



Action Effectiveness Monitoring and Research Status Update

Science Work Group Meeting

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Overview

- 2018 AEMR Status
 - Programmatic AEMR Overview
 - Sites and Metrics
- AEM Metrics and Data
- Discussion

Action Effectiveness Monitoring and Research (AEMR) Objective

- Determine the success of restoration actions at site, landscape, and estuary-wide scales in terms of improved ecosystem functionality

Programmatic Action Effectiveness Monitoring

Columbia Estuary Ecosystem Restoration Program (CEERP) Objectives

- Obj. 1. Increase the capacity (quality) of estuarine and tidal-fluvial ecosystems
- Obj. 2. Increase the opportunity for access by aquatic organisms to and for export of materials from shallow water habitats
- Obj. 3. Improve ecosystem realized functions for juvenile salmonids



Action Effectiveness Monitoring Levels



Level 3 Monitoring (Basic)

- Before/After Sampling Design
- Metrics
 - Hydrology and Water Quality
 - Water surface elevation and water temperature (All Sites)
 - Sediment accretion (All Sites)
 - Photo points (All Sites)
- Frequency
 - 1 year pre-restoration
 - 1 through 5 year post restoration



Level 2 Monitoring (Extensive)

- Before/After Reference Impact Sampling Design
- Metrics
 - Vegetation Composition and Cover
 - Salmonid Prey
 - Channel Cross Sections
 - Fish Status
- Frequency
 - 1 year pre-restoration
 - 1, 3, 5, 10 year post restoration

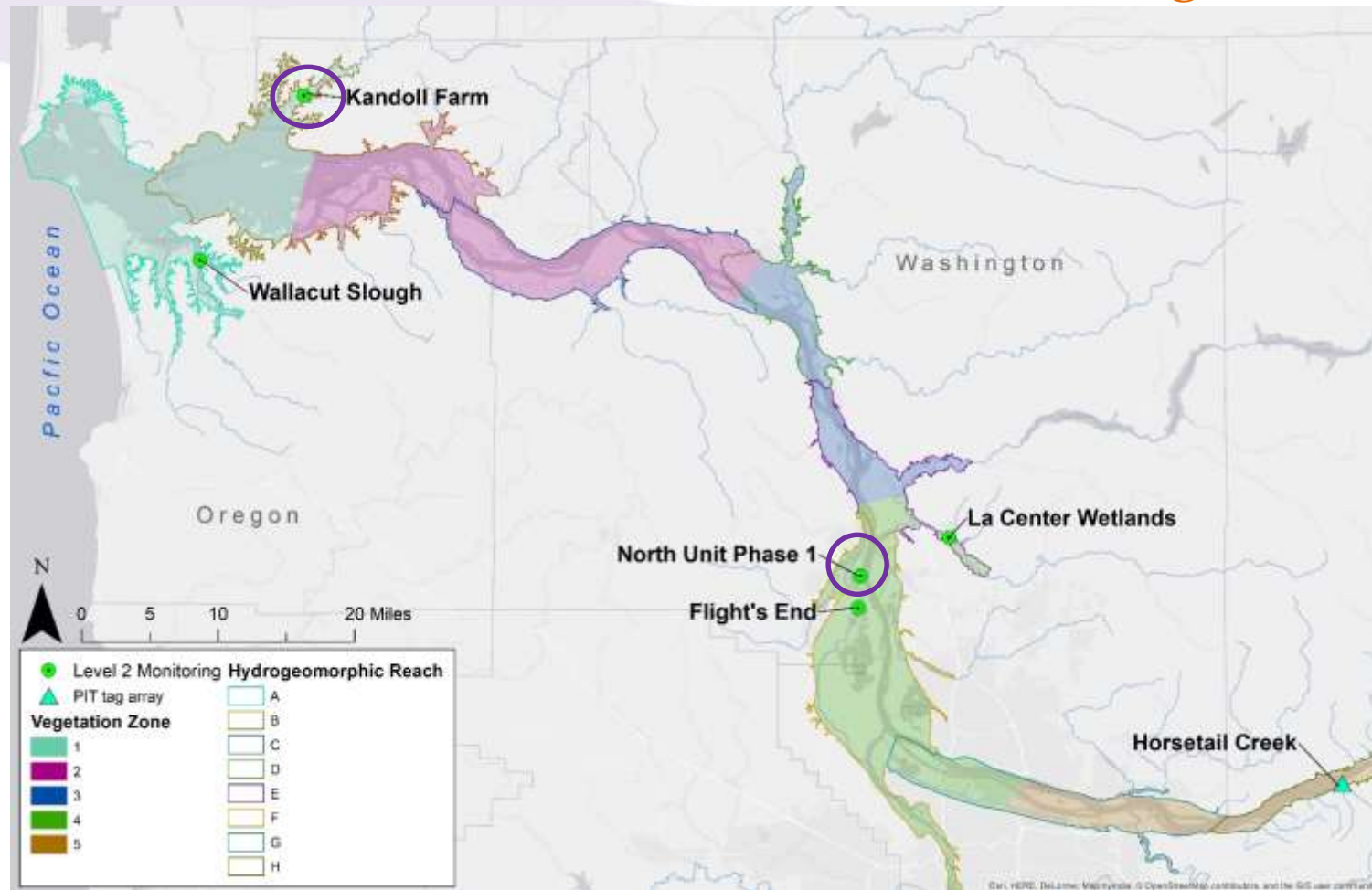


Level 1 Monitoring (Intensive)

- Metrics
 - Chinook Diets
 - Chinook Genetics
 - Stable Isotopes
 - Fish Community
 - Fish condition index
 - Fish length/weight
 - Salmonid Prey (Neuston, Benthos, Terrestrial)
- Frequency
 - 2016 & 2017



Level 2 Action Effectiveness Monitoring in 2018



Level 2 Sampling Rotation

| Site | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 |
|-----------------------------|------|------|------|------|------|------|------|------|------|------|------|------|
| Kandoll Farm | | Pre | Post | | Post | | Post | | | | | Post |
| Kandoll Farm Reference | | Pre | Post | | Post | | Post | | | | | Post |
| Steamboat | | Pre | | Post | | Post | | Post | | | | |
| Steamboat Reference | | Pre | | Post | | Post | | Post | | | | |
| Sauvie Island North Unit P1 | | Pre | Post | | Post | | Post | | | | | Post |
| Sauvie Island North Unit P1 | | Pre | Post | | Post | | Post | | | | | Post |
| Dibblee | | Post | | Post | | Post | | | | | Post | |
| Dibblee Reference | | Post | | Post | | Post | | | | | Post | |
| Wallacut | | | Pre | | | Post | | Post | | Post | | |
| Wallacut Reference | | | Pre | | | Post | | Post | | Post | | |
| Sandy River | | | Post | | Post | | Post | | | | | Post |
| Sandy River Reference | | | Post | | Post | | Post | | | | | Post |
| Sauvie Island North Unit P2 | | | Pre | Post | | Post | | Post | | | | |
| Sauvie Island North Unit P2 | | | Pre | Post | | Post | | Post | | | | |
| La Center | | | | Pre | Post | | Post | | Post | | | |
| La Center Reference | | | | Pre | Post | | Post | | Post | | | |
| Wallooskee-Youngs | | | | Pre | | | Post | | Post | | Post | |
| Wallooskee-Youngs Reference | | | | Pre | | | Post | | Post | | Post | |
| Flights End | | | | | | Pre | Post | | Post | | Post | |
| Flights End Reference | | | | | | Pre | Post | | Post | | Post | |

Consturction Year

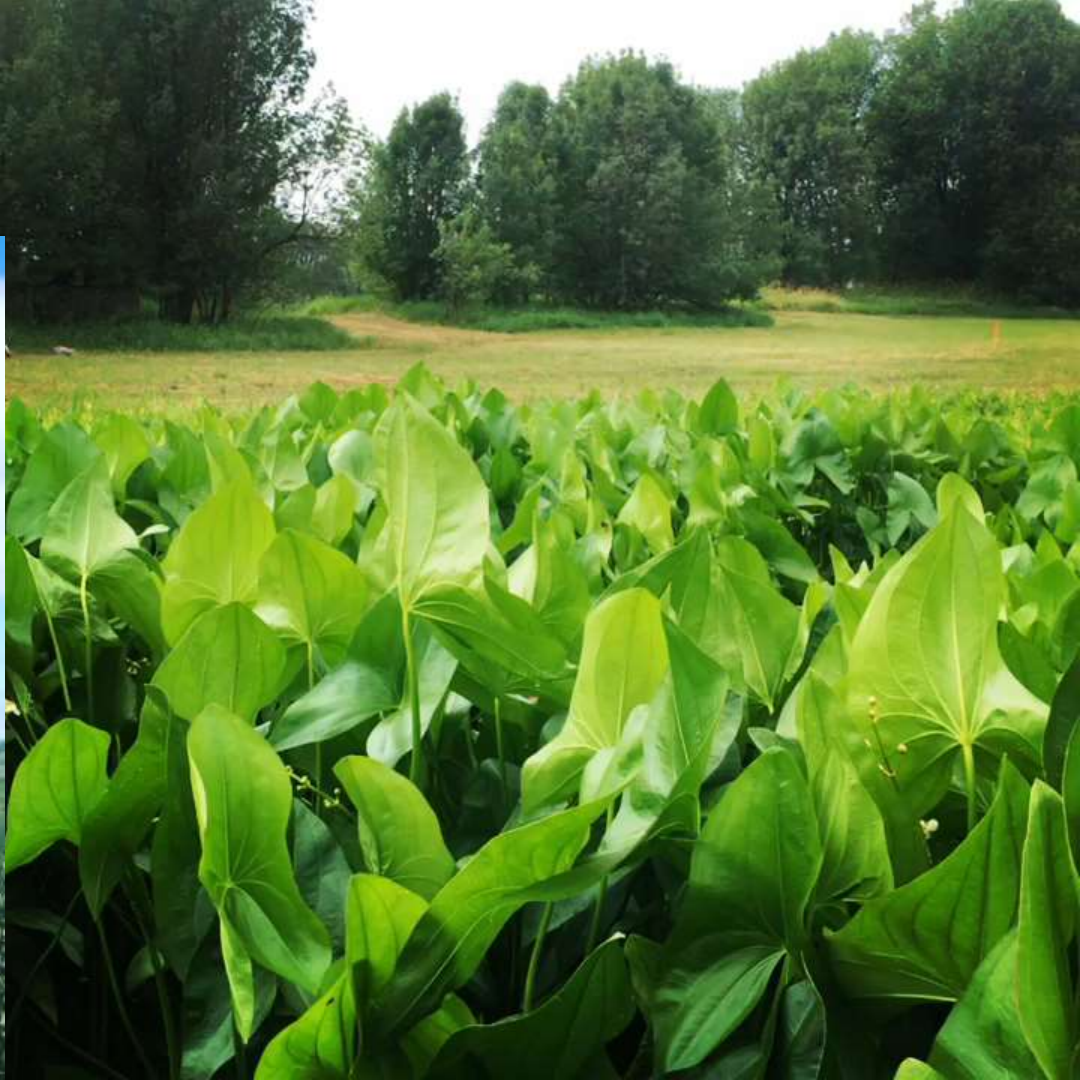
Post = Fish status check

Equipment and Technical Support

- Technical and Field Support
 - Site sampling design
 - Data management
 - Methods
- Hydrology Monitoring Equipment
 - Hobo Onset pressure & temperature data loggers (long-term)
 - Hobo Onset temperature (only) data loggers (long-term)
 - Flow/discharge meter and rod (short-term)
- Survey and Mapping
 - RTK ProMark 200 survey and mapping units (base and rover) including tripod and monopod (short-term)
 - Auto Level including tripod (short-term)
 - Small unmanned aerial vehicle



Results



The Journey

- What does it all mean?
- Temperature and Water Surface Elevation in Context
- Vegetation and soil scrape down
- What would you monitor if you were designing a monitoring plan today for your restoration site?

