

Understanding Vulnerability to Climate Change: An Analysis of Salinity, Water Levels, Marsh Elevation, and Plant Species Communities in a Tidal Freshwater Marsh

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¹Jug Bay Wetlands Sanctuary

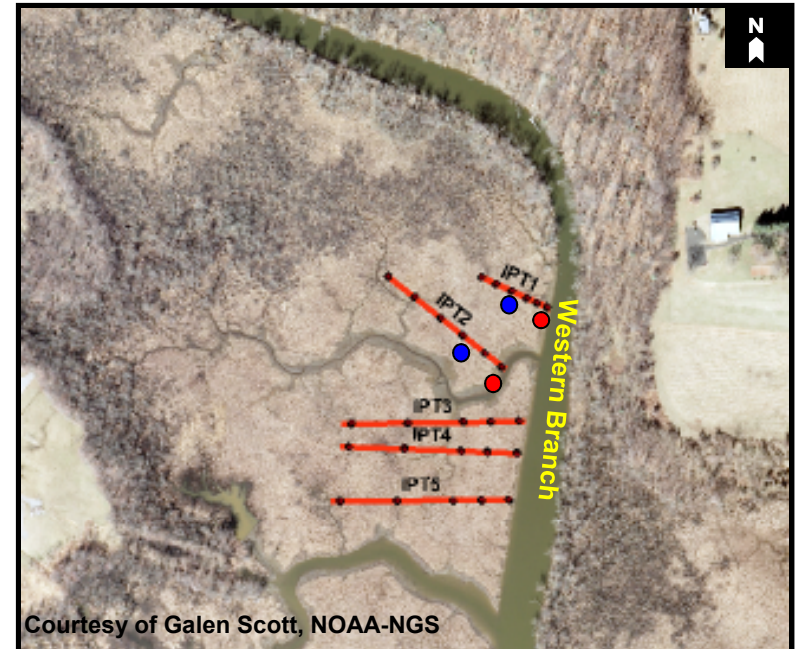
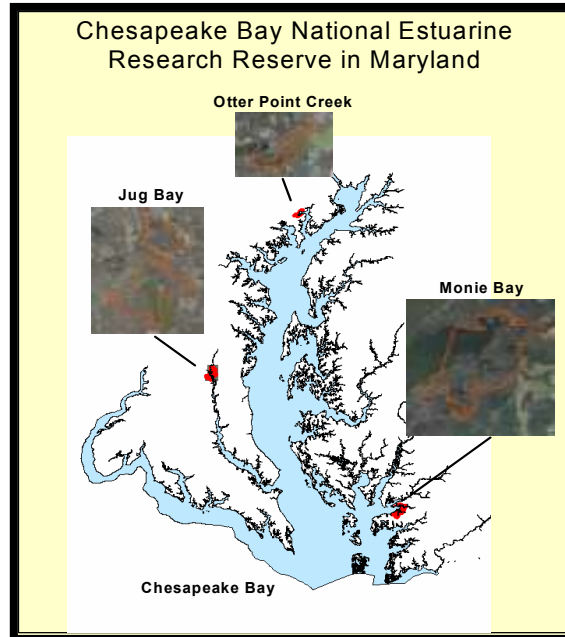
²NOAA National Geodetic Survey

Patuxent River Conference
Jefferson Patterson Park and Museum
June 18 - 19, 2015



Jug Bay – Sentinel Site

Chesapeake Bay Sentinel Site Cooperative



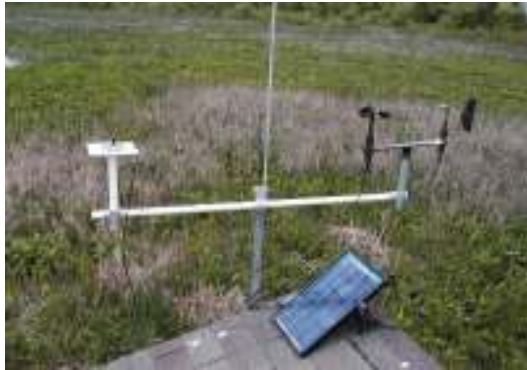
Courtesy of Galen Scott, NOAA-NGS

Sentinel Site monitoring infrastructure at one of Jug Bay study sites: red and blue dots indicate location of SETs; red lines the location of marsh transects.

Established Elements at Jug Bay Sentinel Site:

- Meteorological data
- Water physical and chemical data
- Marsh elevation change data (SETs)
- Vegetation monitoring
- Local geodetic control network

Sentinel Site Monitoring Infrastructure



Weather station instrumentation



Telemetry unit



Continuous water quality monitoring station



Marsh transects



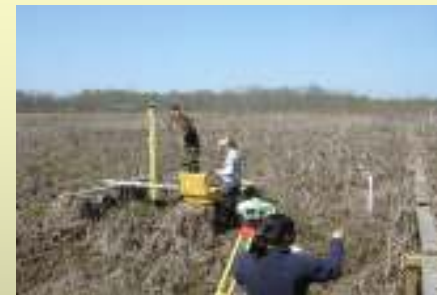
Surface elevation Table (SET)

Local High Accuracy Geodetic Control Network

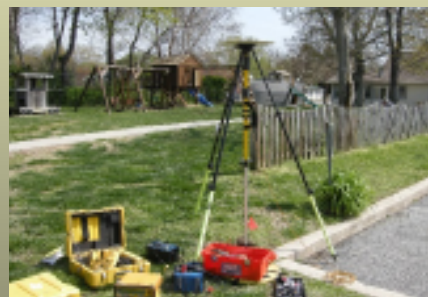
Using geodetic leveling to connect monitoring systems



