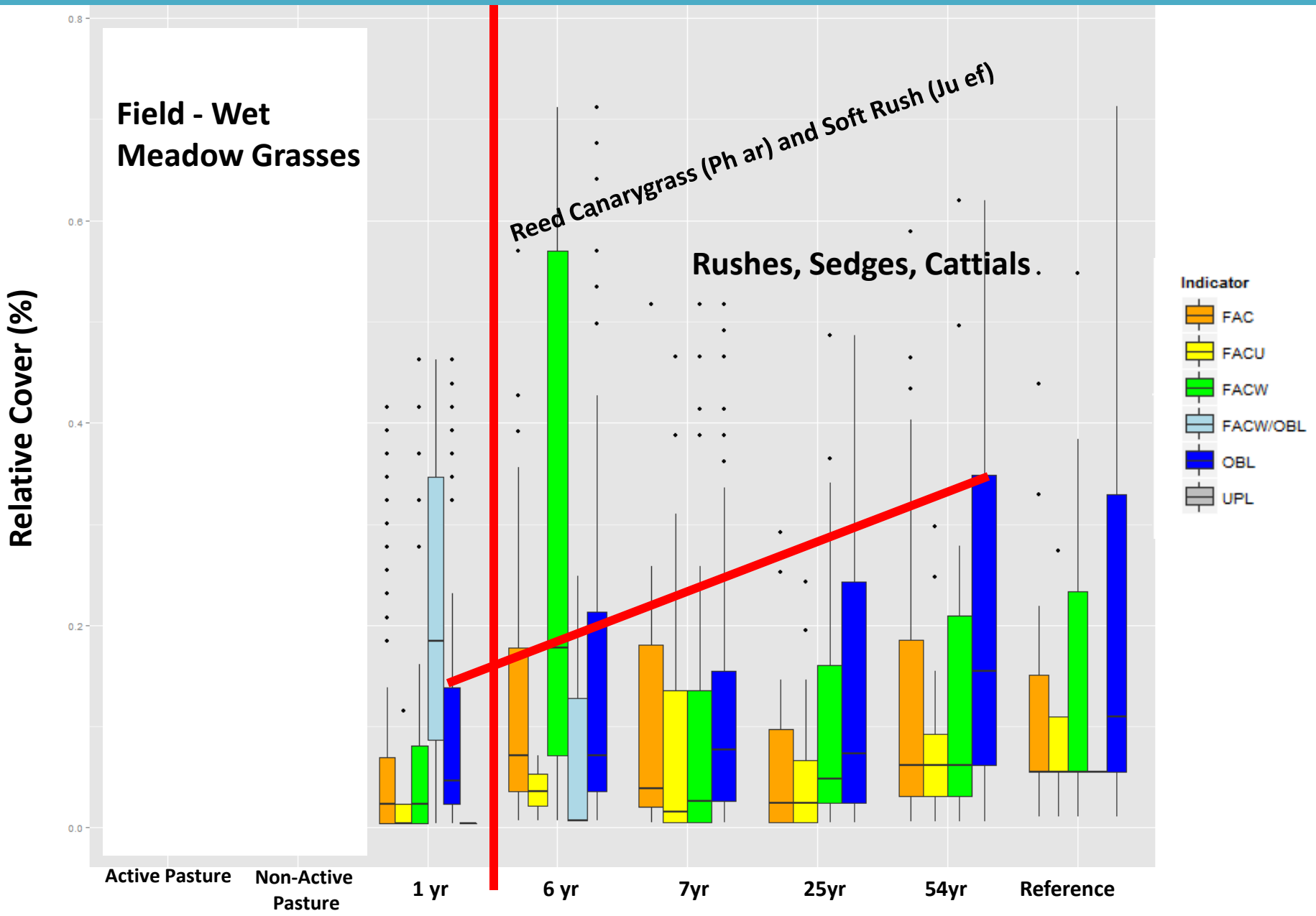
Plant Community Structure and Biodiversity

Native and Non-native Species Richness



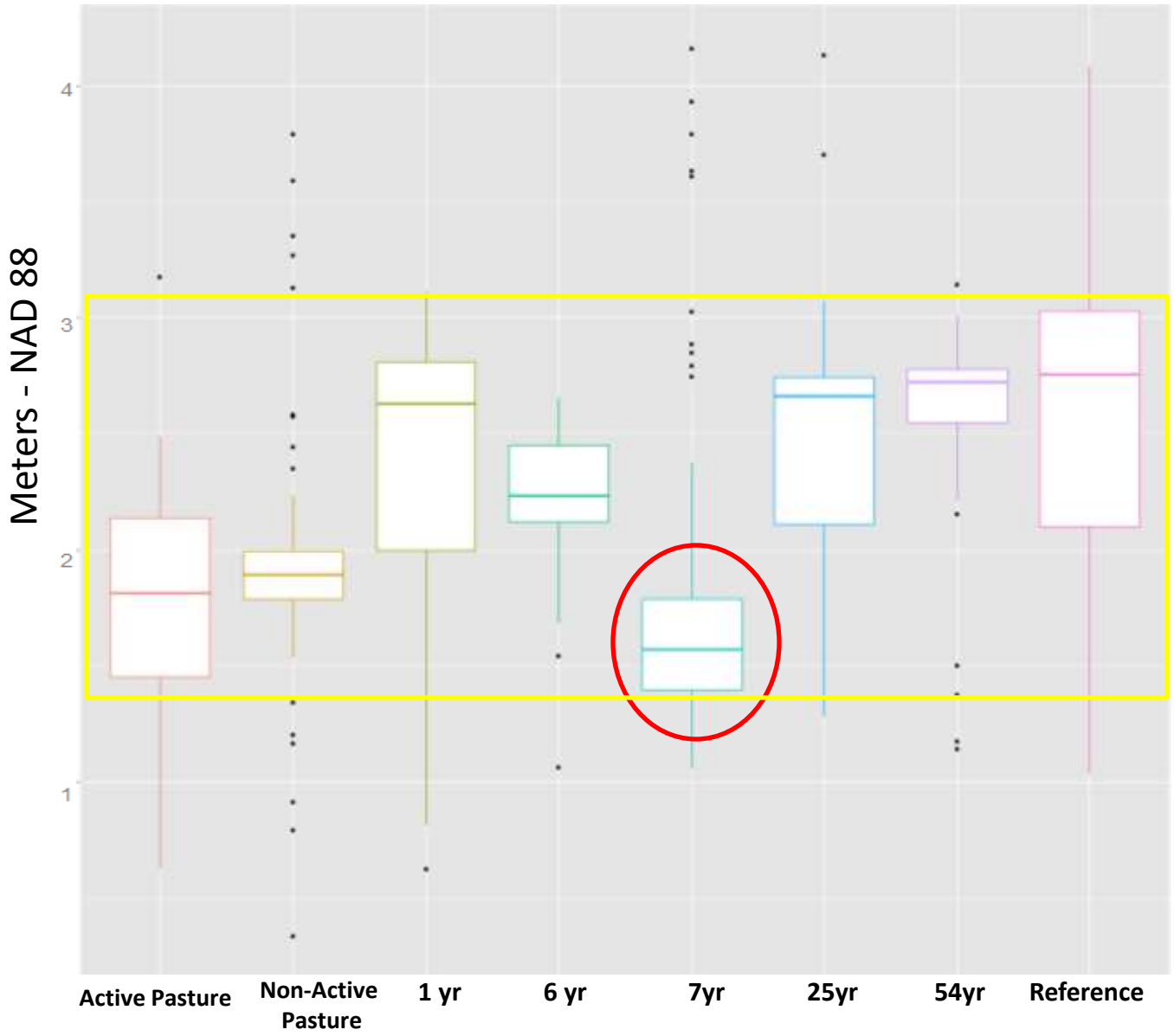
Plant Community Structure and Biodiversity