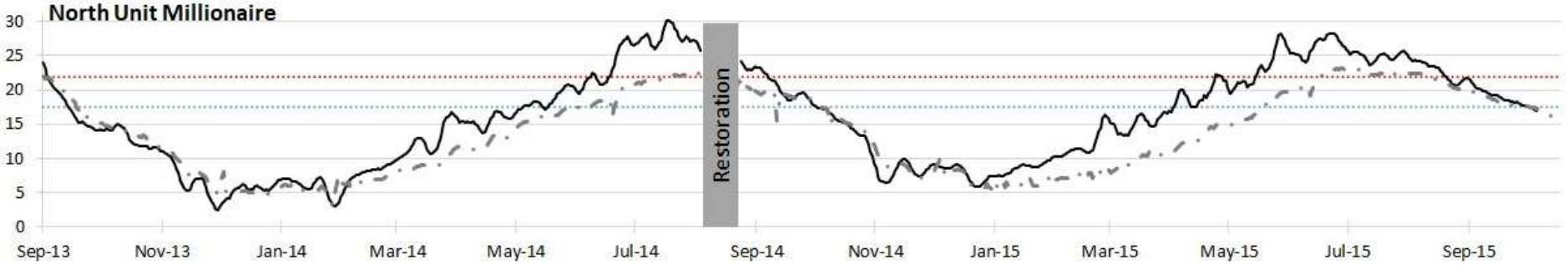


Analysis

- **Water Temperature** – Monthly Average for the 7 day moving average maximum temperature (7-DMAM)
- **Water Surface Elevation** - # of days site exceeded 2-year food elevation
- **Vegetation** - Composition, Abundance, Species Richness, Species Diversity, Average Marsh Elevation



Water Temperature

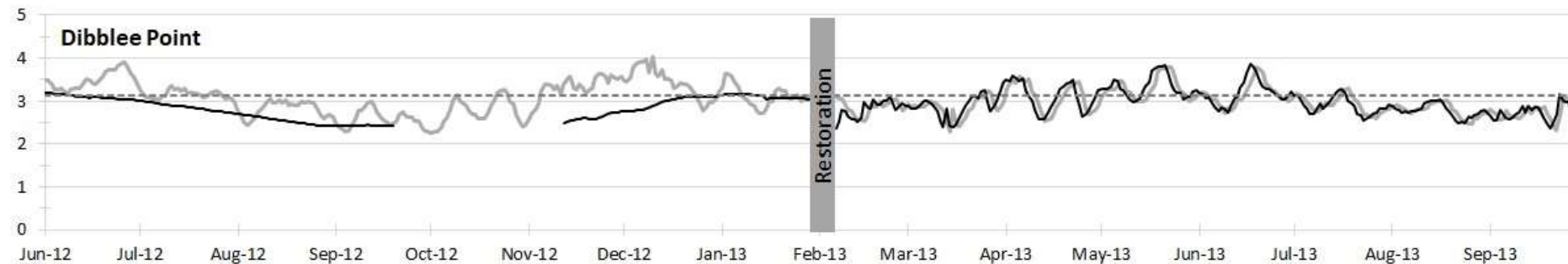


Duration of Pre/Post WSE Monitoring

—— Restored Wetland Max 7DMA
 - - - Mainstem Max 7DMA
 17.5 °C Reference Temp
 22 °C Reference Temp

| Year | | 2013 | | | | 2014 | | | | | | | | 2015 | | | | | | | | | | | | | | |
|-------------|----------|------|------|------|------|------|------|------|------|------|------|------|-------------|------|------|------|------|------|------|------|------|------|------|------|------|-----|-----|----|
| Month | | Sep | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | |
| Restoration | n (days) | 18 | 31 | 30 | 31 | 31 | 28 | 31 | 30 | 31 | 30 | 31 | Restoration | 26 | 31 | 30 | 31 | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 17 |
| | Mean | 19.4 | 14.1 | 9.4 | 5.0 | 6.2 | 6.2 | 10.5 | 14.8 | 17.1 | 20.7 | 27.2 | | 22 | 17.3 | 9.9 | 8.4 | 7.6 | 10.2 | 14.2 | 17 | 21.2 | 25.8 | 25.9 | 24.2 | 20 | 18 | |
| | SE | 0.56 | 0.17 | 0.45 | 0.24 | 0.11 | 0.34 | 0.28 | 0.26 | 0.14 | 0.18 | 0.29 | | 0.3 | 0.3 | 0.49 | 0.11 | 0.19 | 0.18 | 0.31 | 0.3 | 0.21 | 0.27 | 0.3 | 0.16 | 0.2 | 0.1 | |
| Main Stem | n (days) | 18 | 31 | 30 | 31 | 31 | 27 | 31 | 30 | 31 | 30 | 31 | Restoration | 28 | 31 | 30 | 31 | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 29 | |
| | Mean | 20.2 | 14.9 | 10.6 | 5.8 | 5.5 | 5.9 | 8.1 | 11.0 | 14.7 | 17.5 | 20.7 | | 20 | 17.3 | 11.0 | 8.0 | 6.1 | 6.8 | 8.6 | 11.6 | 15.5 | 20 | 22.8 | 22.2 | 20 | 17 | |
| | SE | 0.3 | 0.2 | 0.4 | 0.2 | 0.1 | 0.2 | 0.1 | 0.2 | 0.2 | 0.1 | 0.2 | | 0.2 | 0.3 | 0.4 | 0.1 | 0.1 | 0.1 | 0.2 | 0.2 | 0.2 | 0.2 | 0.1 | 0.1 | 0.2 | 0.1 | |

Water Surface Elevation

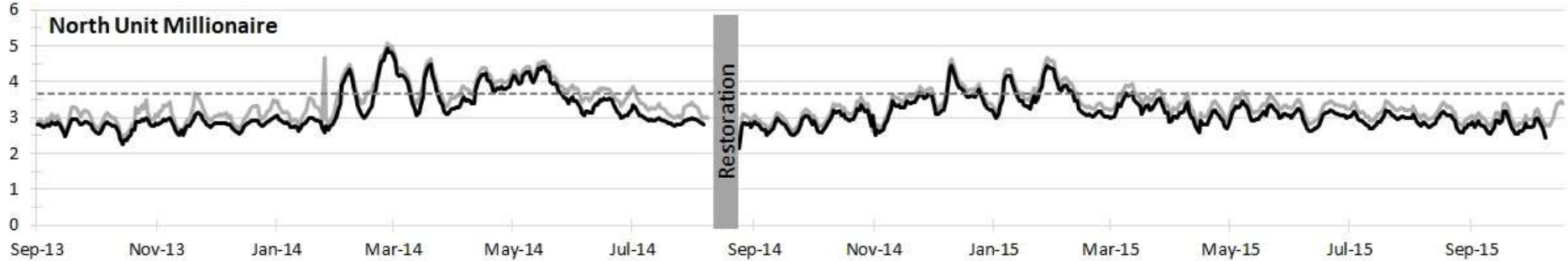


Duration of Pre/Post WSE Monitoring

Restored Wetland
 Outer Reference
 2 yr Flood Elevation

| Year | | 2012 | | | | | | | 2013 | | | | | | | | | |
|-------------|------------------------------------|------|------|------|------|------|------|------|------|-------------|------|------|------|------|------|------|------|------|
| Month | | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct |
| Restoration | n (days) | 23 | 31 | 31 | 26 | | 12 | 31 | 31 | Restoration | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 3 |
| | Mean | 3.12 | 2.92 | 2.61 | 2.43 | | 2.57 | 2.89 | 3.11 | | 2.85 | 3.15 | 3.27 | 3.19 | 2.97 | 2.79 | 2.70 | 2.99 |
| | SE | 0.01 | 0.02 | 0.02 | 0.00 | | 0.01 | 0.03 | 0.01 | | 0.04 | 0.06 | 0.06 | 0.05 | 0.04 | 0.03 | 0.03 | 0.01 |
| | Days Exceeded 2 yr Flood Elevation | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 10 | 9 | 6 | 0 | 0 | 0 | 0 |
| Outside | n (days) | 23 | 31 | 31 | 30 | 31 | 30 | 31 | 31 | Restoration | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 3 |
| | Mean | 3.43 | 3.30 | 2.90 | 2.64 | 2.70 | 3.14 | 3.56 | 3.10 | | 2.83 | 3.12 | 3.25 | 3.17 | 3.01 | 2.80 | 2.67 | 3.01 |
| | SE | 0.03 | 0.05 | 0.04 | 0.04 | | 0.06 | 0.04 | 0.05 | | 0.04 | 0.06 | 0.06 | 0.05 | 0.03 | 0.02 | 0.02 | 0.06 |
| | Days Exceeded 2 yr Flood Elevation | 11 | 6 | 0 | 0 | 0 | 4 | 24 | 4 | | 0 | 7 | 9 | 4 | 0 | 0 | 0 | 0 |

Water Surface Elevation



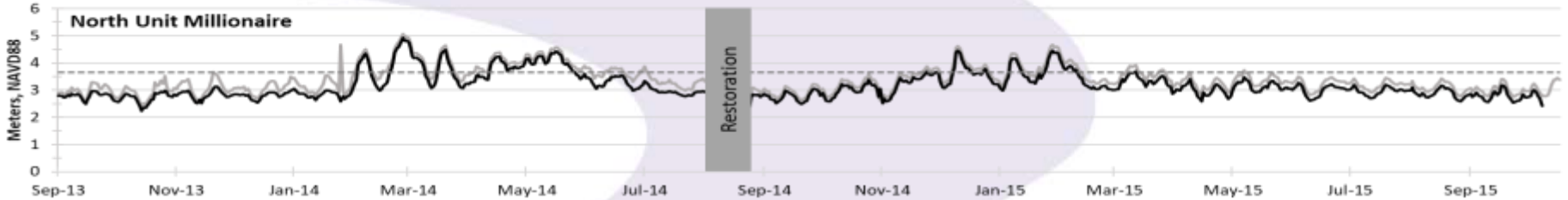
Duration of Pre/Post WSE Monitoring

———— Restored Wetland ————— Outer Reference - - - - - 2 yr Flood Elevation

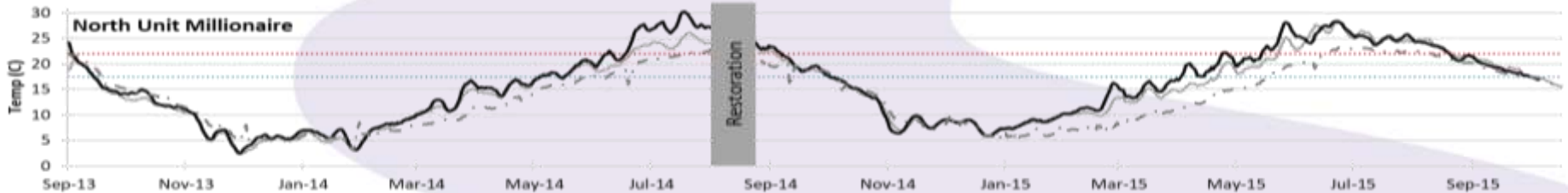
| Year | | 2013 | | | | 2014 | | | | | | | | 2015 | | | | | | | | | | | | | |
|-------------|------------------------------------|------|------|------|------|------|------|------|------|------|------|------|-------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| Month | | Sep | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct |
| Restoration | n (days) | 18 | 31 | 30 | 31 | 31 | 28 | 31 | 30 | 31 | 30 | 31 | Restoration | 26 | 31 | 30 | 31 | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 20 |
| | Max Mean WSE | 2.77 | 2.70 | 2.81 | 2.83 | 2.86 | 3.27 | 4.03 | 3.62 | 4.06 | 3.48 | 3.08 | | 2.74 | 2.86 | 3.09 | 3.63 | 3.52 | 3.77 | 3.25 | 3.11 | 3.07 | 3.01 | 2.99 | 2.96 | 2.81 | 2.74 |
| | SE | 0.03 | 0.03 | 0.02 | 0.03 | 0.02 | 0.10 | 0.10 | 0.07 | 0.04 | 0.05 | 0.03 | | 0.03 | 0.04 | 0.05 | 0.06 | 0.06 | 0.08 | 0.04 | 0.05 | 0.03 | 0.04 | 0.03 | 0.02 | 0.03 | 0.04 |
| | Days Exceeded 2 yr Flood Elevation | 0 | 0 | 0 | 0 | 0 | 7 | 21 | 11 | 31 | 6 | 0 | | 0 | 0 | 0 | 11 | 9 | 17 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Outside | n (days) | 18 | 31 | 30 | 31 | 31 | 28 | 31 | 30 | 31 | 30 | 31 | Restoration | 26 | 31 | 30 | 31 | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 29 |
| | Mean | 2.90 | 2.91 | 3.06 | 3.08 | 3.17 | 3.61 | 4.24 | 3.86 | 4.23 | 3.78 | 3.43 | | 2.91 | 3.03 | 3.24 | 3.80 | 3.70 | 3.99 | 3.48 | 3.34 | 3.31 | 3.24 | 3.22 | 3.19 | 3.03 | 3.02 |
| | SE | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.10 | 0.09 | 0.07 | 0.04 | 0.03 | 0.04 | | 0.03 | 0.04 | 0.06 | 0.06 | 0.06 | 0.07 | 0.04 | 0.05 | 0.04 | 0.04 | 0.03 | 0.03 | 0.03 | 0.04 |
| | Days Exceeded 2 yr Flood Elevation | 0 | 0 | 0 | 1 | 0 | 11 | 27 | 18 | 31 | 23 | 6 | | 0 | 0 | 0 | 22 | 16 | 23 | 7 | 5 | 1 | 0 | 0 | 0 | 0 | 0 |