Using static GPS and CORS to obtain high accuracy elevations



Using RTK (Real Time Kinematic) GPS to obtain high accuracy elevations



Obtaining elevations from existing, published surveying monuments

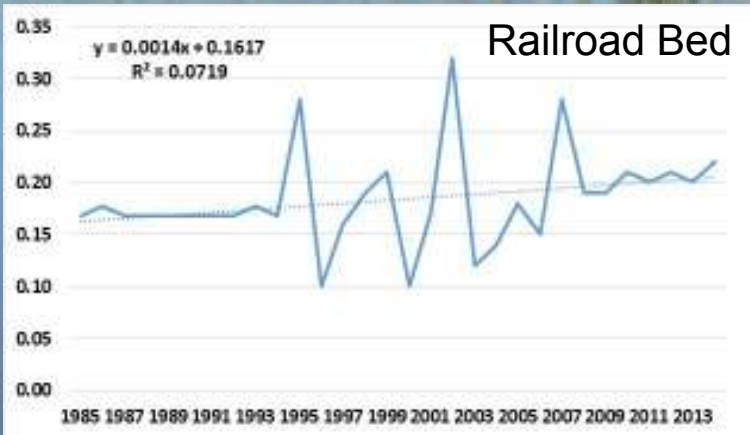
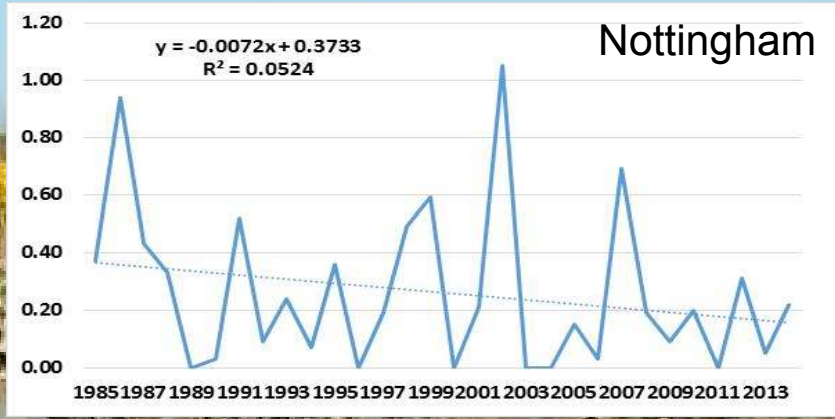
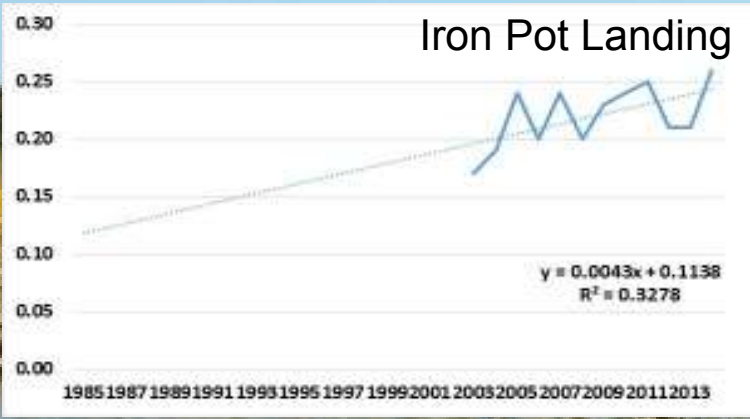
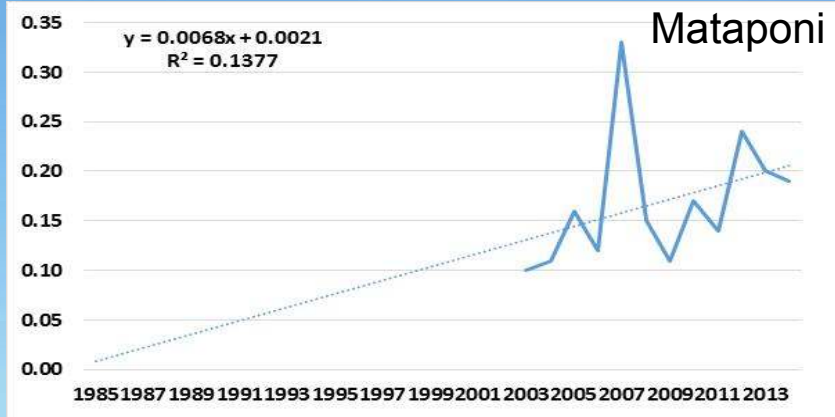
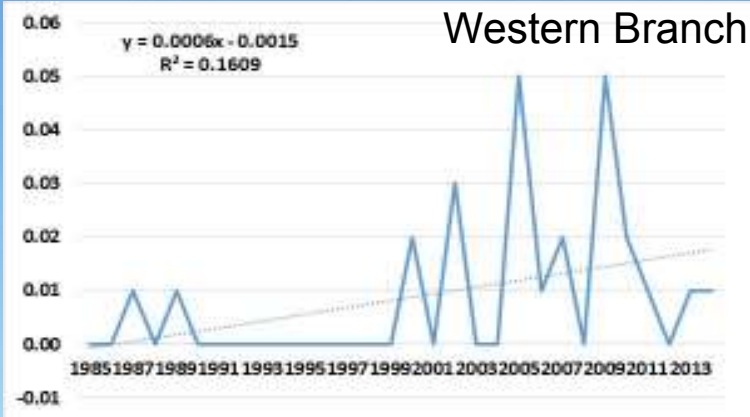
Establishing SETs as permanent control points



Study Sites

- Salinity Trends
- Water Level Trends
- Marsh Elevation Change
- Marsh Vegetation Response to Flooding