Wetland Indicator Status- Relative Abundance (%)



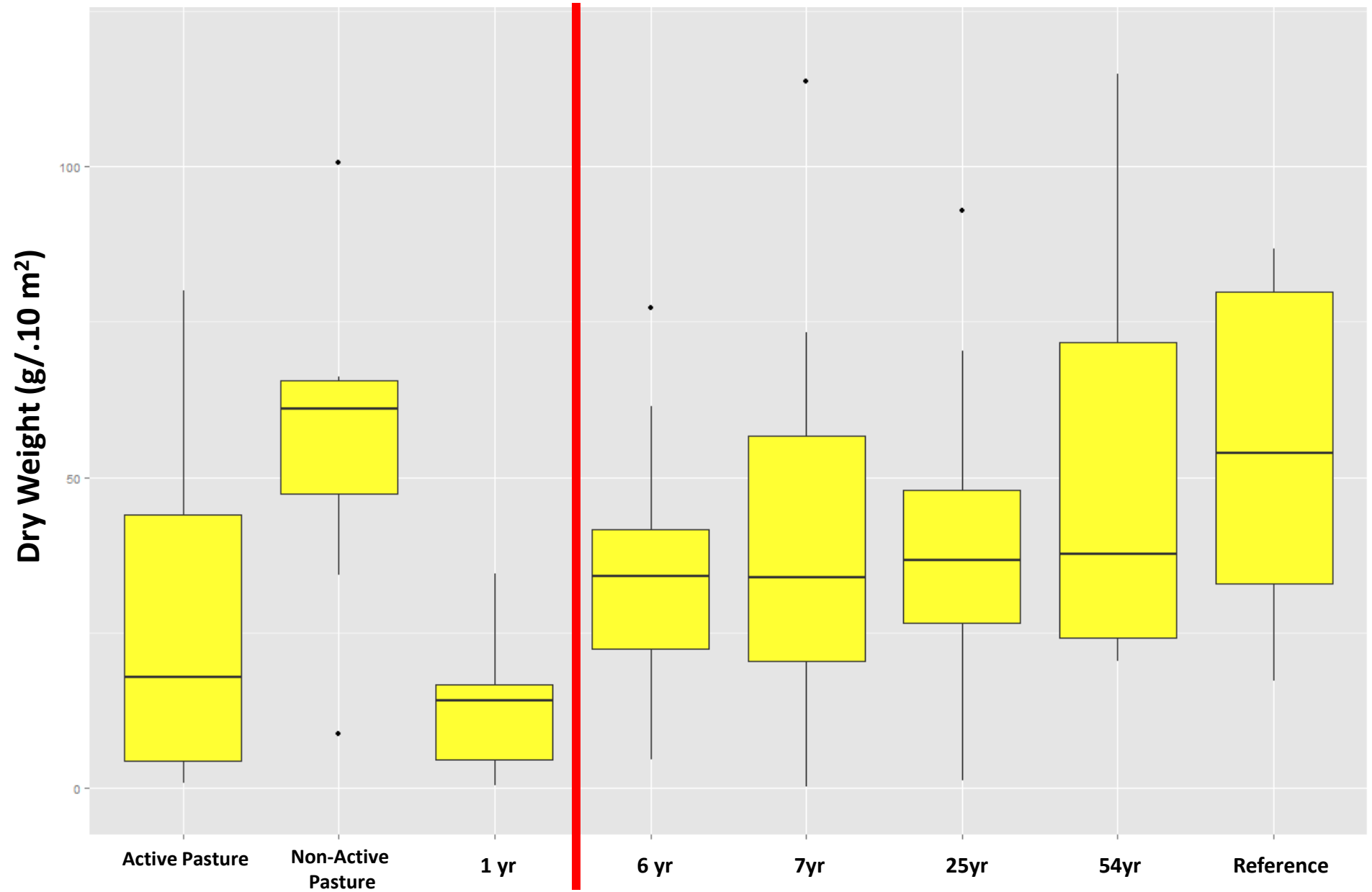
Site Topography

Elevation (NAD 88) Meter



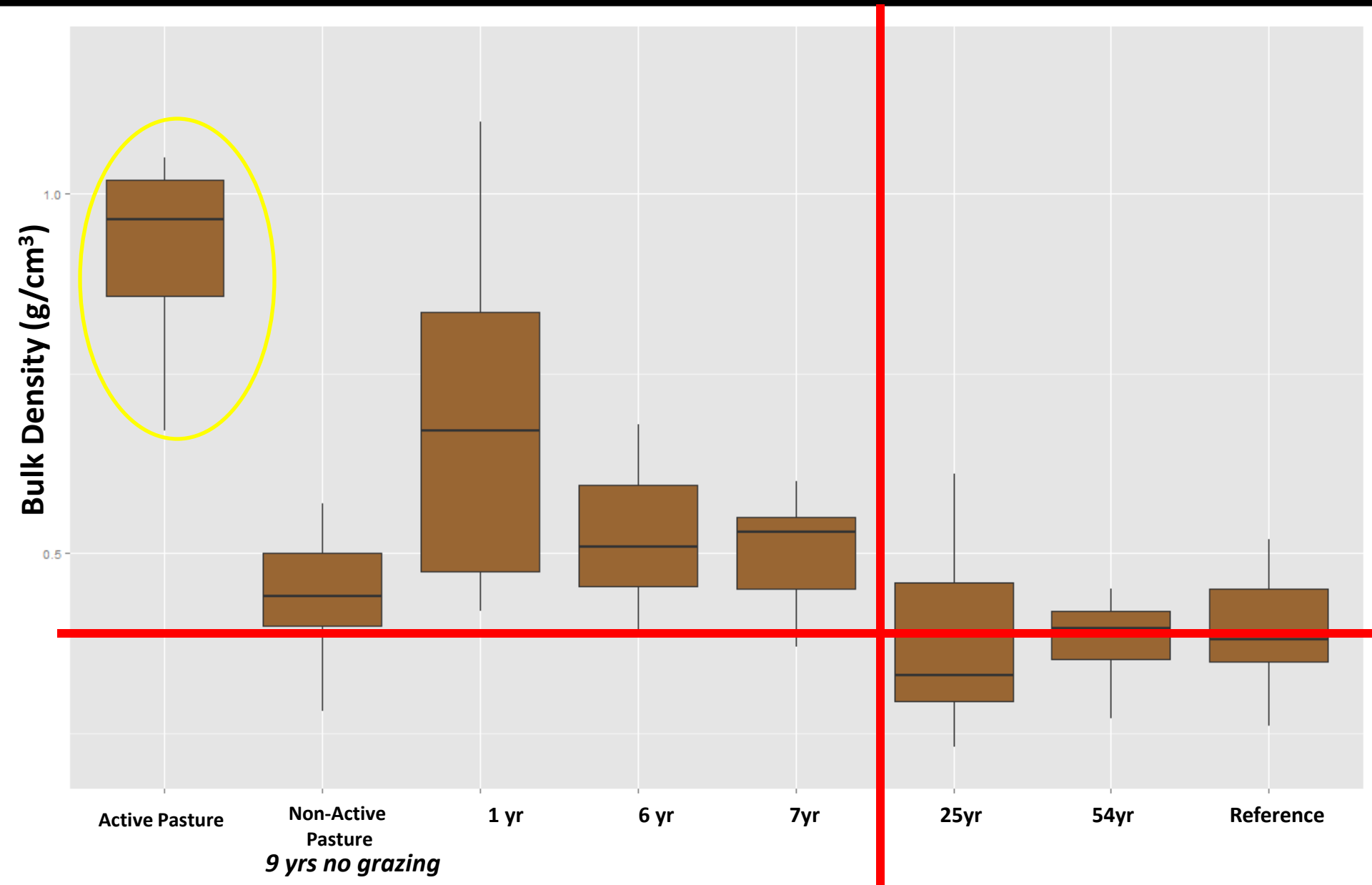
Plant Abundance - Biomass

Biomass - Dry Weight (g/.10 m^2)



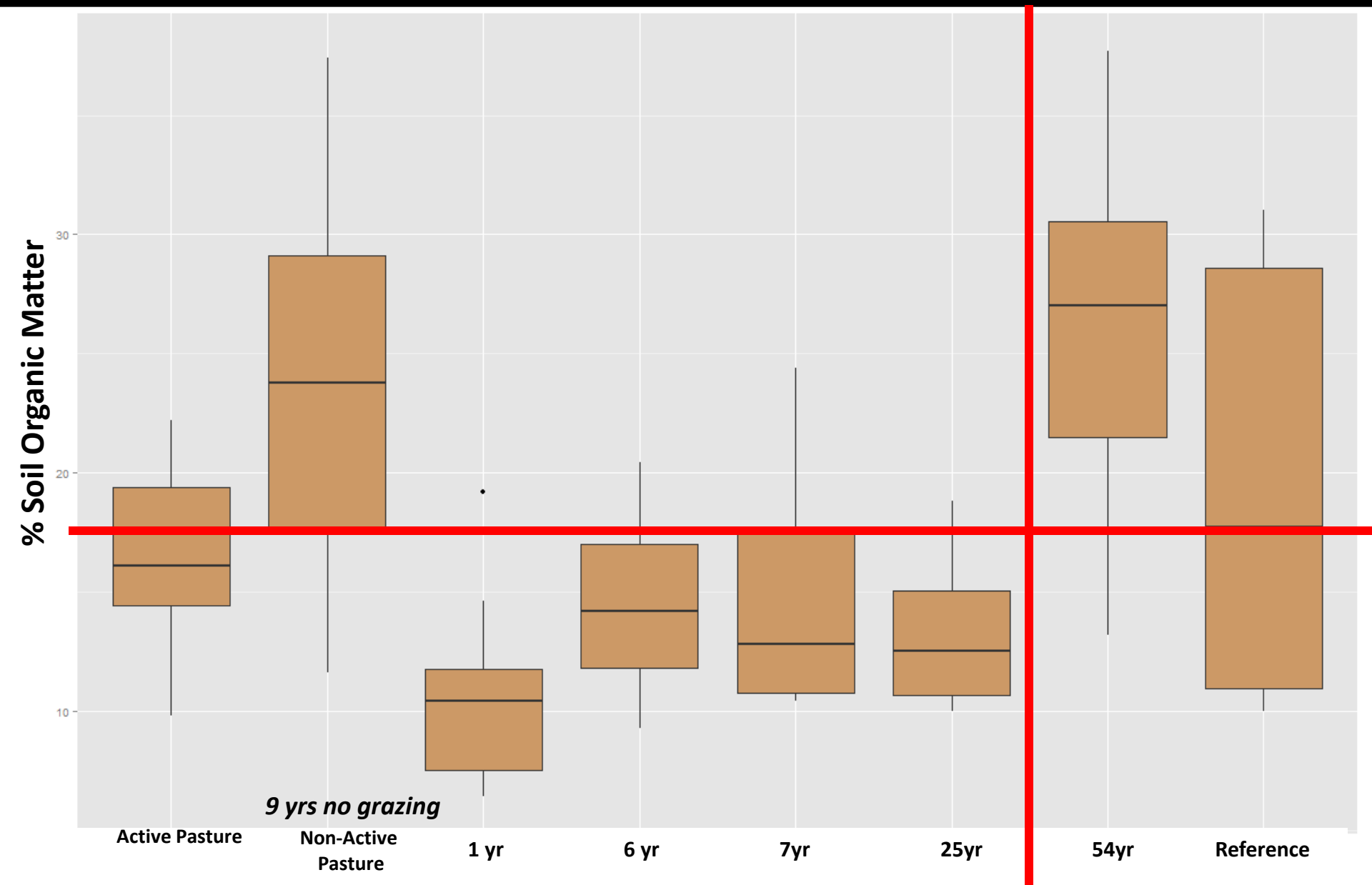
Soil Development

Bulk Density - Compaction (g/cm³)