Opportunity

Habitat Access = Water Surface Elevation



Habitat Quality = Water Temperature



Habitat Access + Habitat Quality = Opportunity

Water surface elevation and water temperature used together tells a more complete story

Opportunity

- Optimal: When water depth is ≥ 0.5 m and temp is ≤ 17.5 C
- Marginal: When water depth is ≥ 0.5 m and temp is between 17.5-22 C

Wetland Channel Pre-Restoration

Water Control Structure
(such as a closed tide gate)

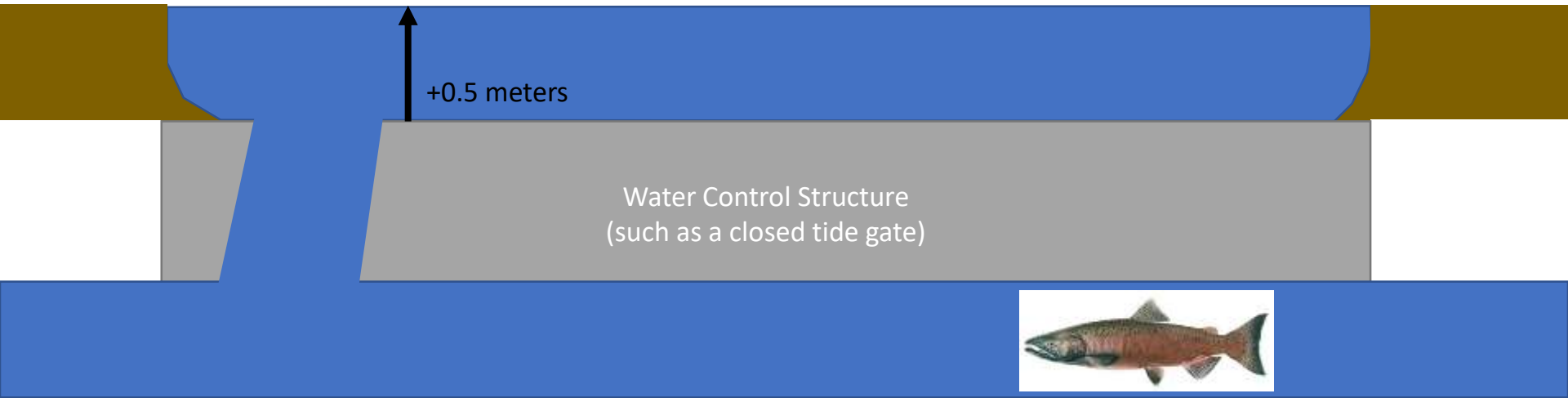


Salmonid Habitat Opportunity

- Optimal: When water depth is ≥ 0.5 m and temp is ≤ 17.5 C
- Marginal: When water depth is ≥ 0.5 m and temp is between 17.5-22 C

Wetland Channel Pre-Restoration

Opportunity Depth = Top WCS Elevation + 0.5 m

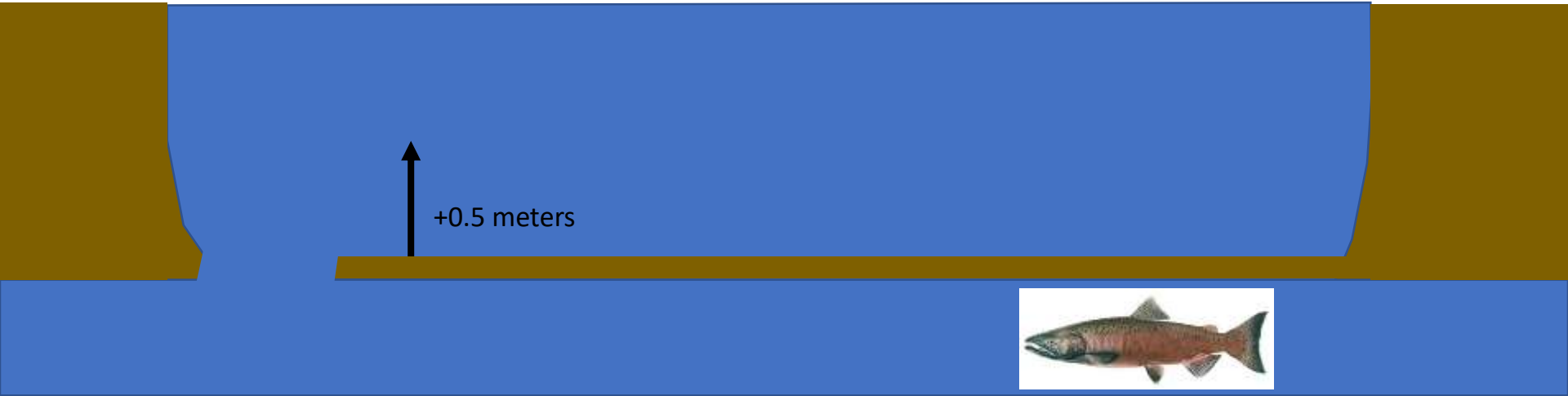


Salmonid Habitat Opportunity

- Optimal: When water depth is ≥ 0.5 m and temp is ≤ 17.5 C
- Marginal: When water depth is ≥ 0.5 m and temp is between 17.5-22 C

Wetland Channel Post-Restoration

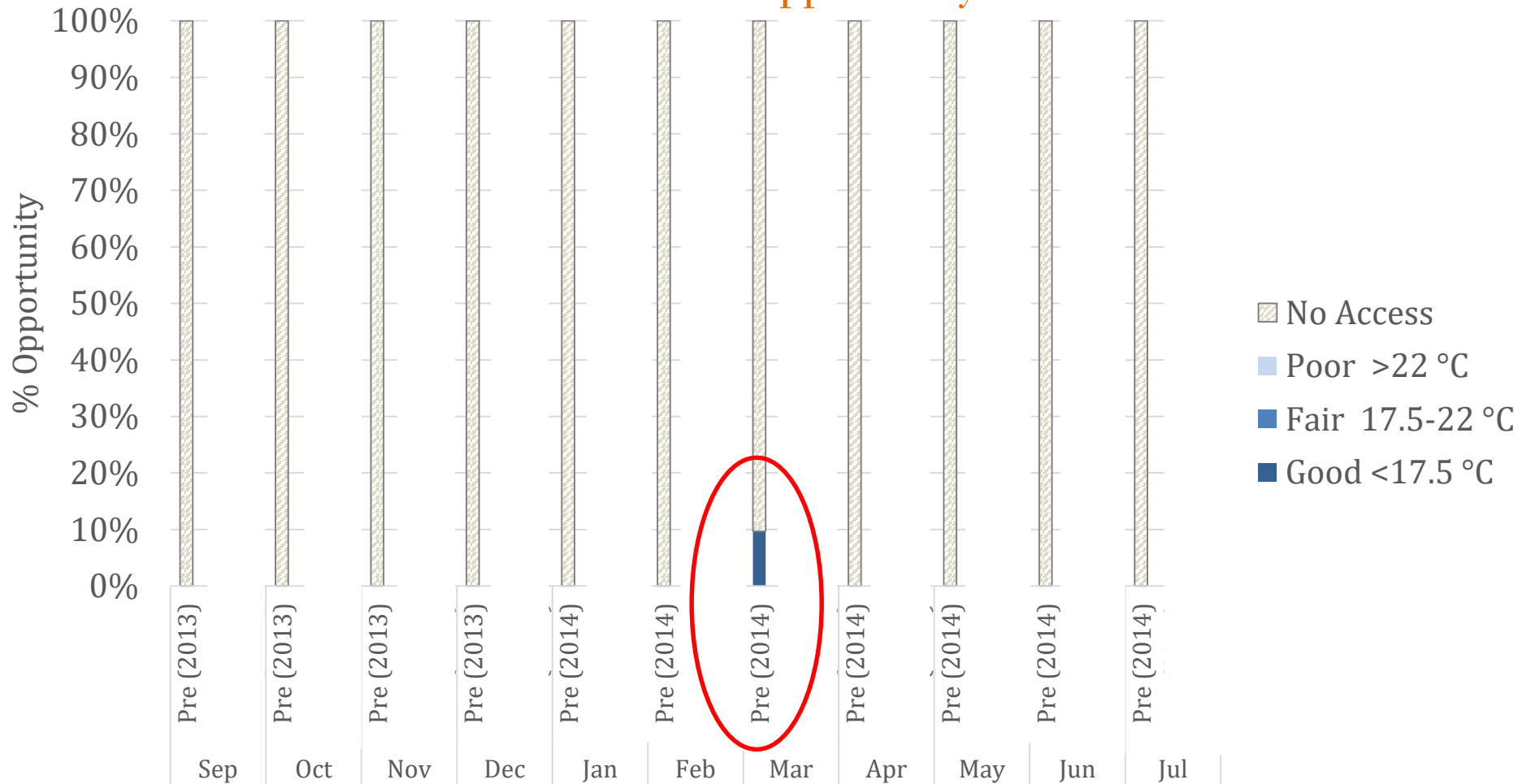
Opportunity Depth = Bottom of Channel Elevation + 0.5 m