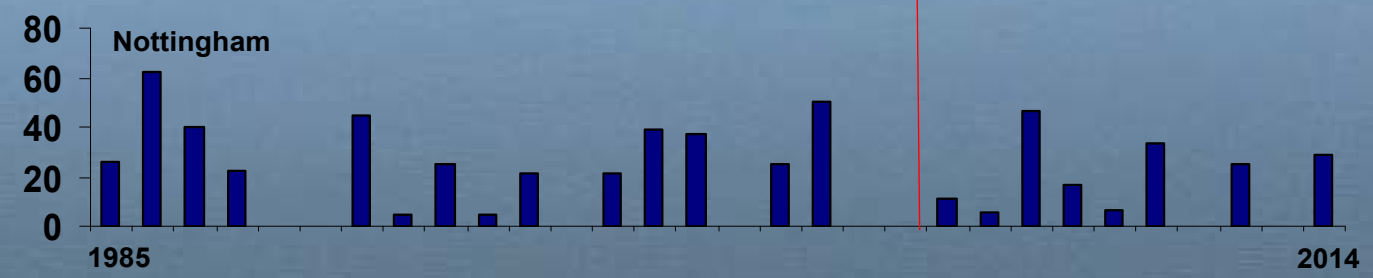
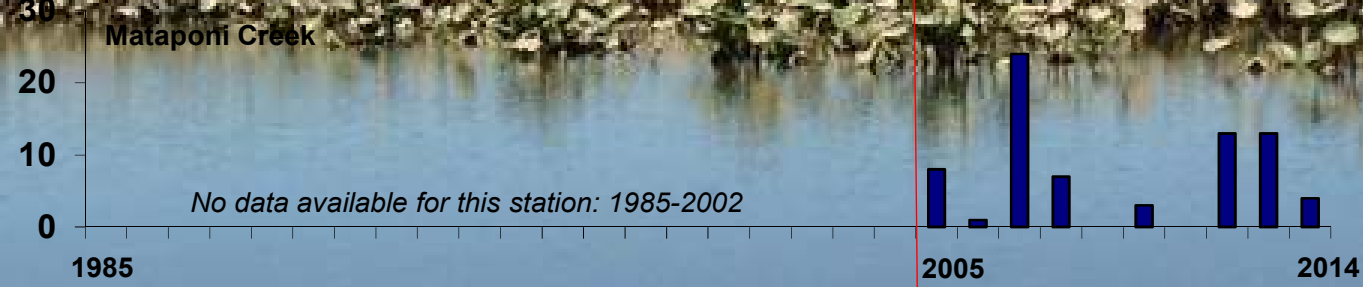
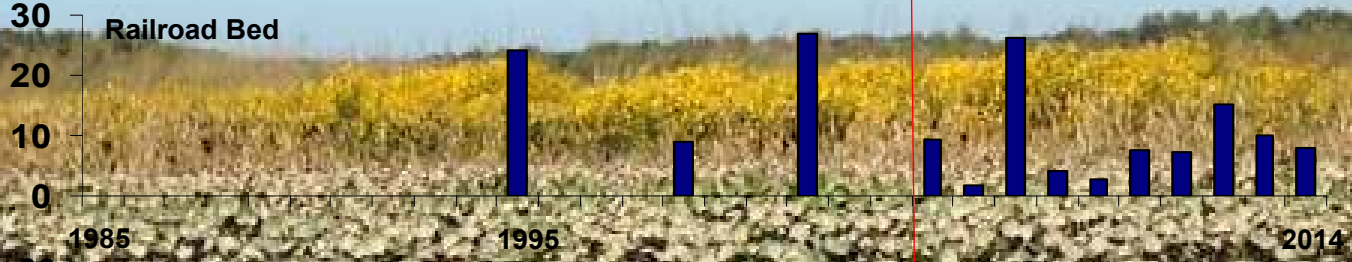
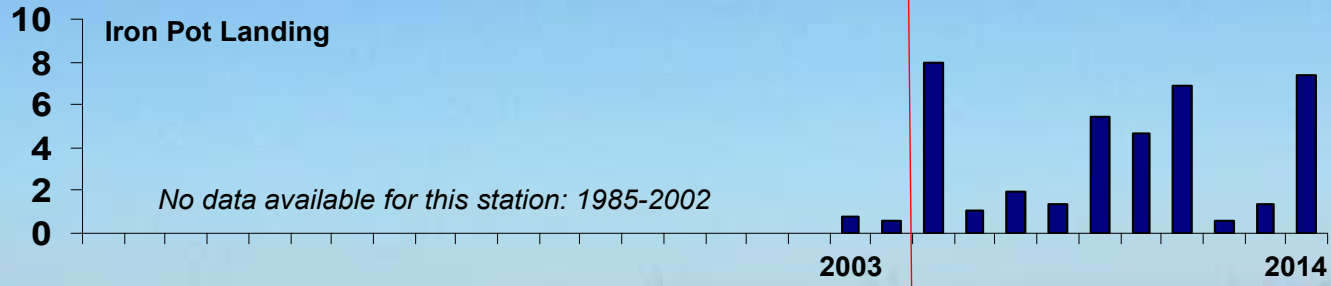
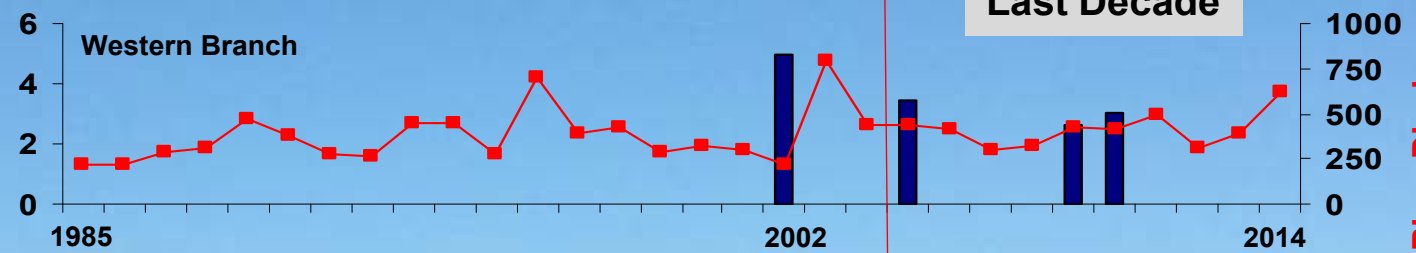