Soil Development

Soil Organic Matter (%) - Loss on Ignition



Preliminary Timescales of Response

Preliminary data and field observations:

- Years **1 - 5** appear to be a critical time for wetland plant community development and biomass accumulation
- Between **7 - 25** years appears to be critical time for soil bulk density reduction
- Between **25 - 55** years appears to be critical time for soil organic matter development
- Summer 2014 add - 3yr, 5yr, 9yr, 34yr, 44yr old sites and a second reference site

Why does this matter? Adaptive Management and Planning

Inform the expectation and assessment of restoration goals over appropriate time scales

What is the biggest driver of wetland plant and soil development in these systems?

Is it inundation regime?

- How are small variations in restored tidal wetland site hydrology influencing vegetation and soil development?

STUDY 2 (SUMMER 2013-15): IDENTIFYING HYDROLOGIC INUNDATION CHARACTERISTICS DRIVING TIDAL WETLAND PLANT COMMUNITY RESTORATION AND ECOLOGICAL DEVELOPMENT

How will changes in inundation duration and frequency (from management or SLR) influence plant community assemblages in these restored wetlands?

Thank you for listening!

I better get back to work ☺

Big thanks to all these folks for helping me make it happen!

Email: sarahkidd@pdx.edu
Twitter: @science_kidd
Web: SarahKidd.Info

Research Sponsors

NSF

SWS

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NATIONAL PARK SERVICE

Columbia LAND TRUST

PORT OF ASTORIA

City of Seaside

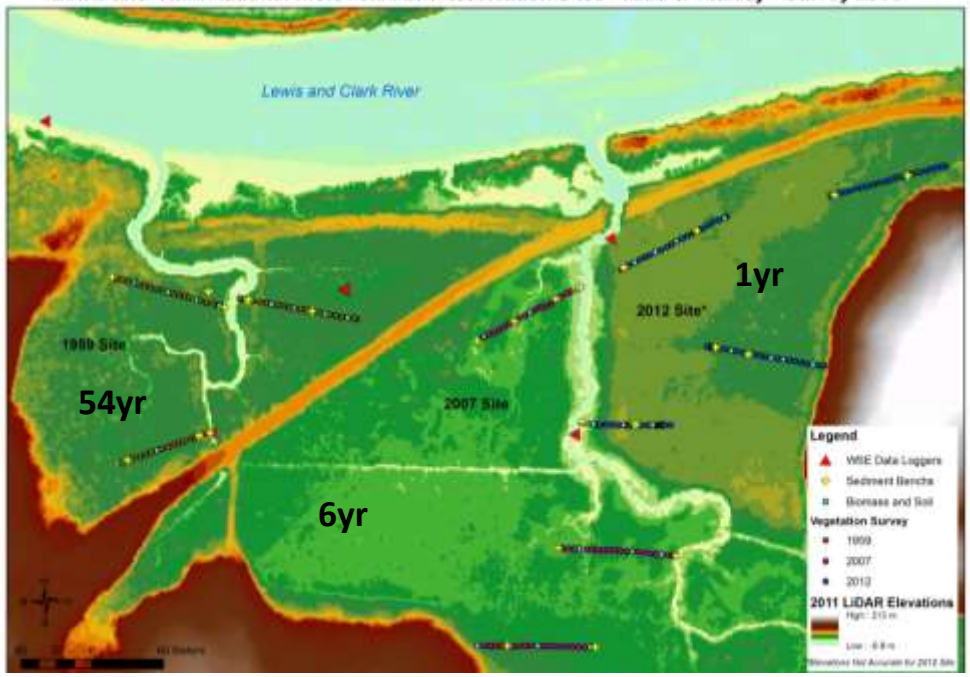
crest COLUMBIA RIVER ESTUARY STUDY TASKFORCE