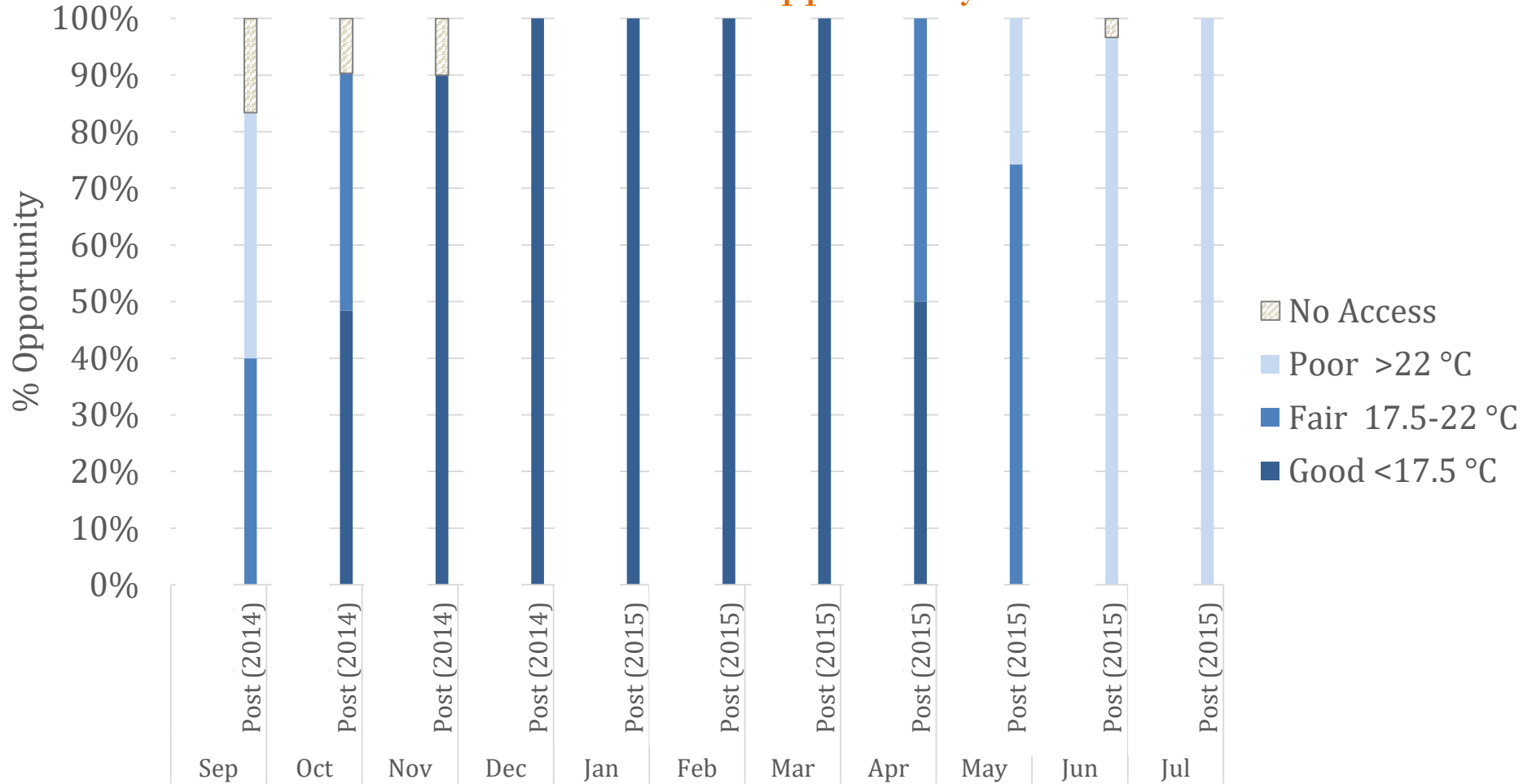
Salmonid Habitat Opportunity



Salmonid Habitat Opportunity



Salmonid Habitat Opportunity



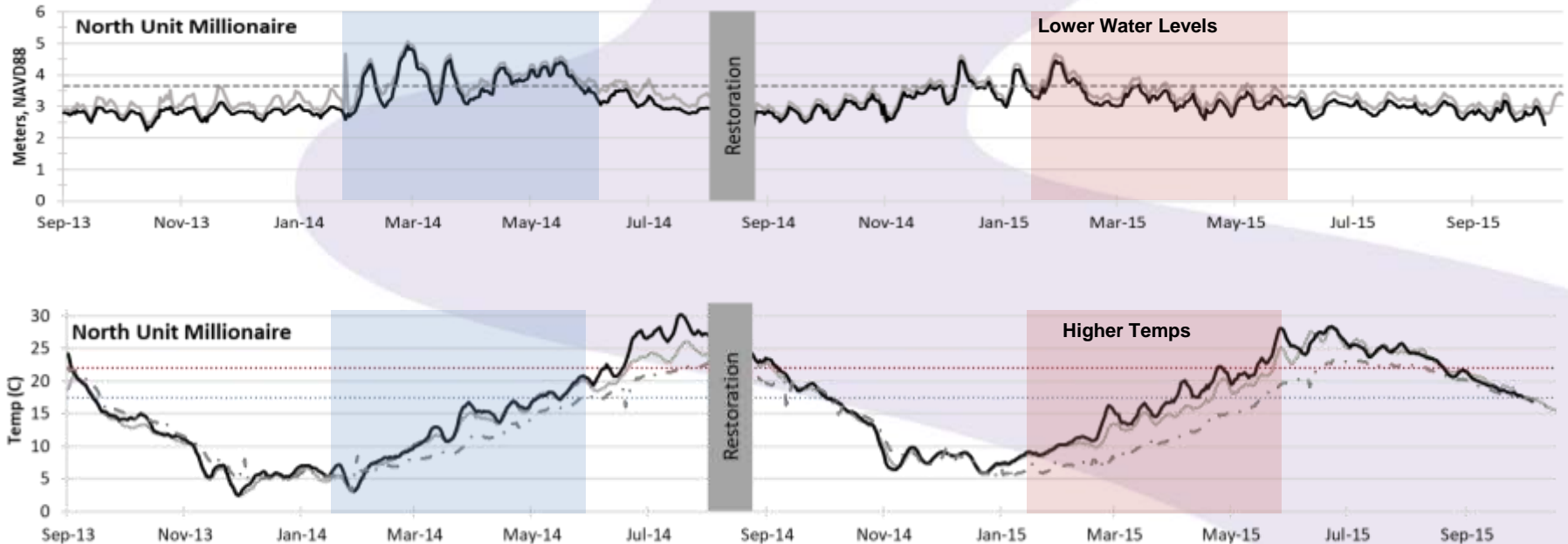
Salmonid Habitat Opportunity

North Unit Millionaire Opportunity (% Access)

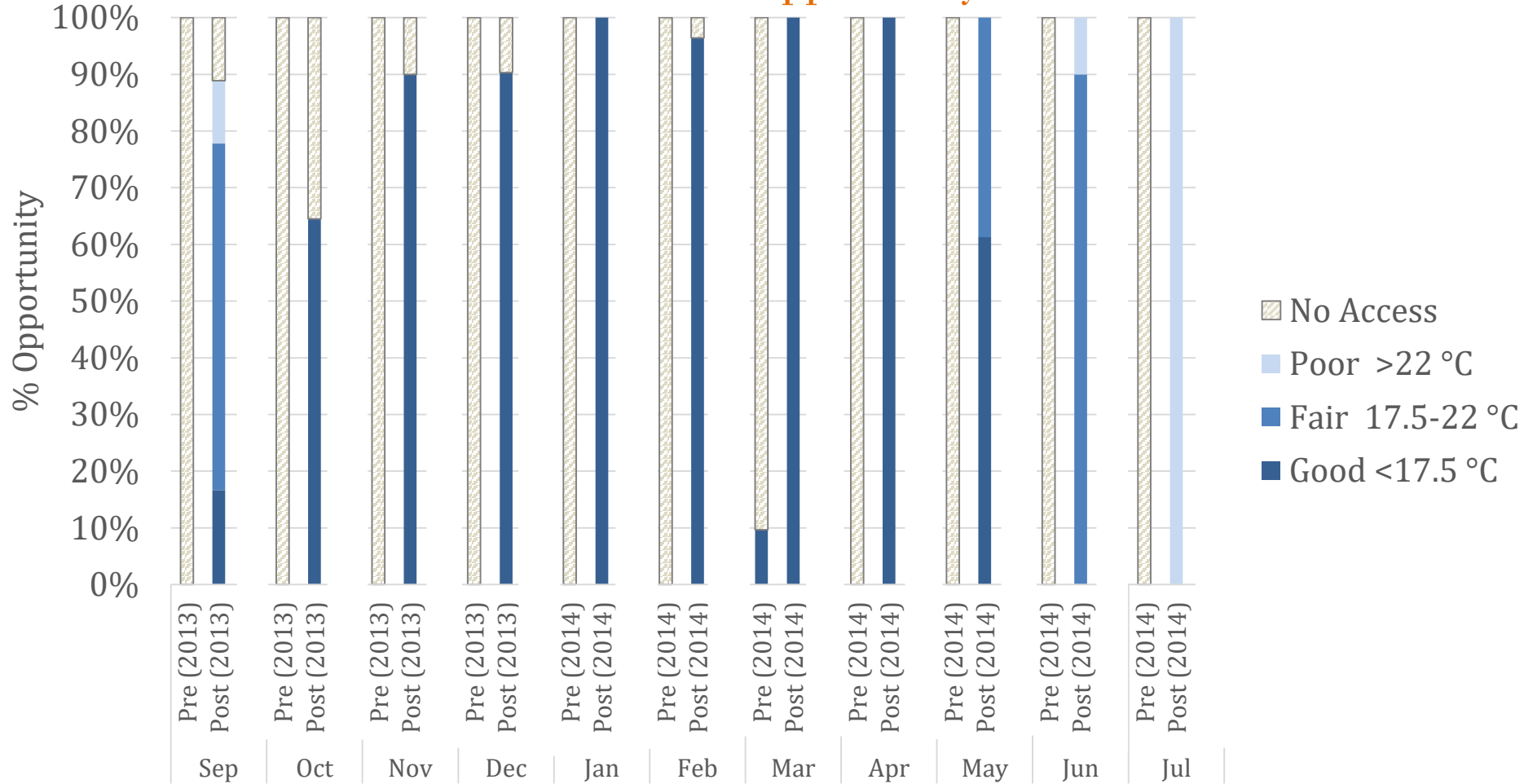
| Years | 2013 | | | | 2014 | | | | | | | | 2015 | | | | | | | | | | | | | |
|--------------|------|-----|-----|-----|------|-----|-----|-----|-----|-----|-----|-------------|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Months | Sep | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct |
| Good <17.5 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 0 | 0 | 0 | 0 | Restoration | 0 | 48 | 90 | 100 | 100 | 100 | 100 | 50 | 0 | 0 | 0 | 0 | 0 | 24 |
| Fair 17.5-22 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 46 | 42 | 0 | 0 | 0 | 0 | 0 | 50 | 74 | 0 | 0 | 0 | 100 | 76 |
| Poor >22 Pre | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 50 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 26 | 97 | 100 | 100 | 0 | 0 |
| No Access | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 0 | 0 | 0 | 0 | | 96 | 90 | 90 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 97 | 100 | 100 | 100 |

Water Year Matters

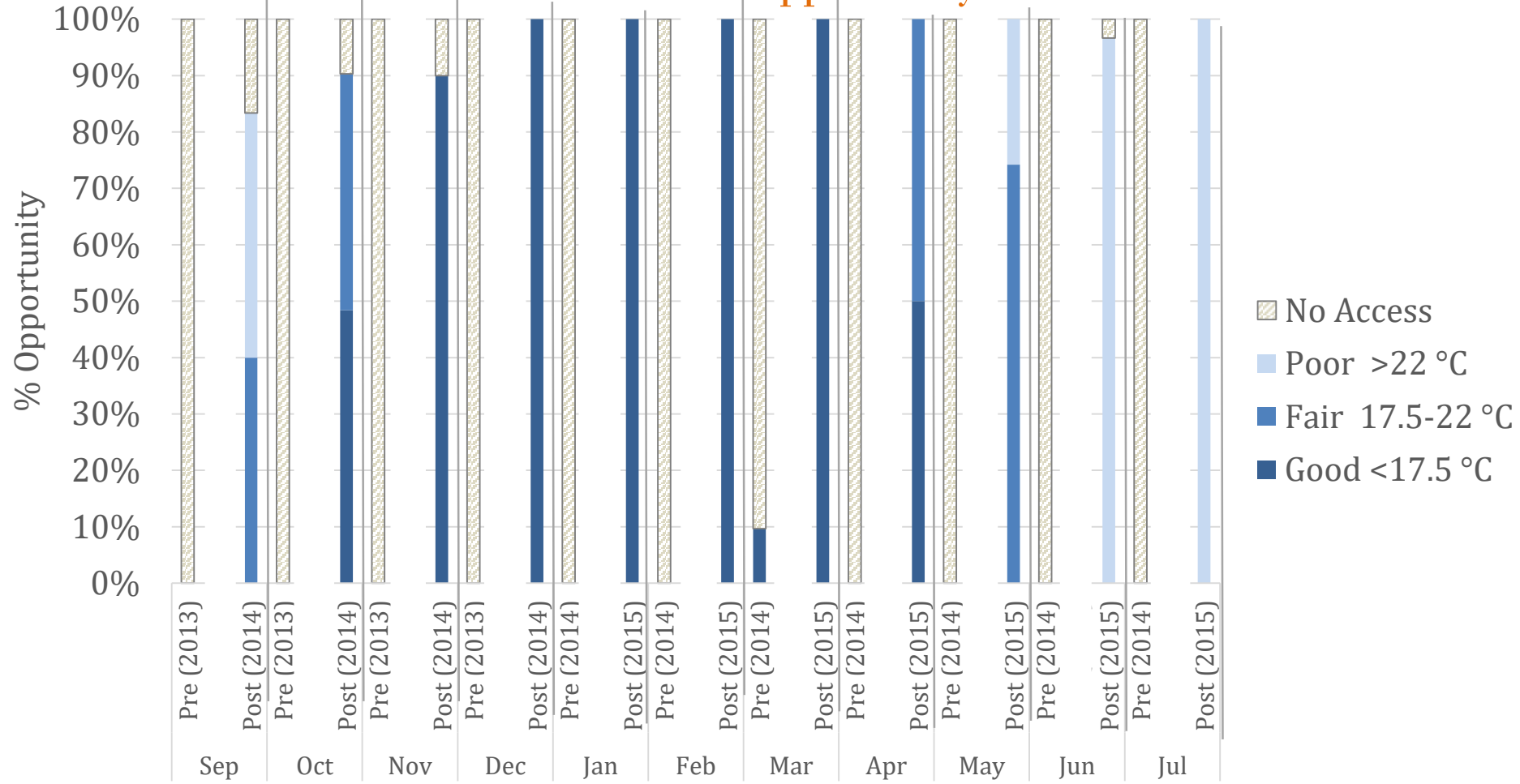
- Example Looking at Pre/Post Data from 2014 and 2015
- Important when determining what is the result of restoration actions vs different climatic conditions