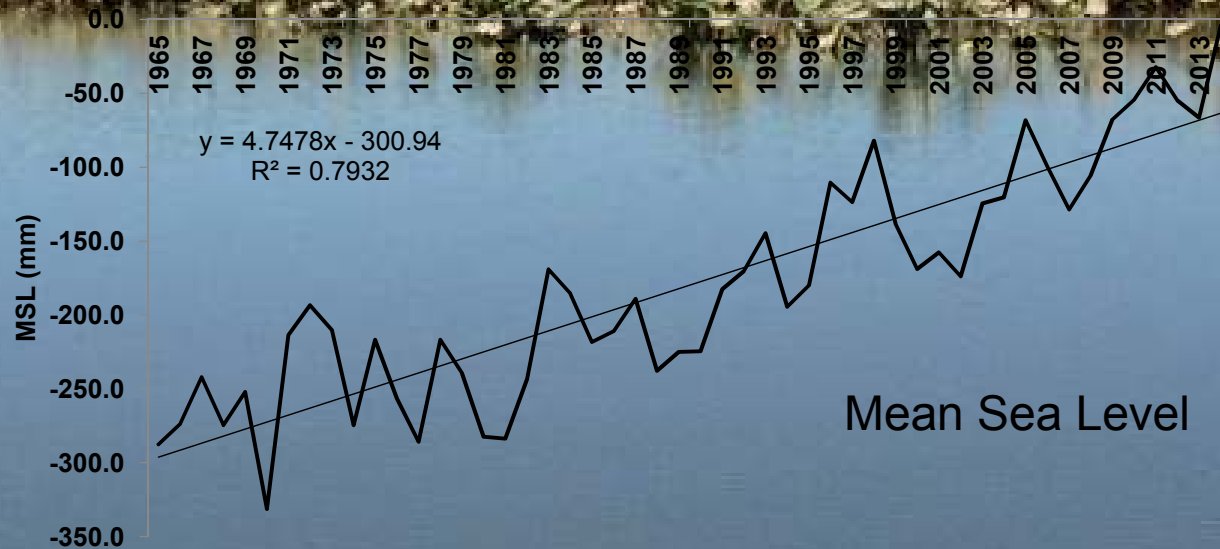
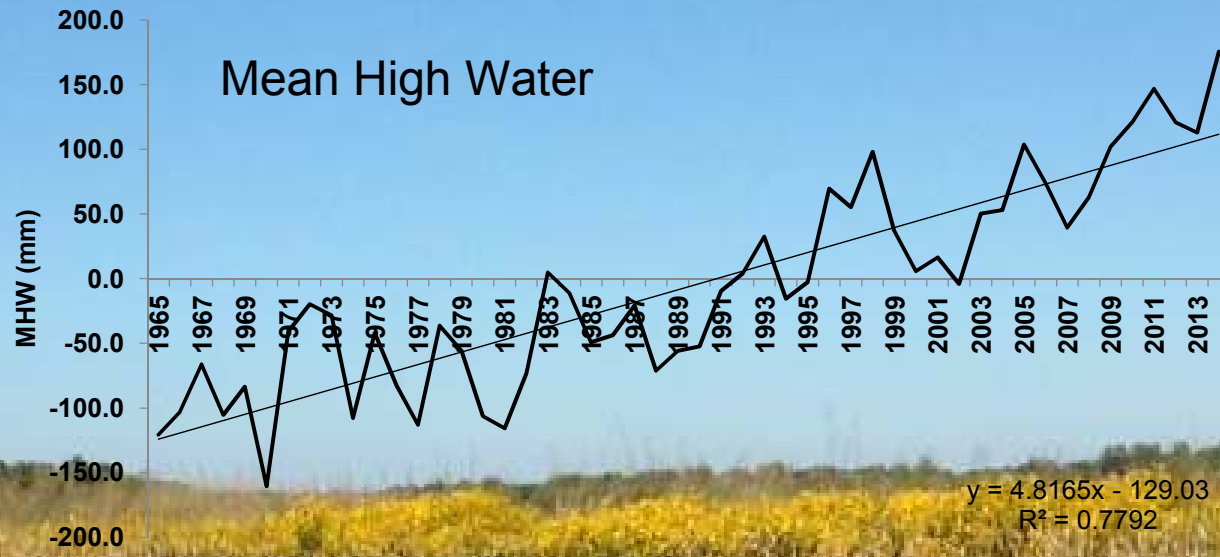
% Values with Salinity Equal or Greater than 0.5 ppt

Last Decade

River Discharge (ft³/s)



Water Level Trends – Solomons Island Station



Marsh Elevation Change (mm yr⁻¹)

Western Branch

T1: Low marsh: **-9.65**; High marsh: **6.31**
T2: Low marsh: **1.20**; High marsh: **2.11**

Railroad Bed

T1: Low marsh: **-13.16**; High marsh: **3.62**
T2: Low marsh: **-13.02**; High marsh: **2.58**

Mataponi Creek

T1: Low marsh: **22.96**; High marsh: **4.78**
T2: Low marsh: **13.72**; High marsh: **8.77**

Is this marsh keeping up with SLR?