Lower Columbia Estuary Partnership

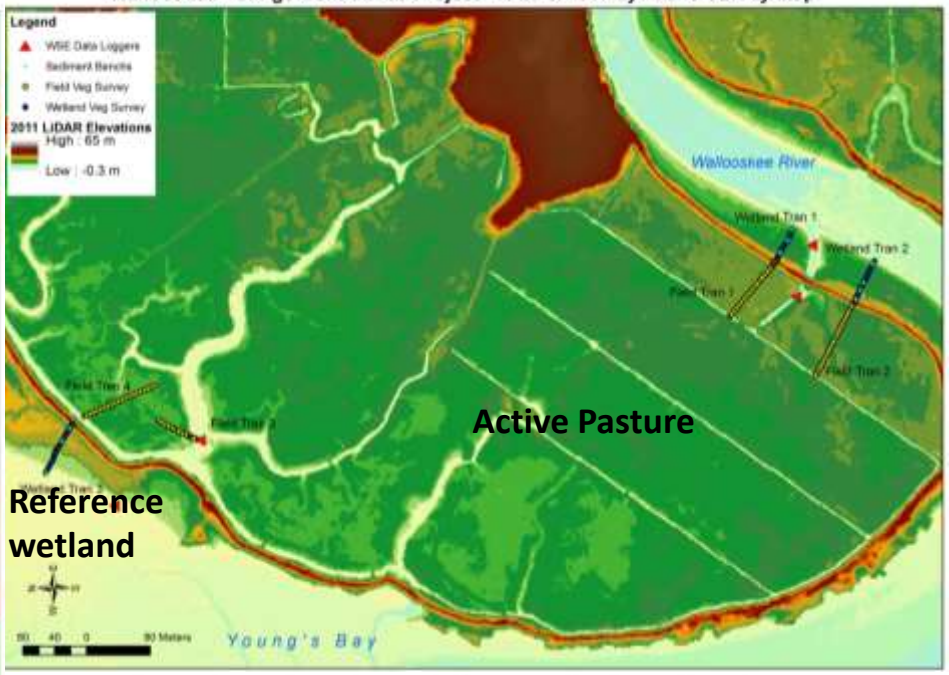
Site Topography

Elevation Ranges of Common Dominant Plant Species By WIS

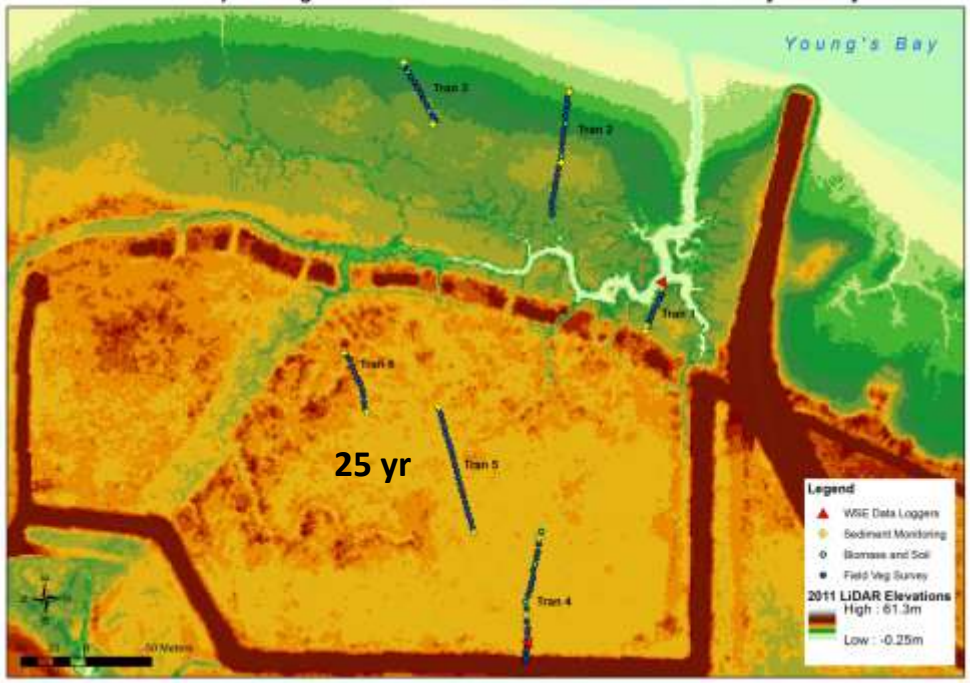
Lewis and Clark National Historical Park Restoration Sites - Kidd & Yeakley - Survey 2013



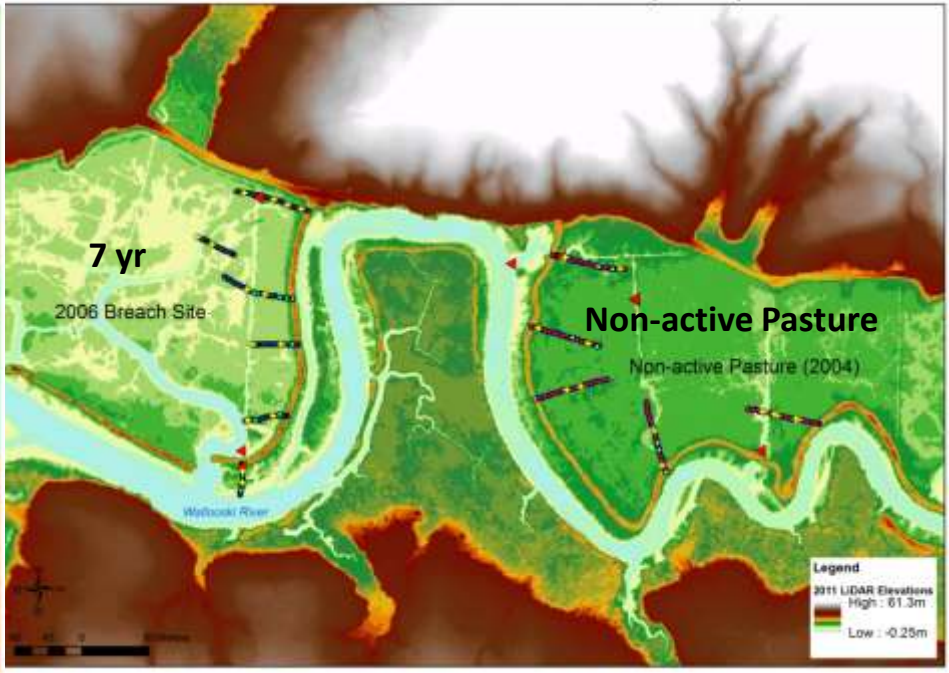
Wallooskee-Youngs Confluence Project - Kidd & Yeakley - 2013 Survey Map