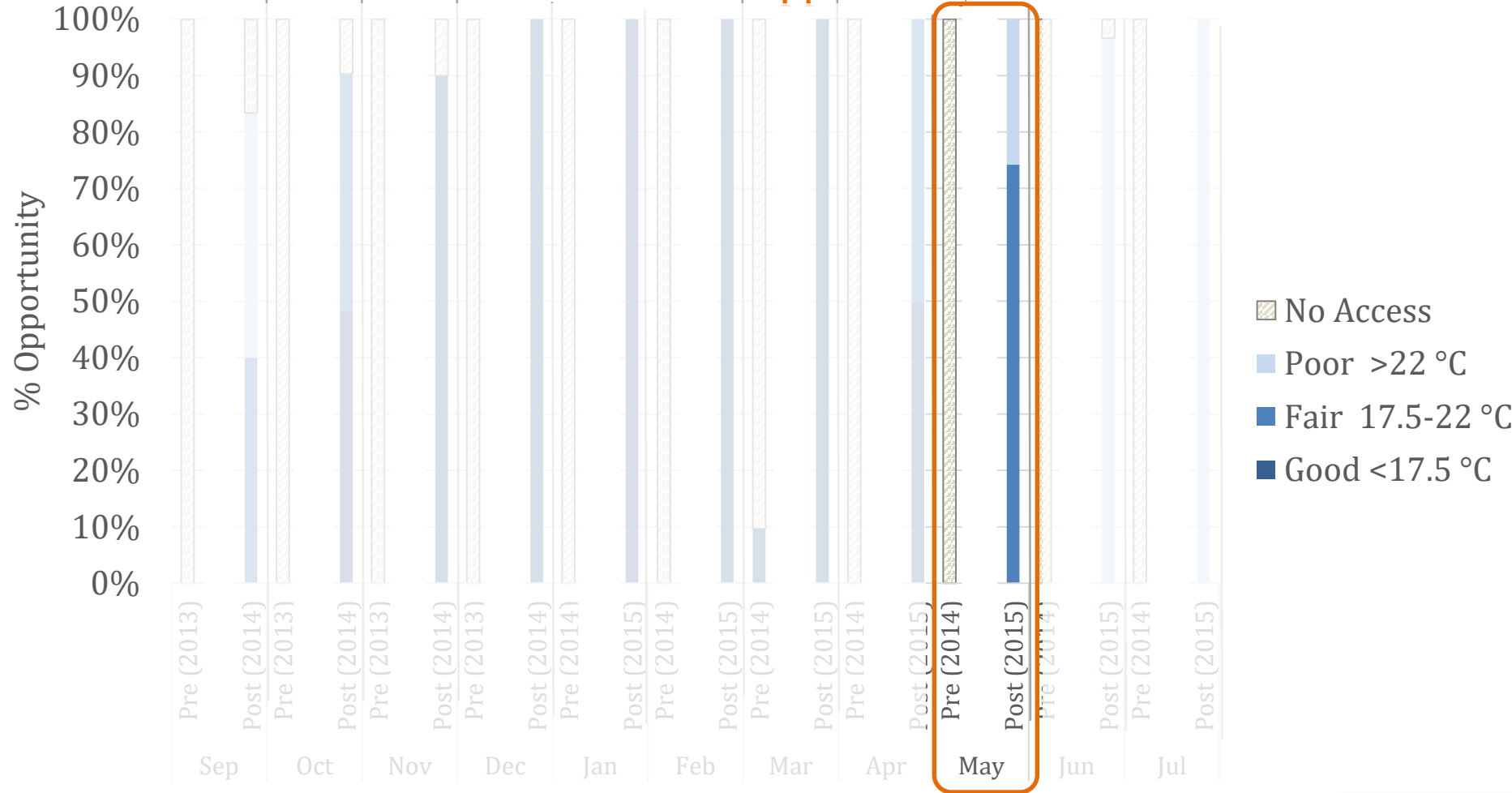
Salmonid Habitat Opportunity



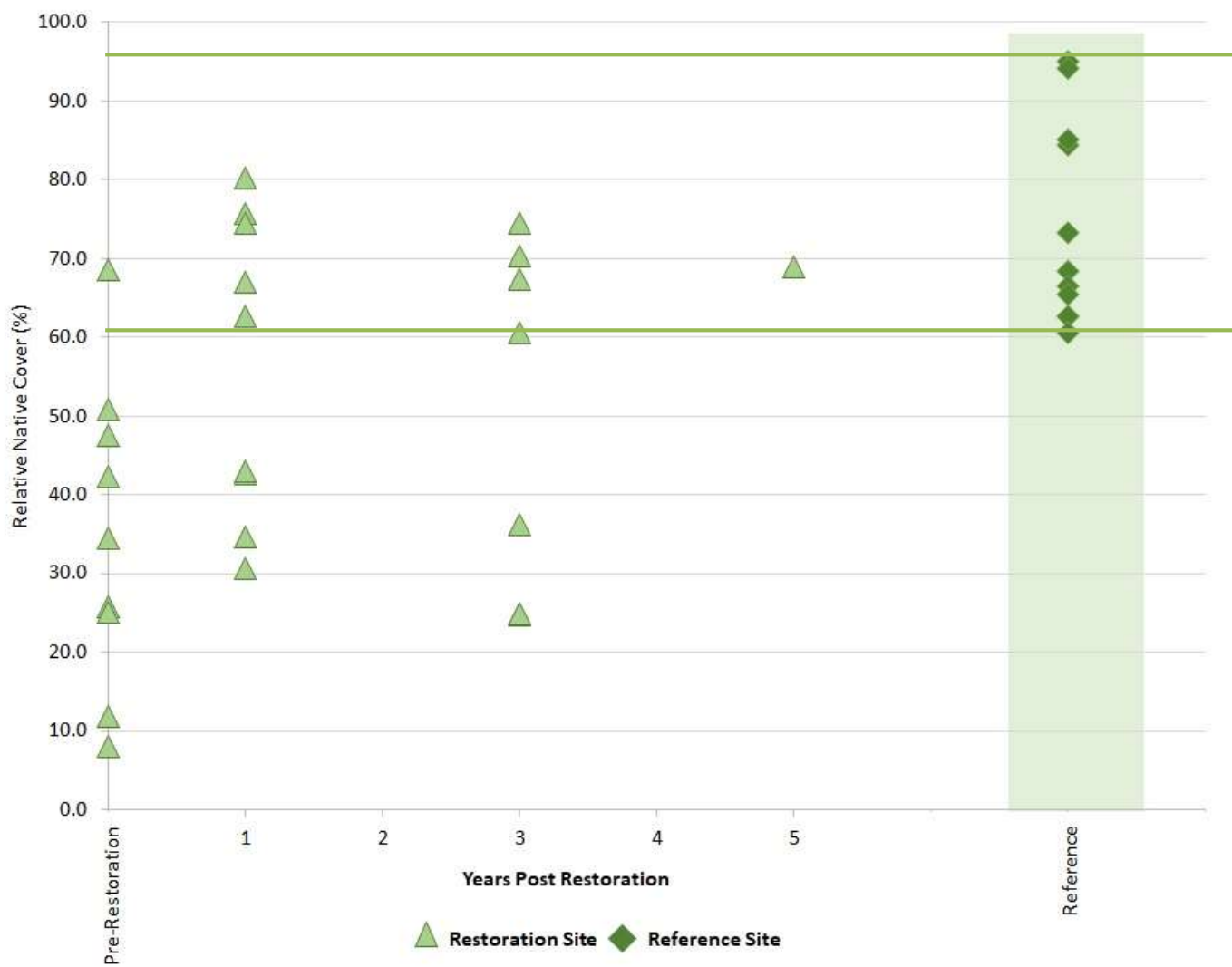
Salmonid Habitat Opportunity



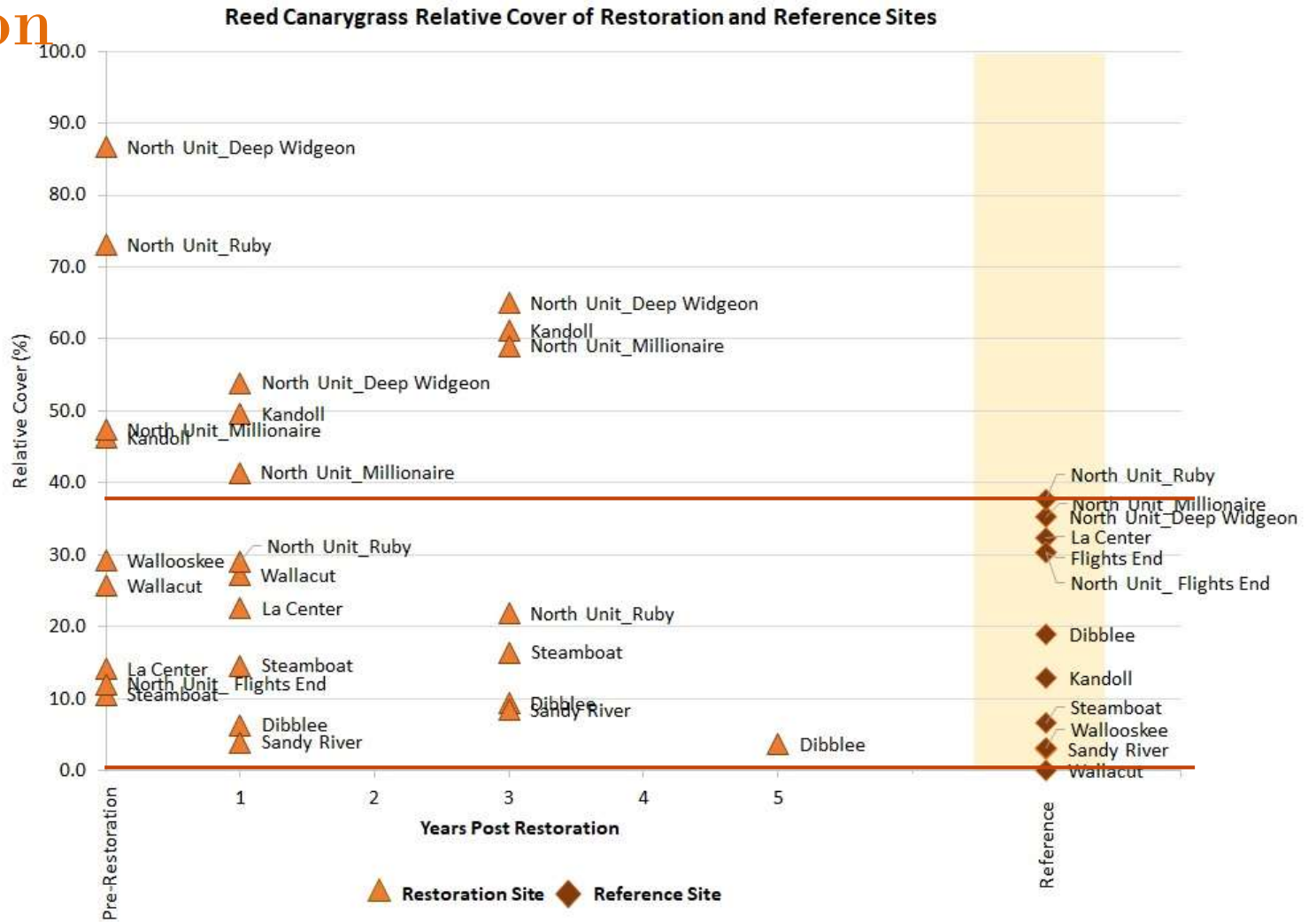
Salmonid Habitat Opportunity



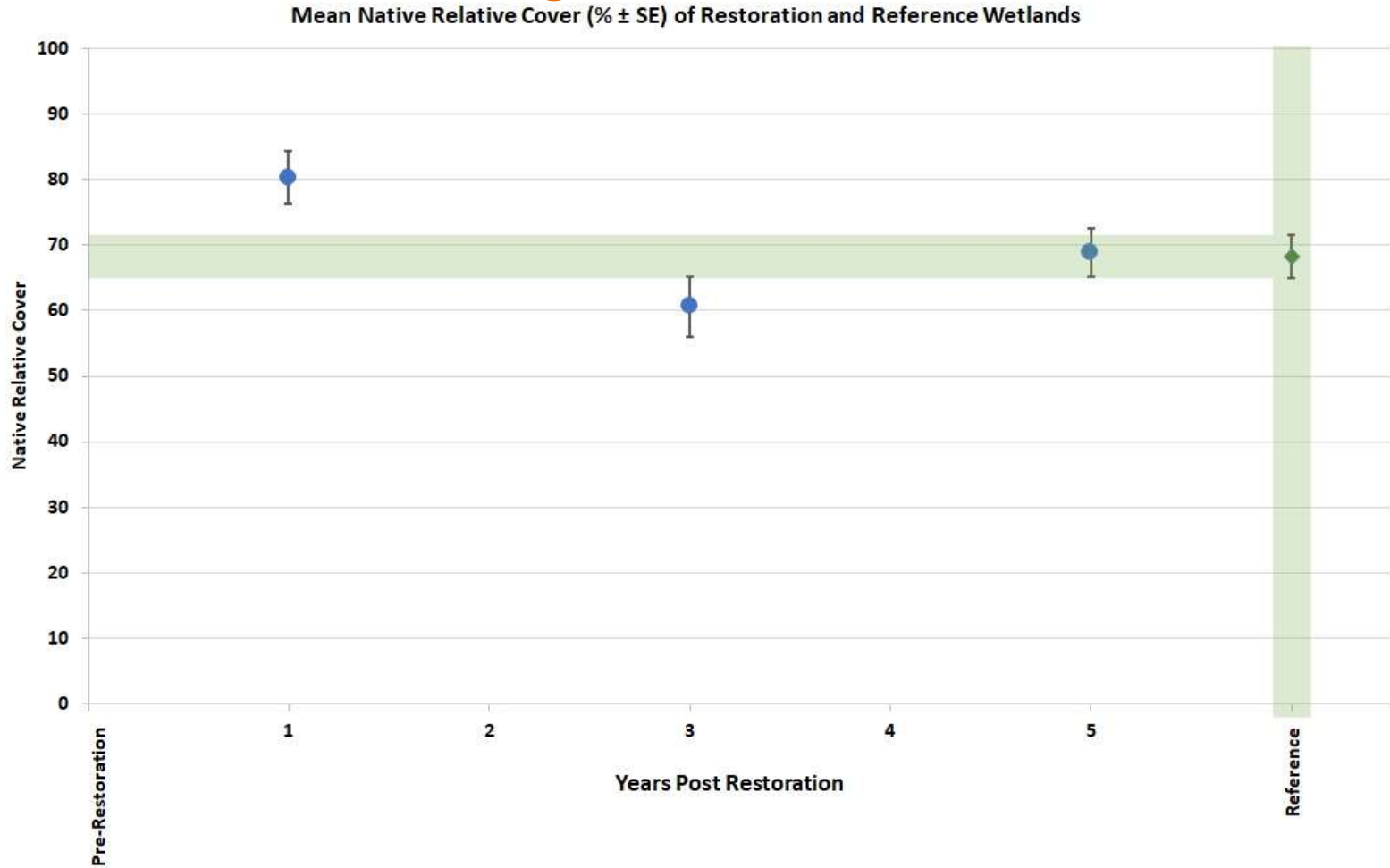
Vegetation