Annapolis SLR rate during the last decade:
4.8 mm yr⁻¹

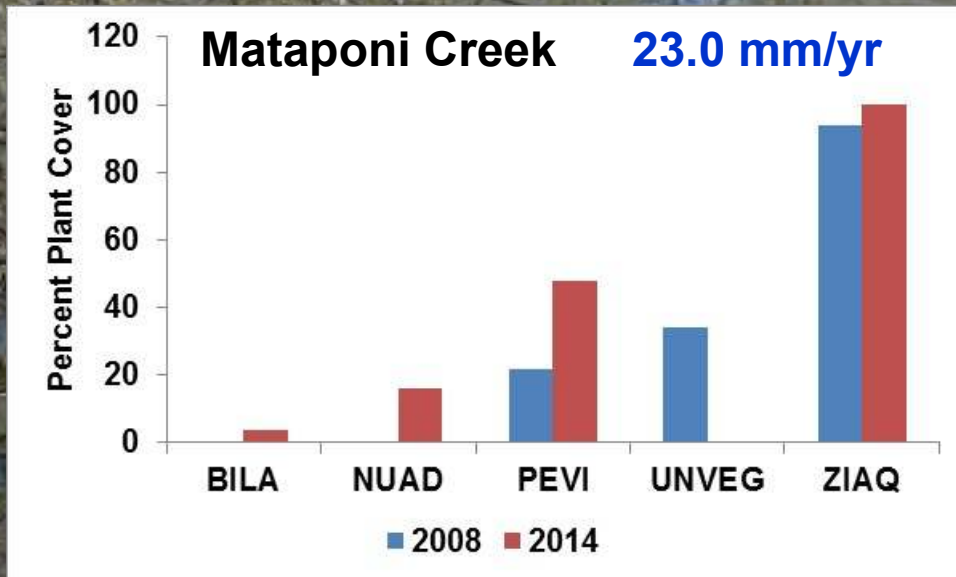
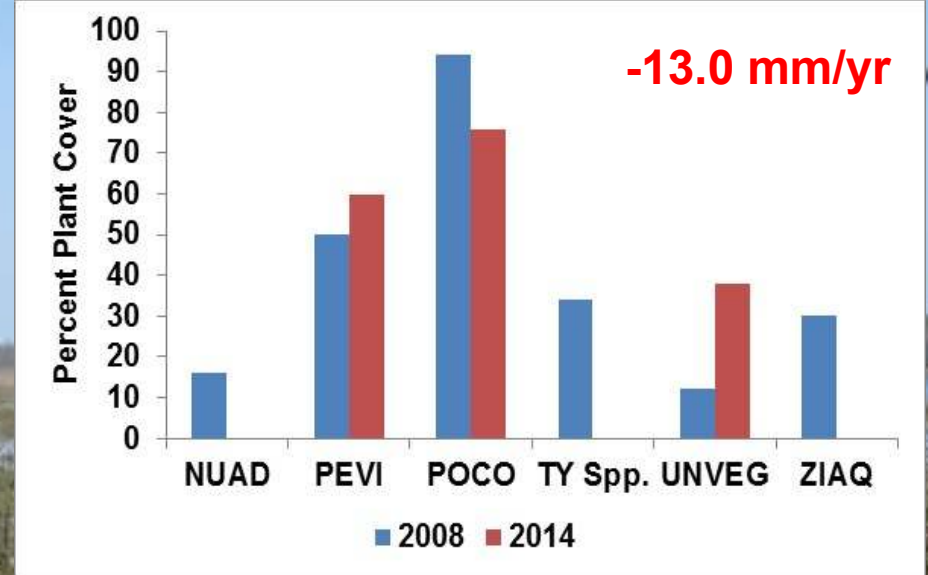
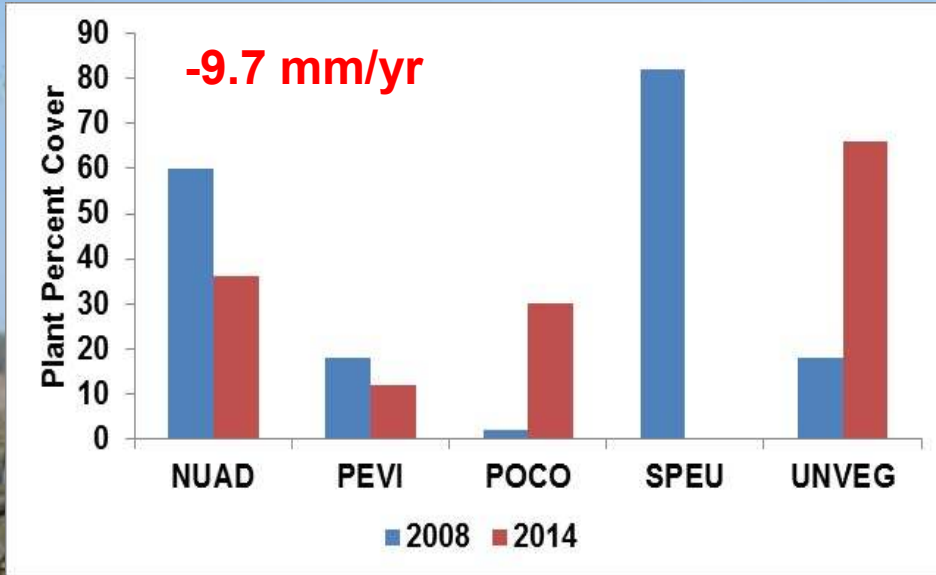
Patuxent River



Temporal Changes of Marsh Plant Cover in the Low Marsh Zone

Western Branch

Railroad Bed



Species Codes:

- NUAD: Spadderdock
- PEVI: Arrow arum
- POCO: Pickerelweed
- SPEU: Bur-reed
- BILA: Beggartick
- ZIAQ: Wild rice
- TY Spp: Cattail
- UNVEG: Unvegetated