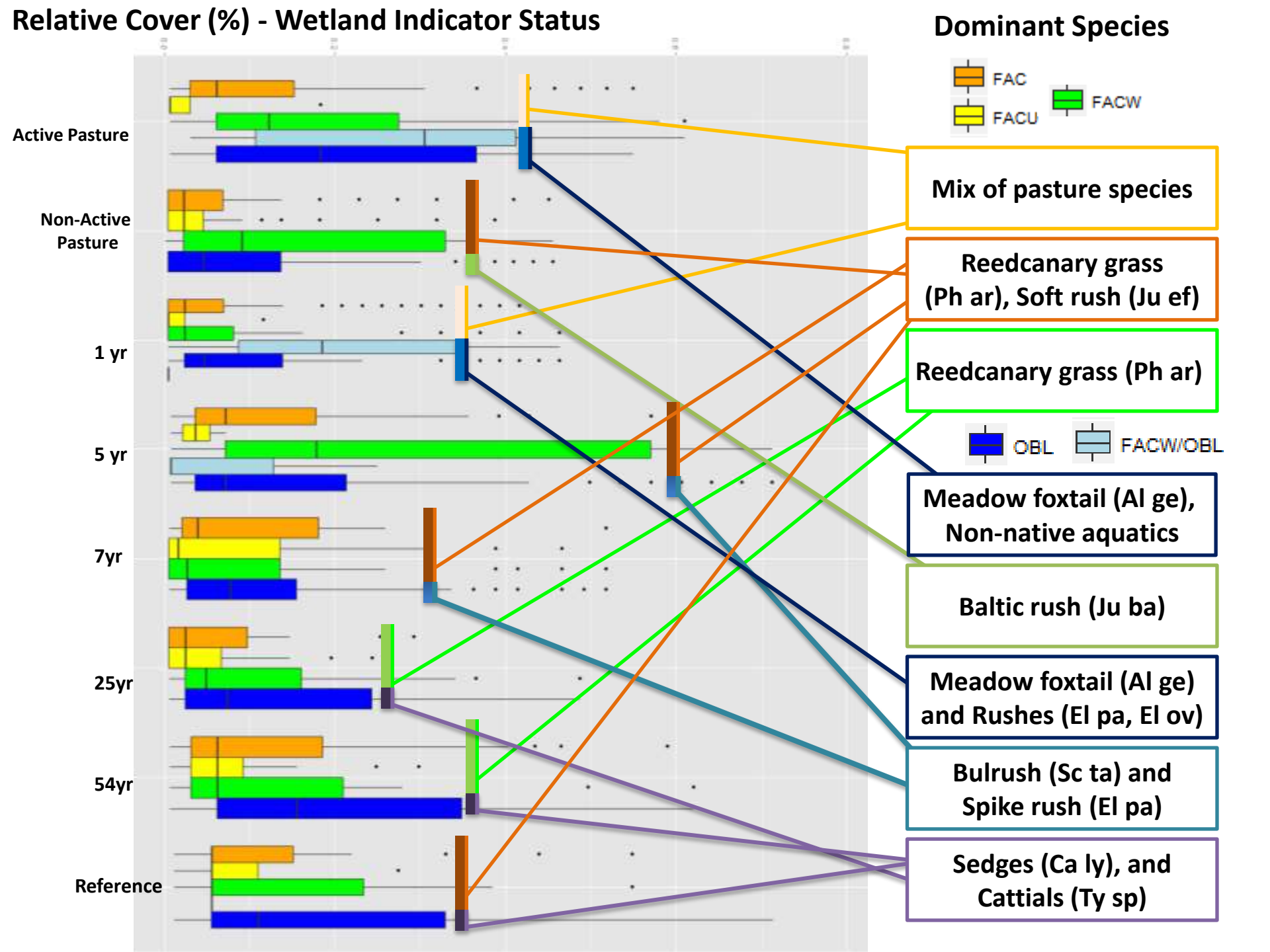


Port of Astoria - Airport Mitigation Bank - 1988 Breached Site - Kidd & Yeakley - Survey 2013