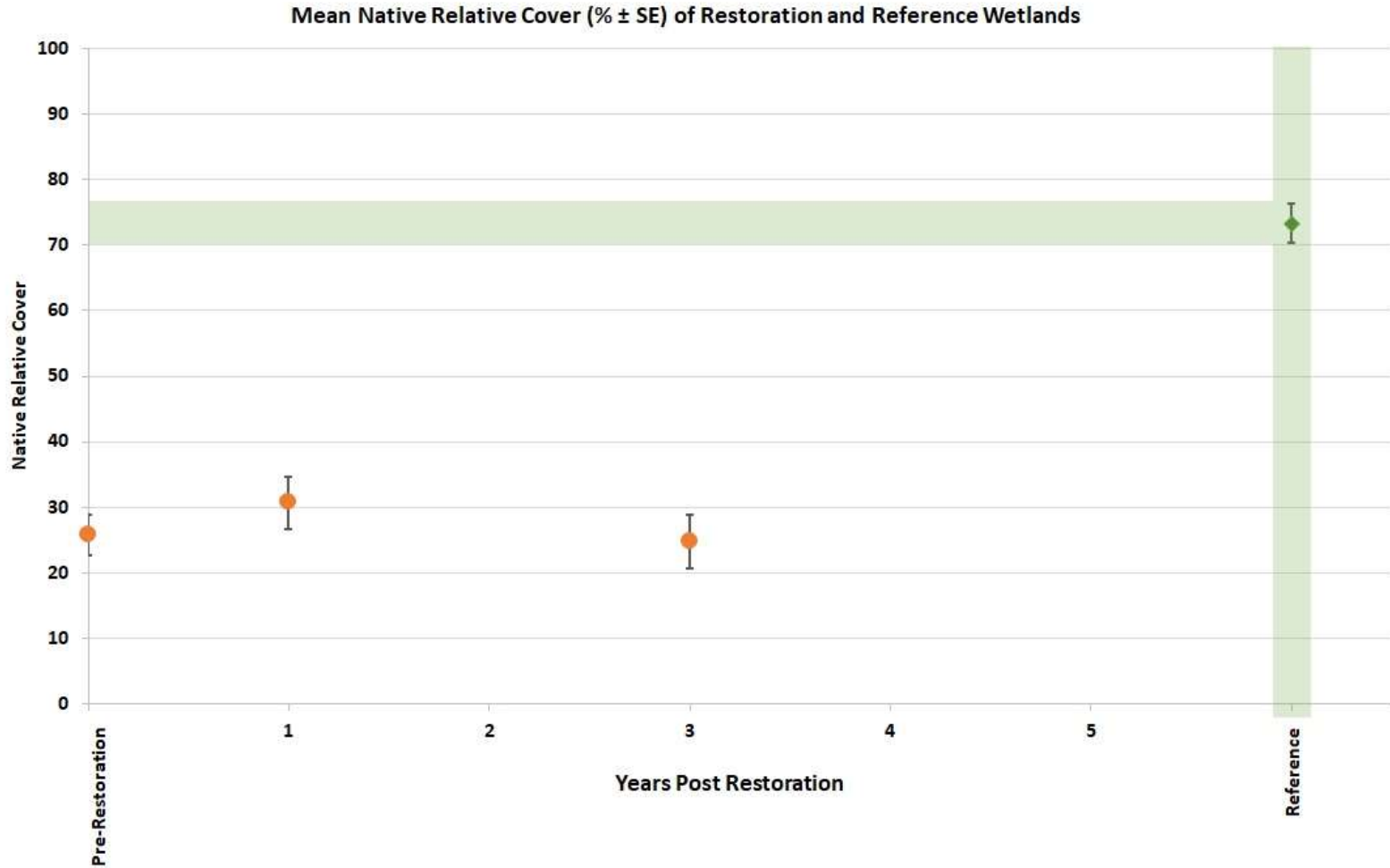
Vegetation



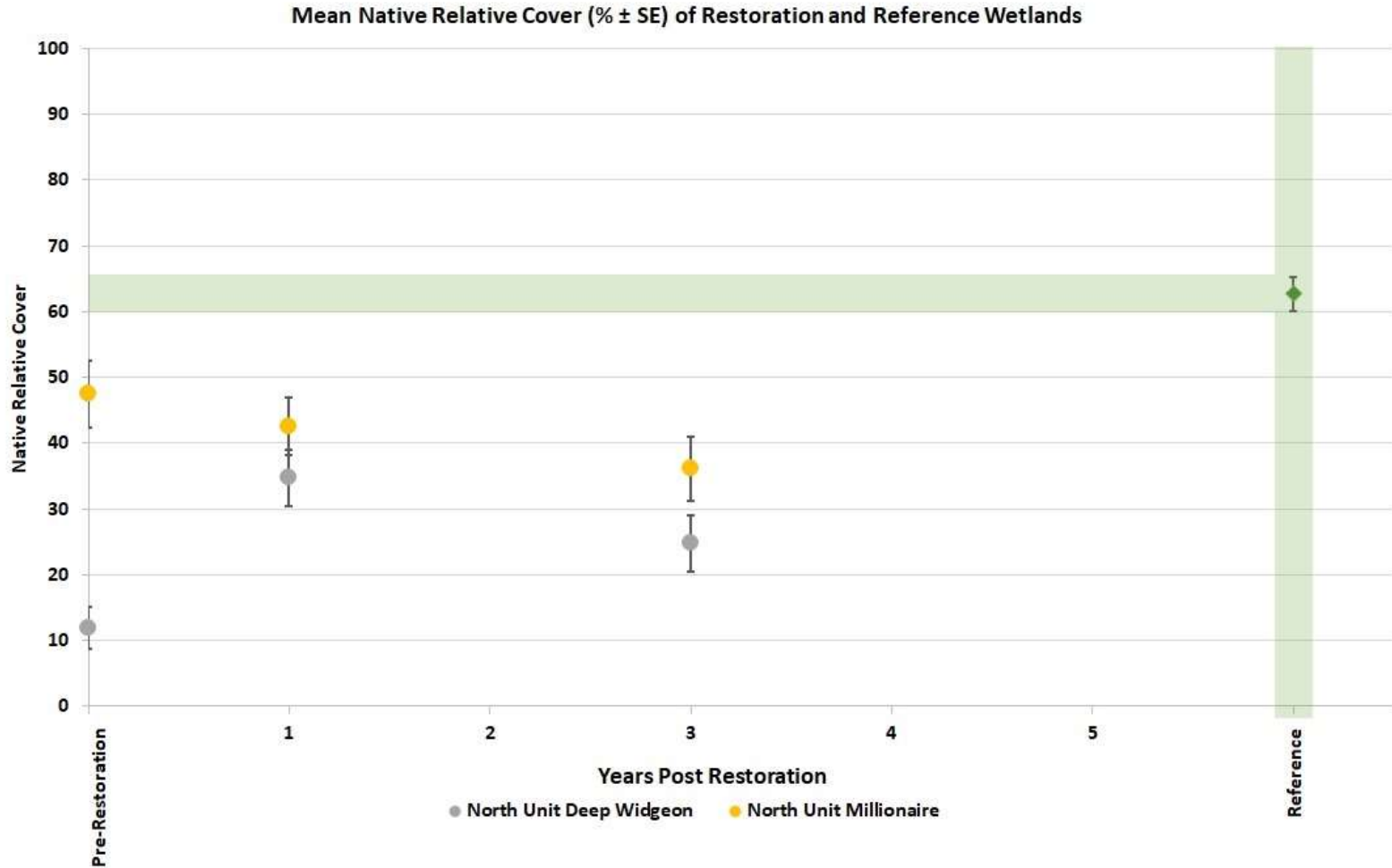
Vegetation – Dibblee Slough



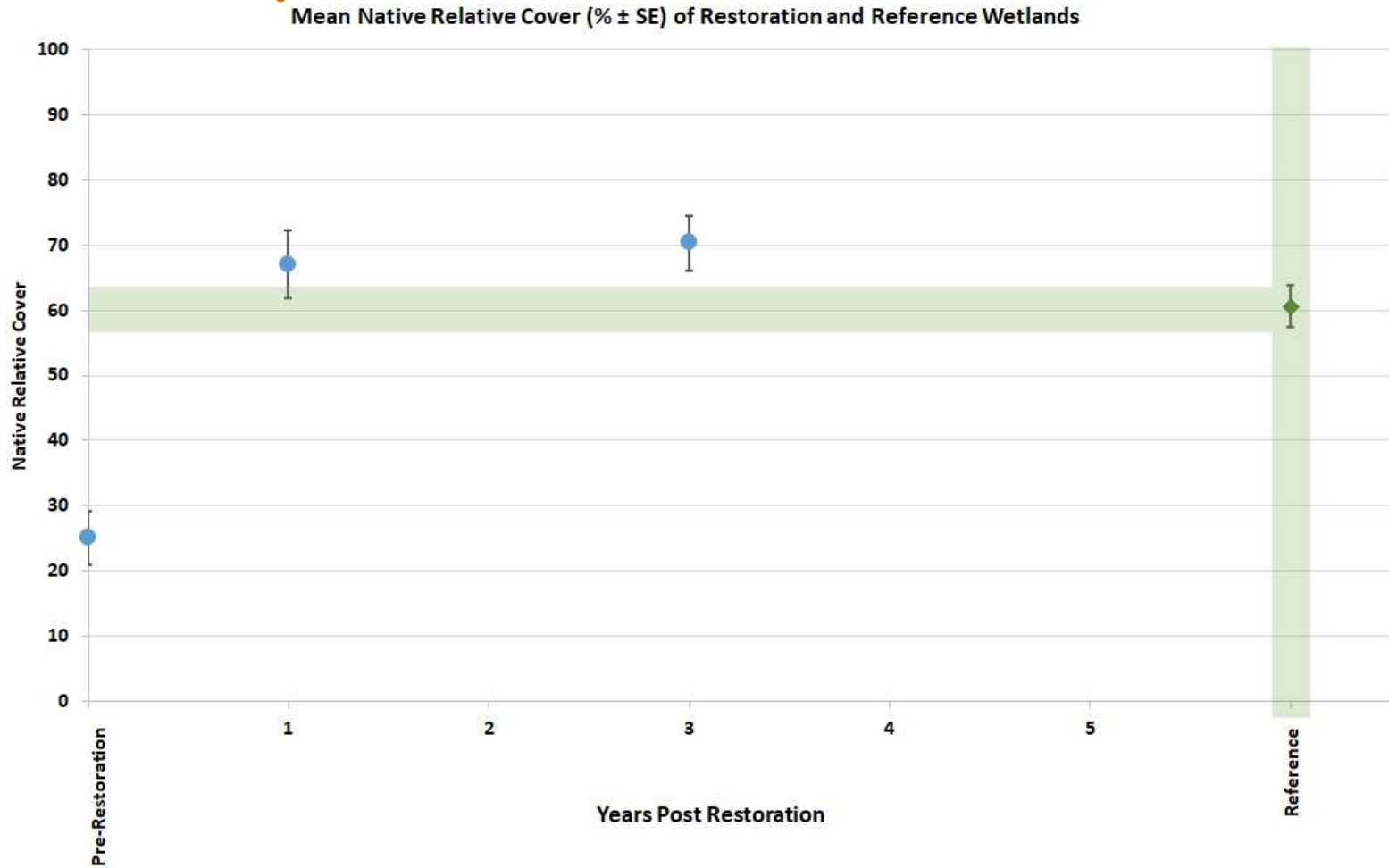
Vegetation – Kandoll Farm



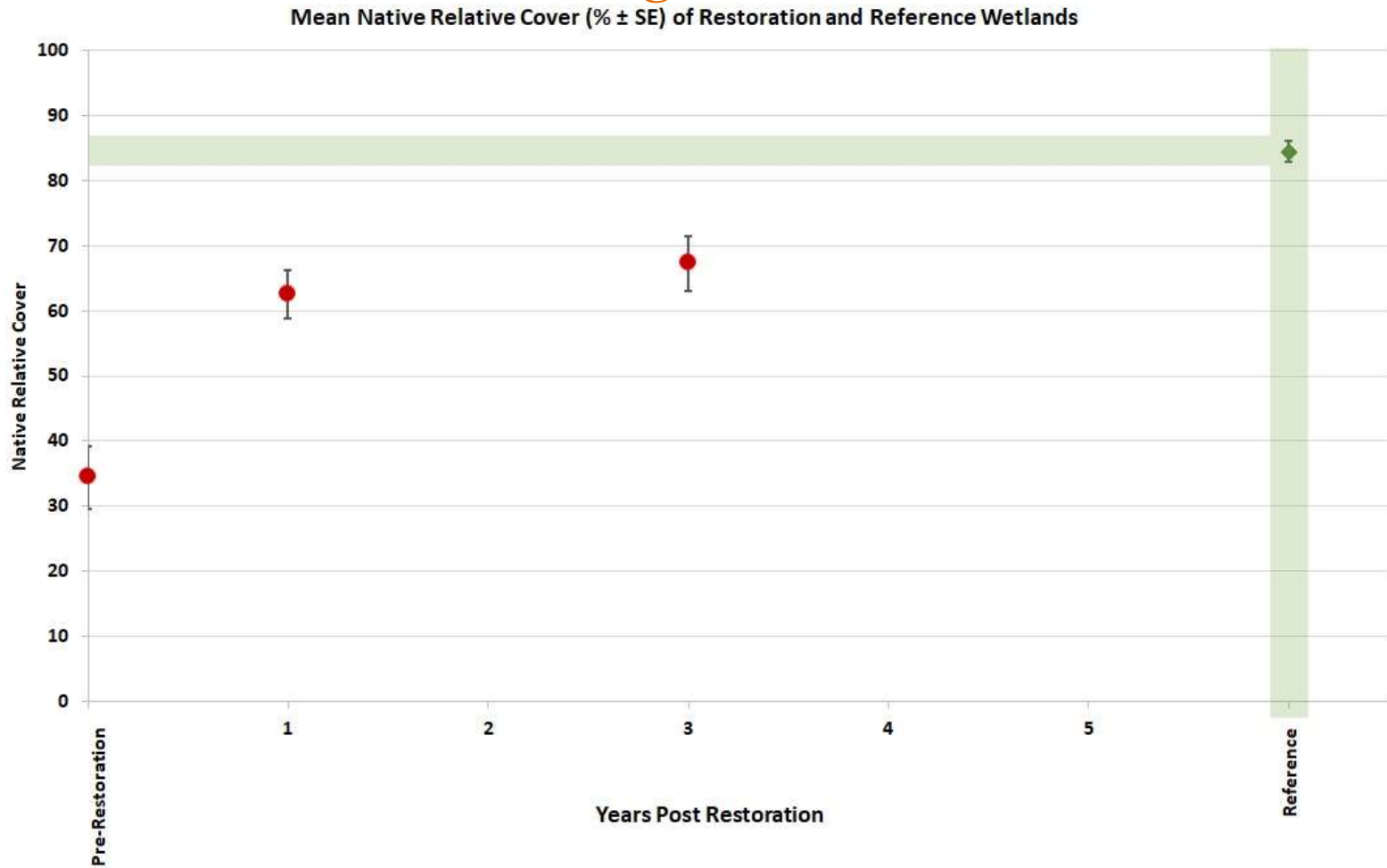
Vegetation – North Unit Phase 2



Vegetation – Ruby Lake