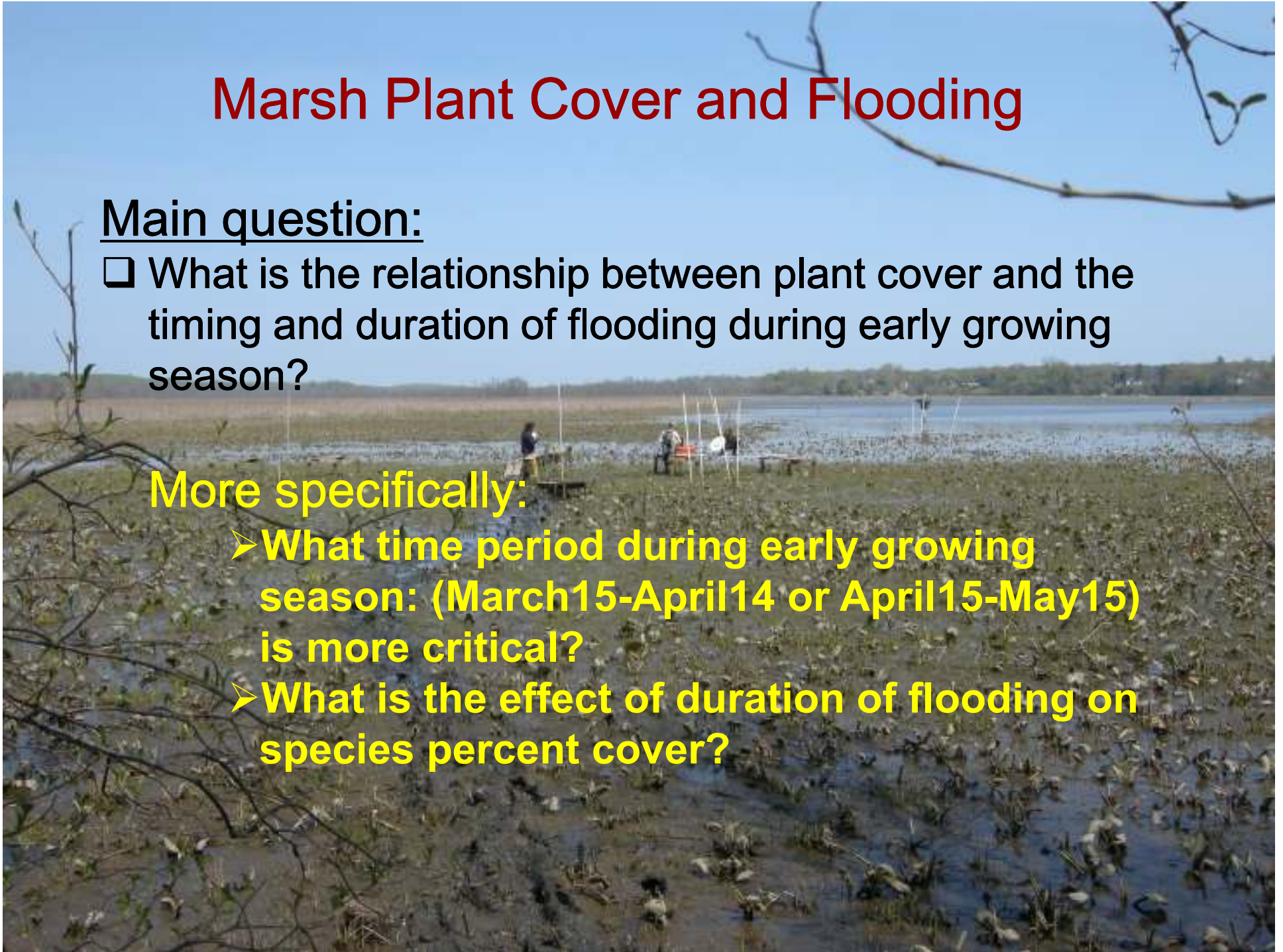
Marsh Plant Cover and Flooding

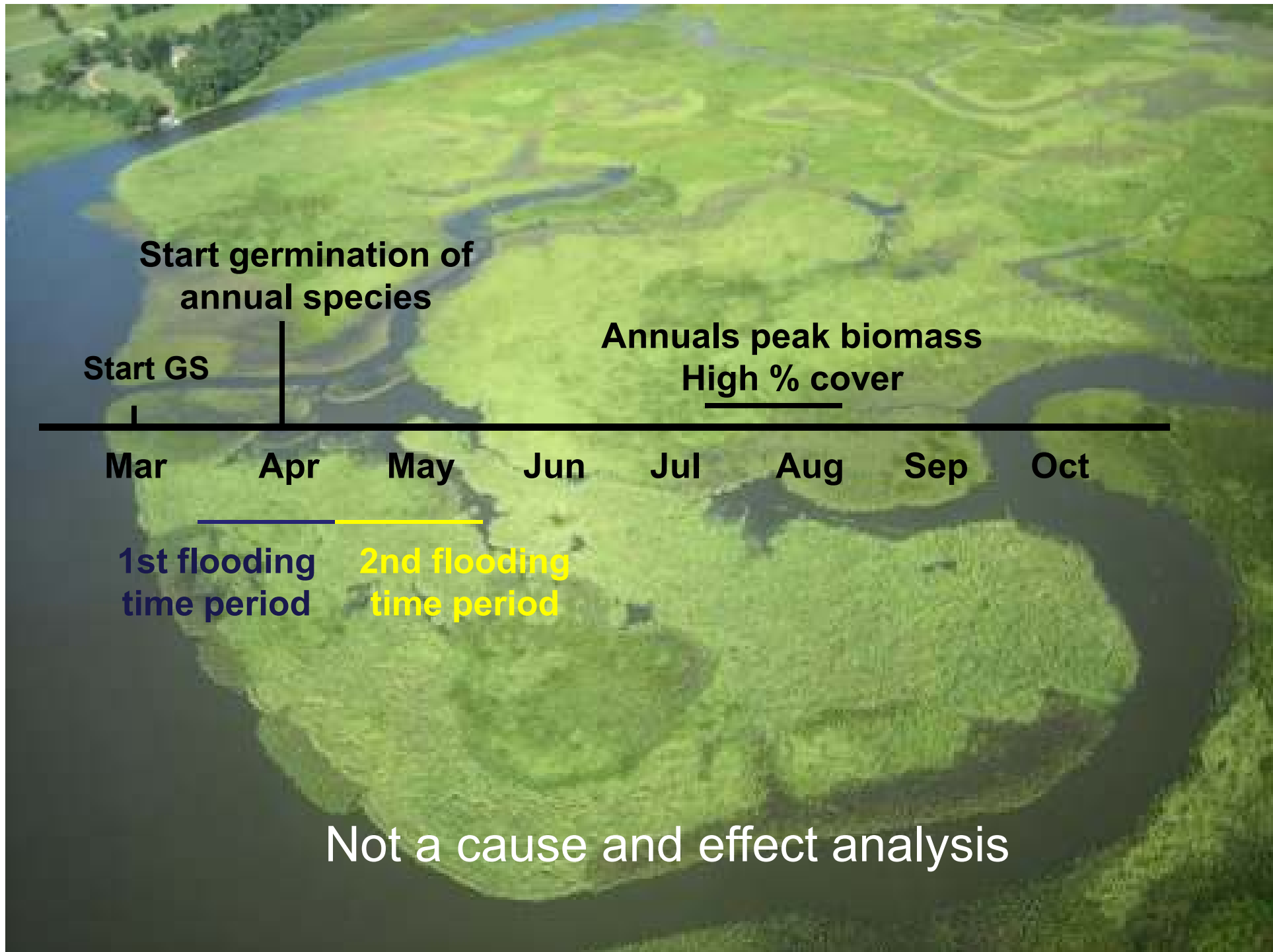
Main question:

- ❑ What is the relationship between plant cover and the timing and duration of flooding during early growing season?