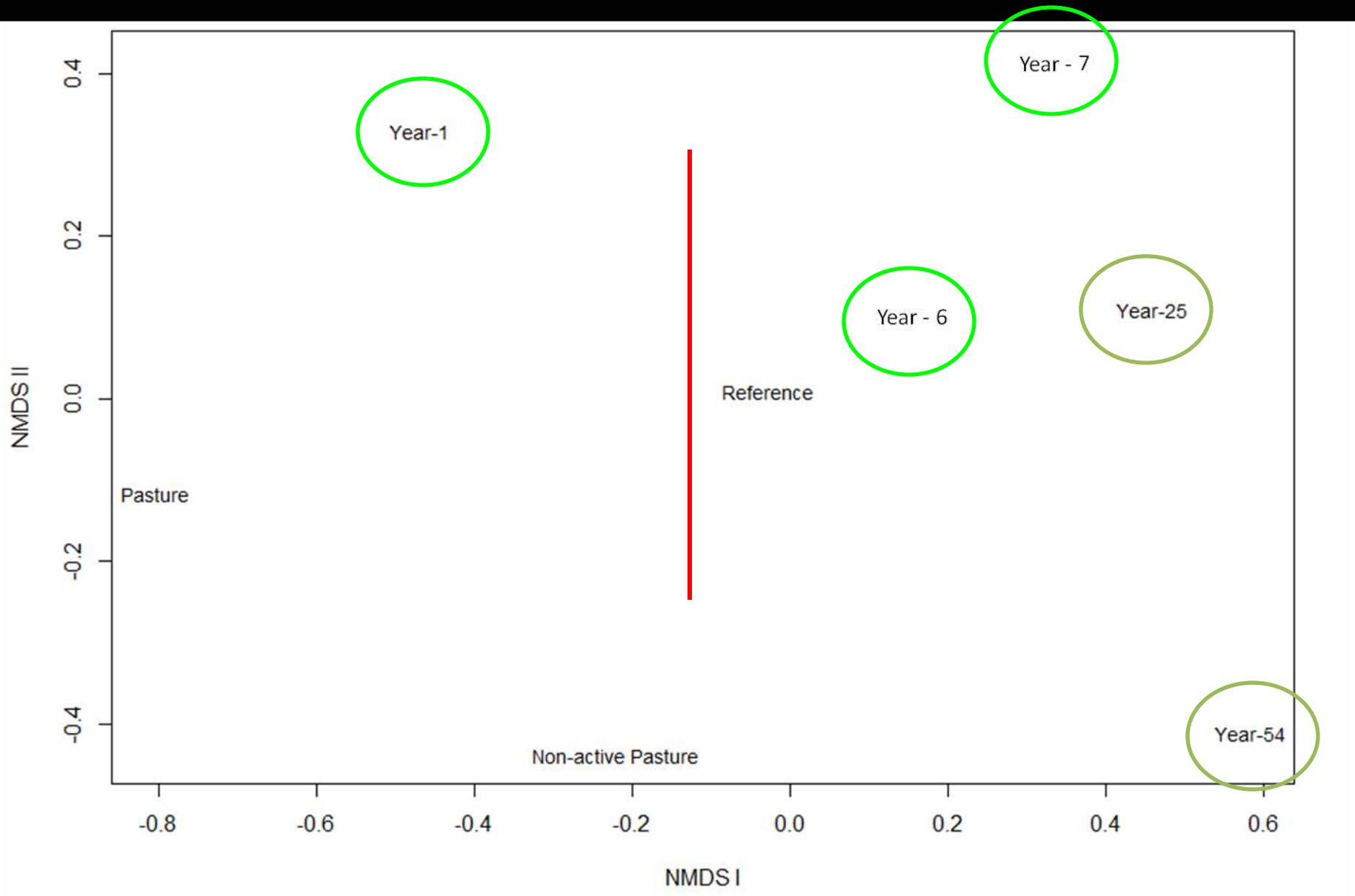


Columbia Land Trust - Restoration Sites - Kidd & Yeakley - Survey 2013



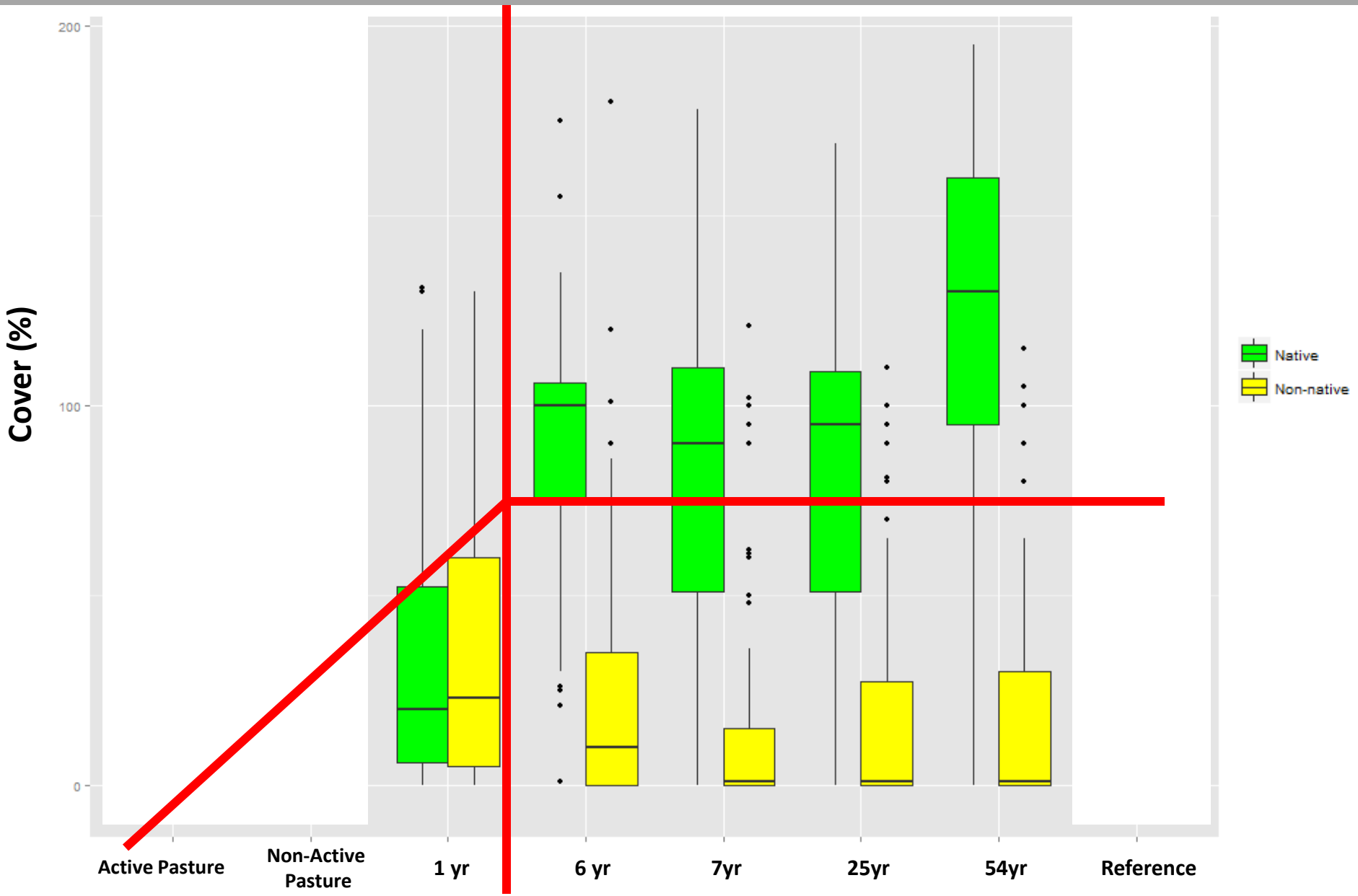

Relative Cover (%) - Wetland Indicator Status
Dominant Species
FAC
FACU
FACW
OBL
FACW/OBL
Active Pasture
Non-Active Pasture
1 yr
5 yr
7yr
25yr
54yr
Reference
Mix of pasture species
Reedcanary grass (Ph ar), Soft rush (Ju ef)