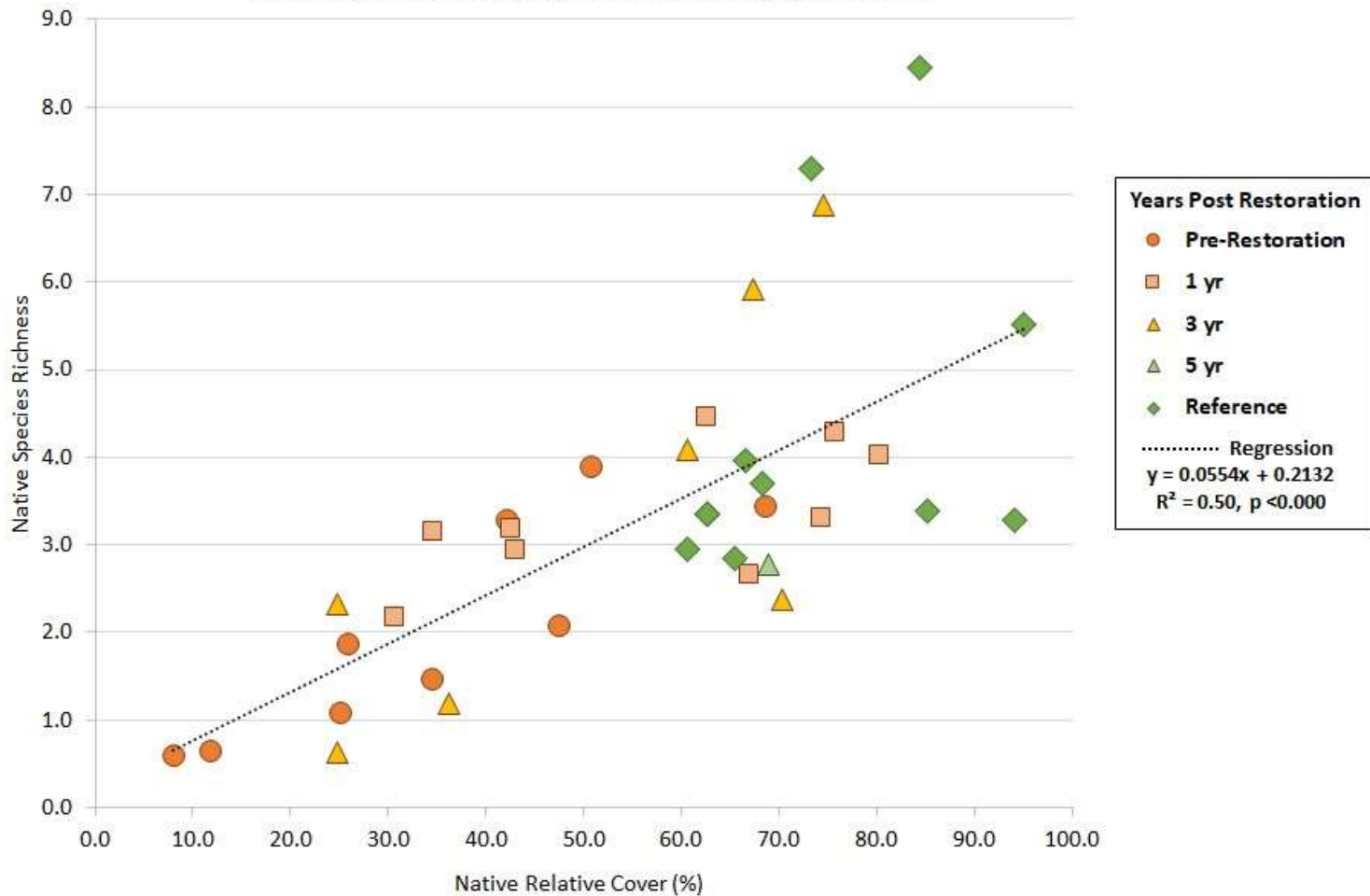


Vegetation – Steamboat Slough



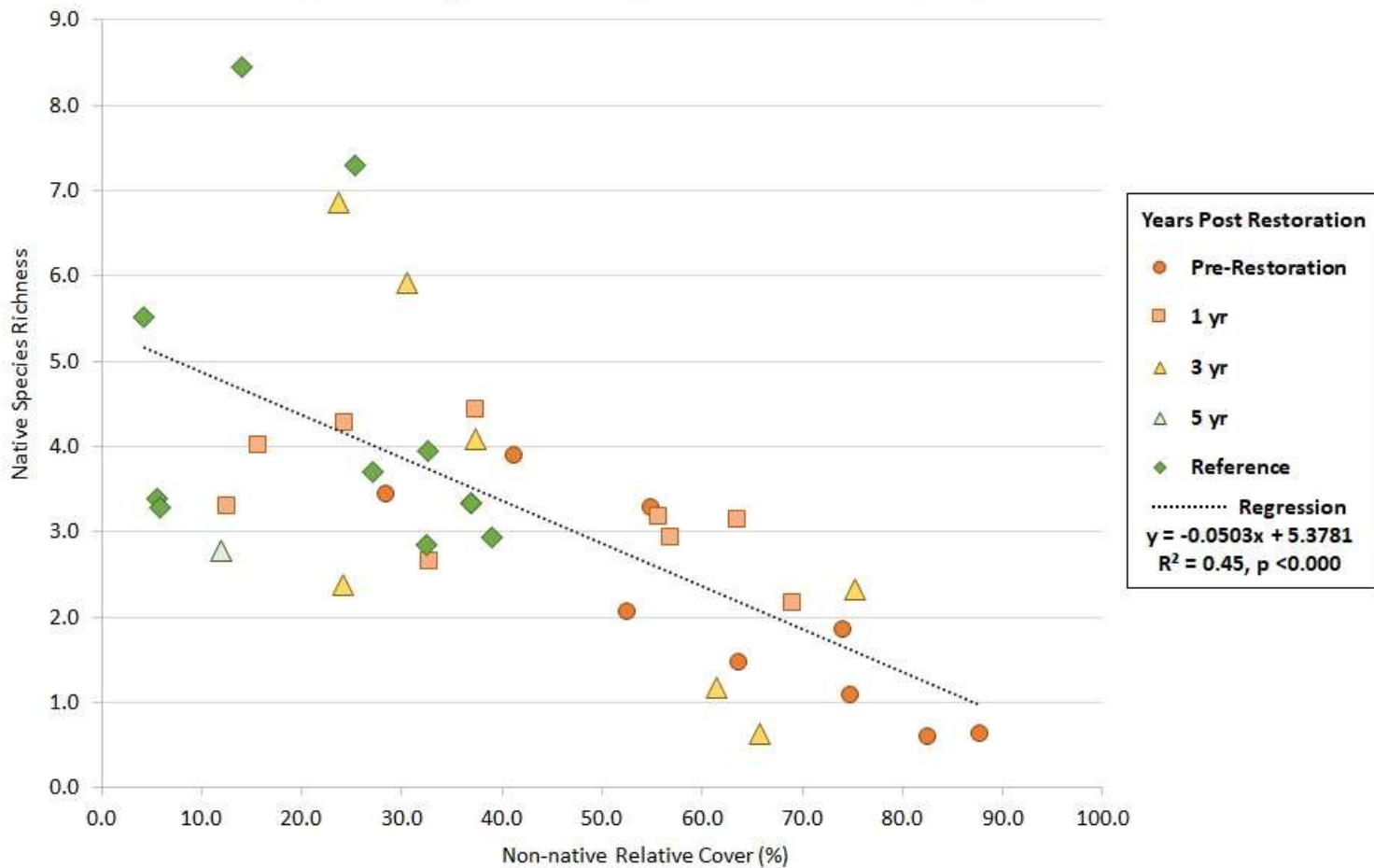
Vegetation

Restoration and Reference Sites
Mean Native Species Richness vs. Native Relative Cover



Vegetation

Restoration and Reference Sites
Mean Native Species Richness vs. Non-native Relative Cover