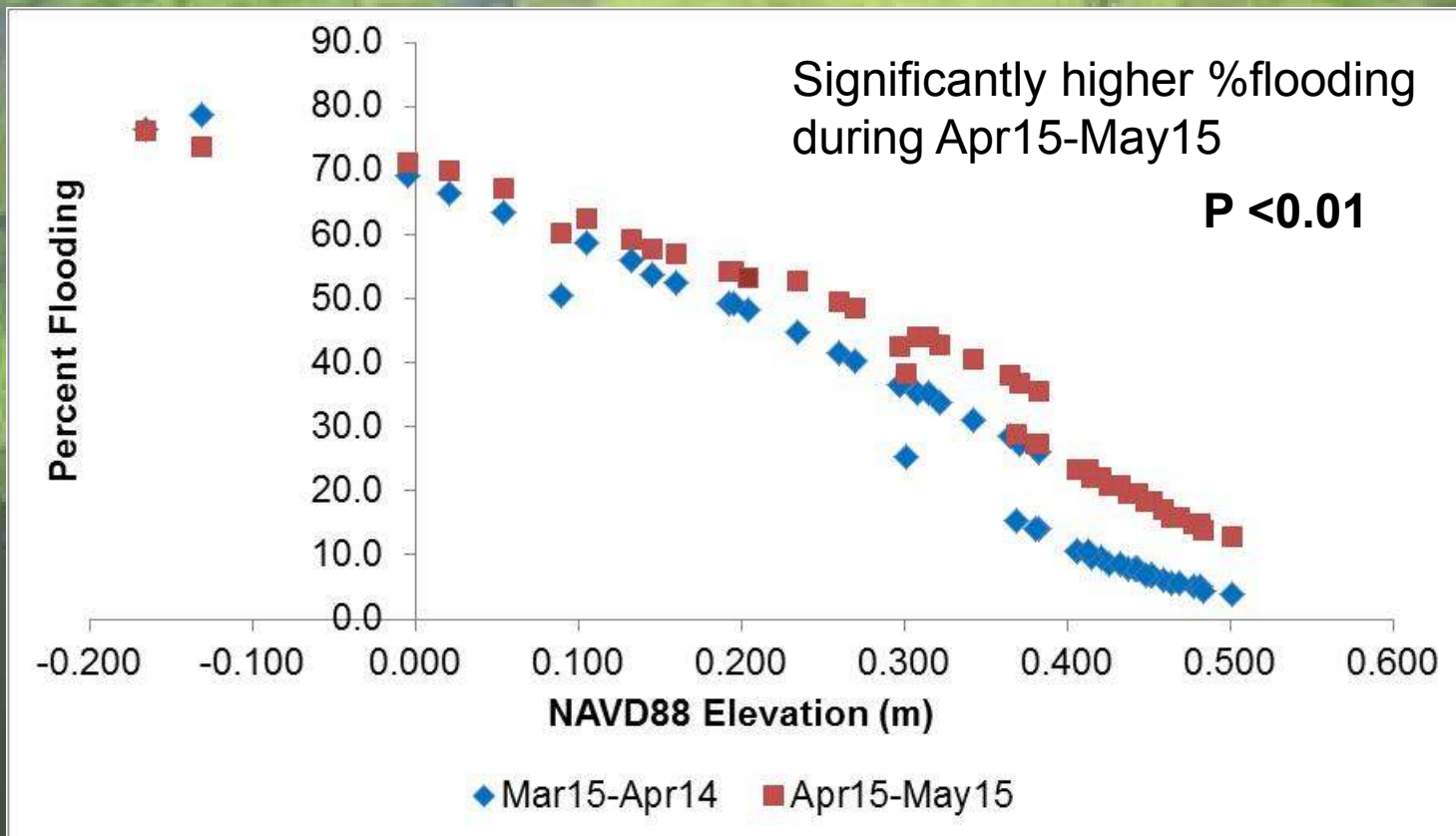
More specifically:

- What time period during early growing season: (March 15-April 14 or April 15-May 15) is more critical?
- What is the effect of duration of flooding on species percent cover?





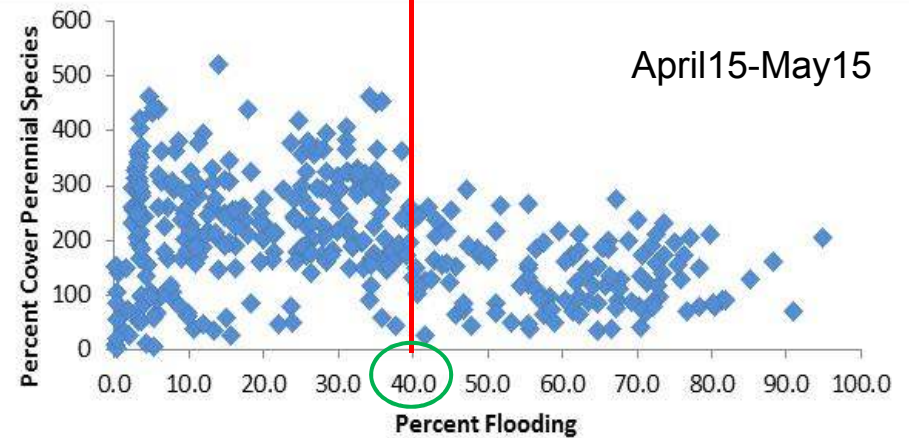
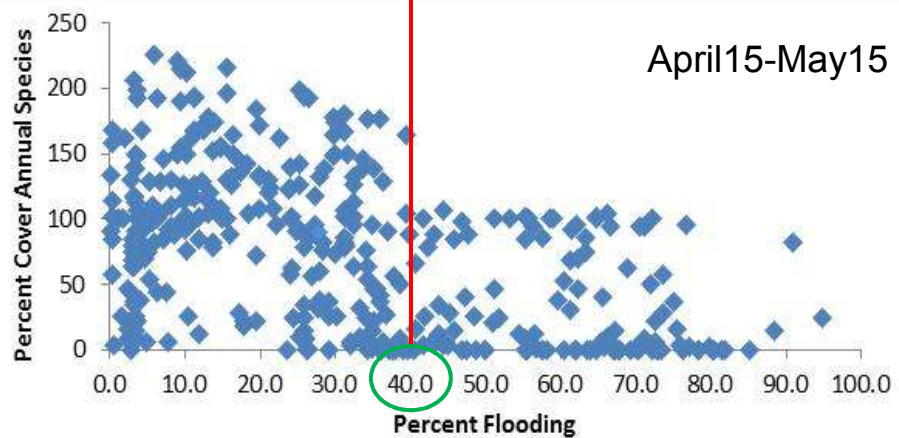
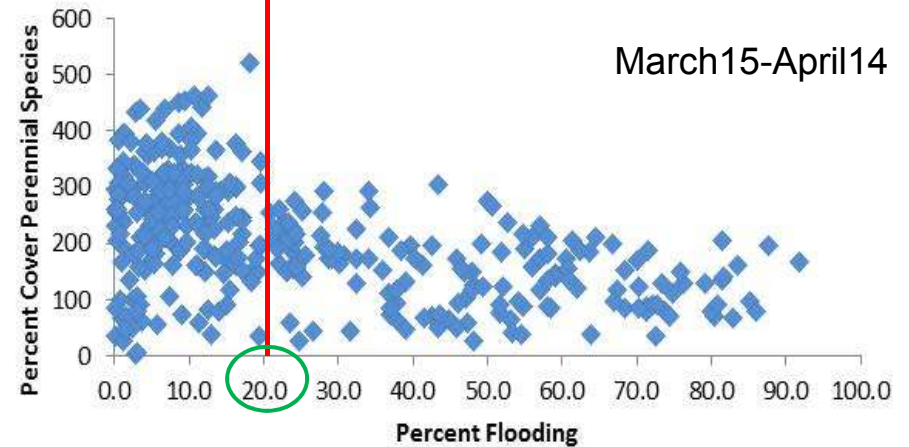
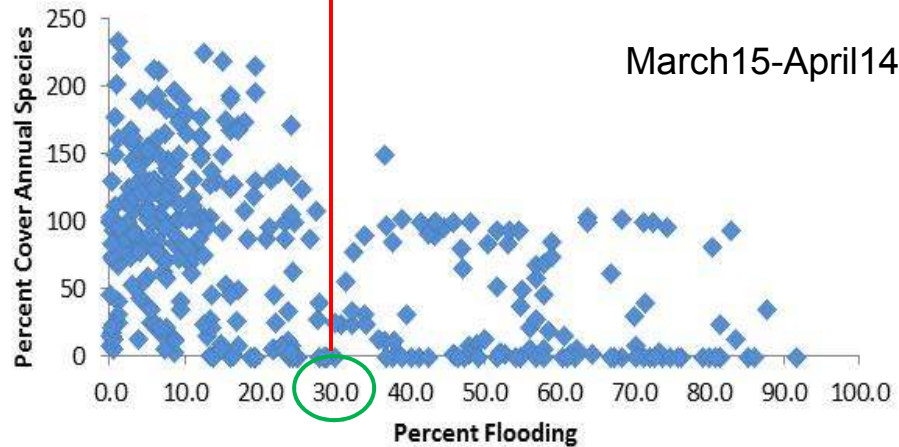
What time period: (March15-April14 or April15-May15) is more critical?