Reedcanary grass (Ph ar)
Meadow foxtail (Al ge), Non-native aquatics
Baltic rush (Ju ba)
Meadow foxtail (Al ge) and Rushes (El pa, El ov)
Bulrush (Sc ta) and Spike rush (El pa)
Sedges (Ca ly), and Cattials (Ty sp)

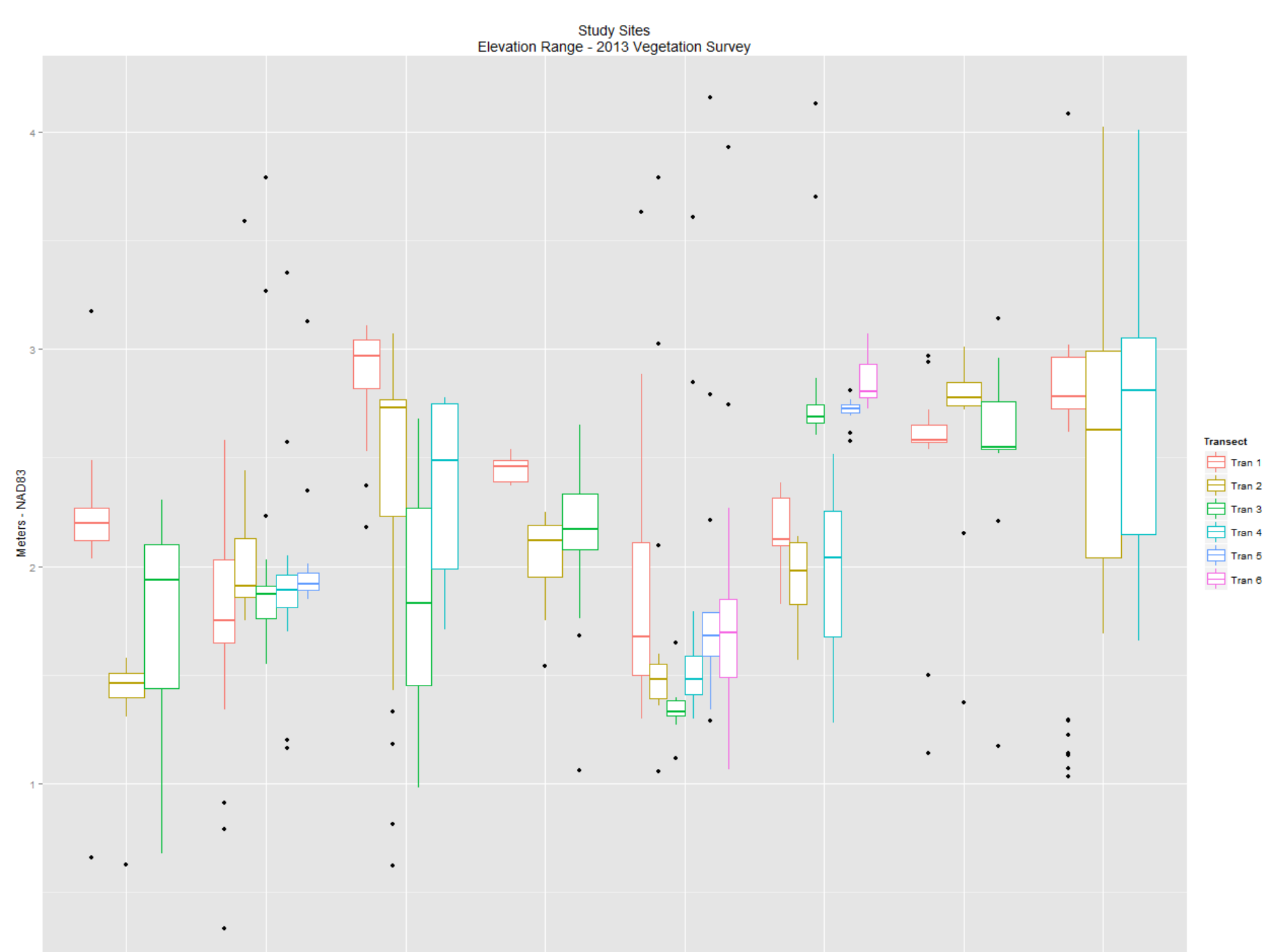
NMDS Ordination: Site Comparison
Bray Curtis Similarity - Species Abundance (Stress: 0.08)

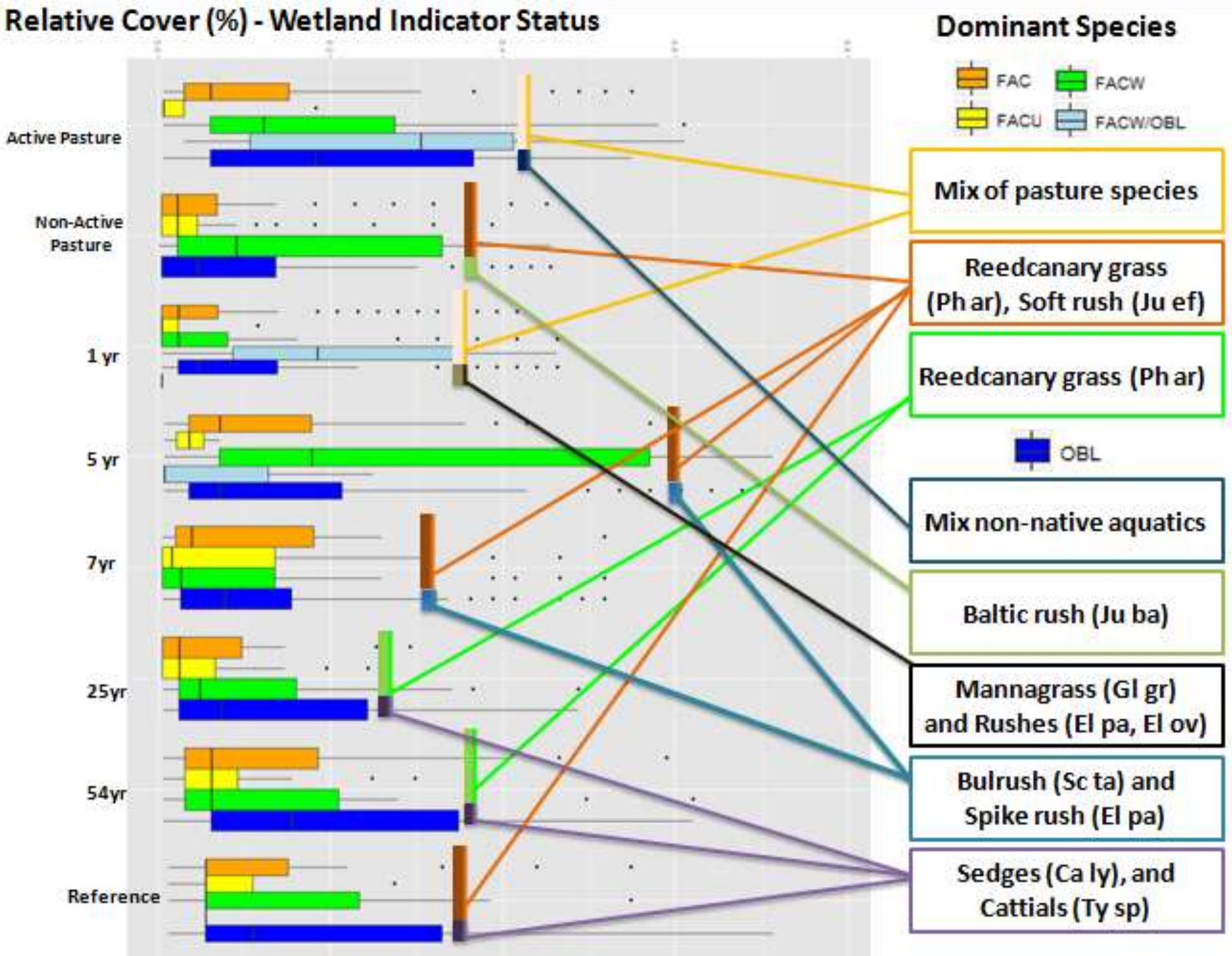


Plant Community Structure and Biodiversity

Native and Non-native Species Abundance




Study Sites
Elevation Range - 2013 Vegetation Survey
Meters - NAD83
4
3
2
1
Transect
Tran 1
Tran 2
Tran 3
Tran 4
Tran 5
Tran 6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Reference
Dominant Species
FAC
FACW
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FACW/OBL
Mix of pasture species
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Reedcanary grass (Ph ar)
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Mix non-native aquatics
Baltic rush (Ju ba)
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Bulrush (Sc ta) and Spike rush (El pa)
Sedges (Ca ly), and Cattials (Ty sp)

State of Tidal Wetland Restoration
In the Lower Columbia River Estuary

- **Mitigation credits** based on the potential benefits the project is assumed to provide after restoration

- Assumed that tidal restoration sites will naturally follow restoration trajectories toward self sustaining reference conditions after initial tidal reconnection is completed

  (Thom 1997, Thom et al. 2005, Roegner et al. 2009, Borja et al. 2010, Thom et al. 2010, ERTG 2011).

- Need more evidence to support this theory *(e.g., Zedler 2000, Hilderbrand et al. 2005, Borja et al. 2010, Mossman et al. 2012, Smith and Warren 2012).*