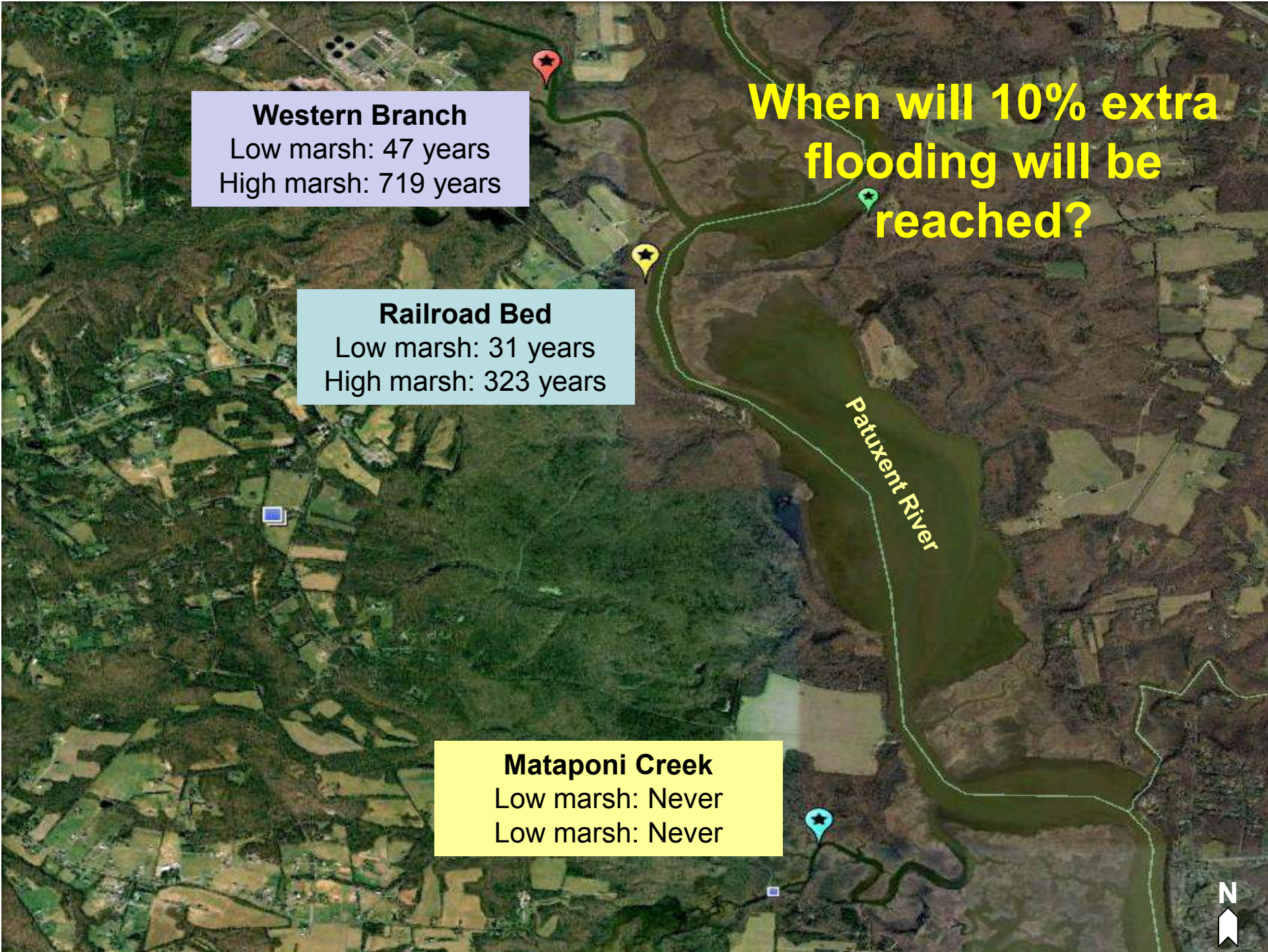
Effect of Duration of Flooding on Plant Cover

Annuals

Perennials



Red line corresponds to 60% decrease on % cover





Implications

- ❑ Salinity trends are changing – this may trigger marsh vegetation changes in the future (other spp?). Need salinity model for the entire Patuxent.
- ❑ Increase flooding is causing vegetation changes – the rate of change, timing, and species sensitivity should be considered in any restoration project.
- ❑ Marsh elevation change is highly variable – any predictions should be based on local data as possible. Developing new methodology to collect this information in a larger scale, cheaper, and faster.



Implications

- ❑ Maintain the marsh healthy – remove stressors (e.g. invasive species); continue wild rice restoration efforts.
- ❑ Identify erosion and marsh migration “hot spots” – protect these areas.
- ❑ To better understand salinity changes it may be helpful to study groundwater recharge and its potential effect on salinity.

Acknowledgments

A photograph of a person in a boat on a misty lake at sunrise. The sun is low on the horizon, creating a bright glow and reflecting on the water. The person is seen from behind, looking out over the water. The scene is peaceful and serene.

NOAA – Chesapeake Bay National Estuarine Research Reserve in Maryland
NOAA – National Geodetic Survey
Field assistants: CBNERR-MD and Volunteers from Jug Bay Wetlands Sanctuary