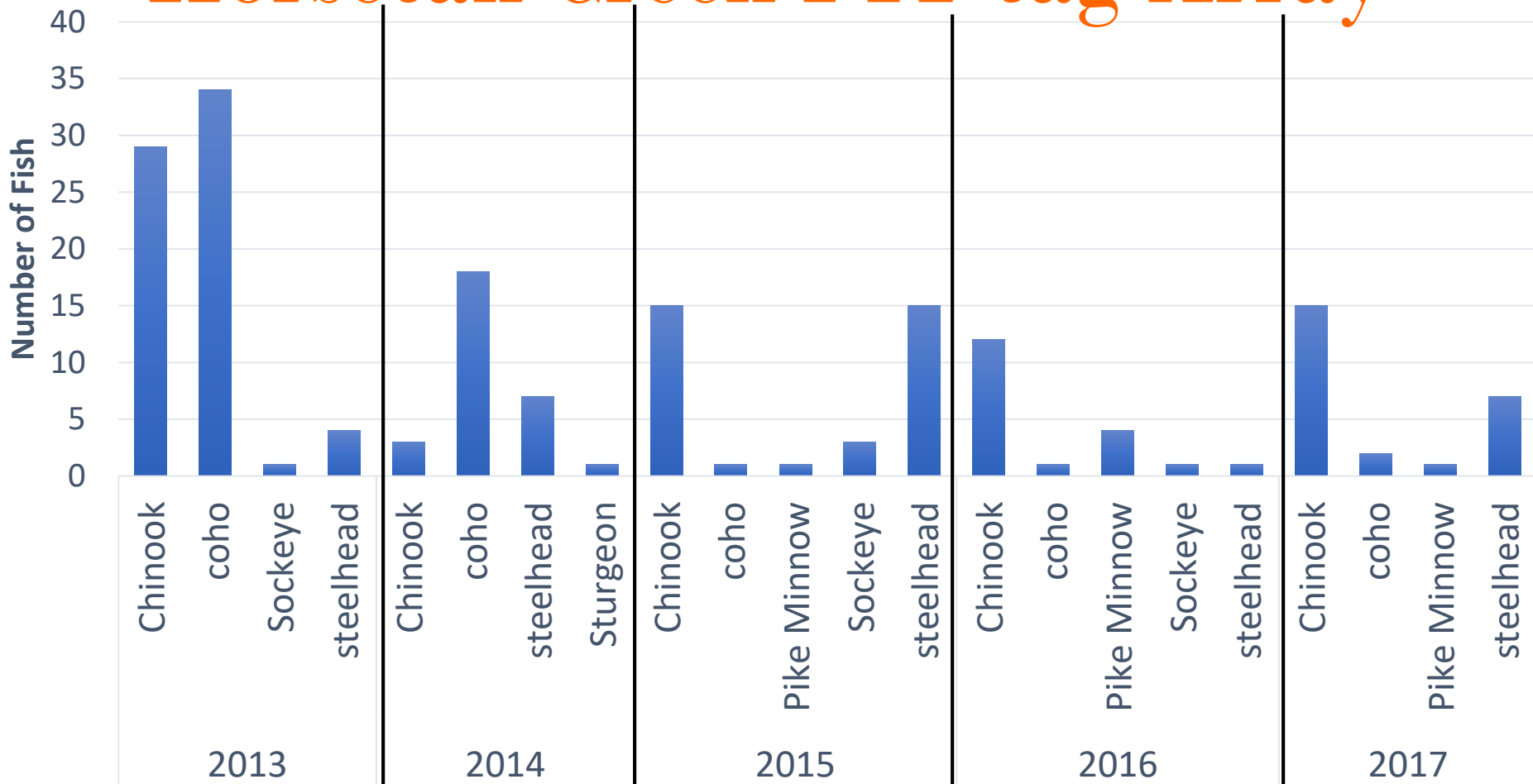


Horsetail Creek PIT tag Array

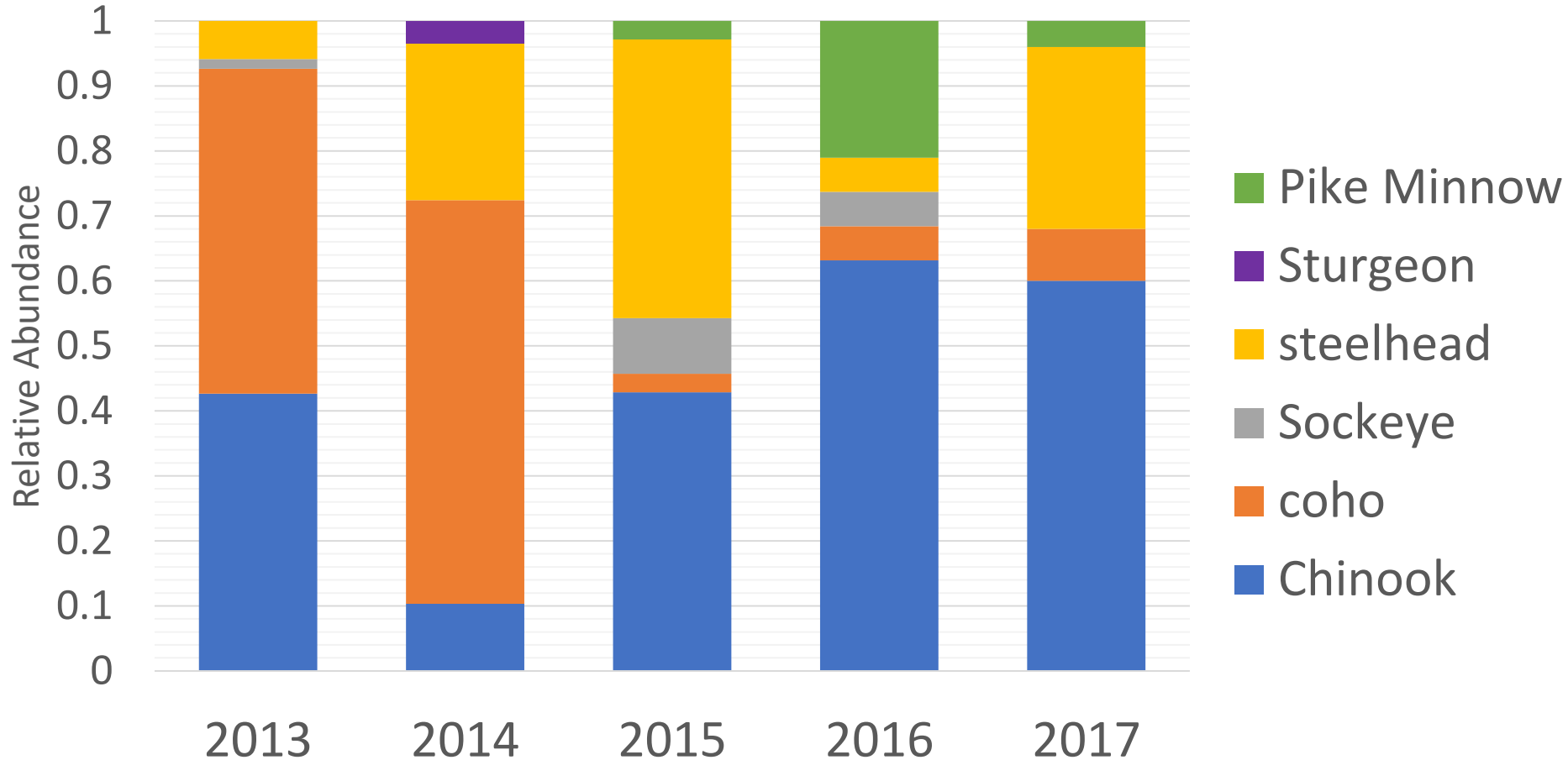
- Operating Pre and Post Restoration
- Identify fish/life stage
- Determine if fish transit culvert



Horsetail Creek PIT tag Array



Horsetail Creek PIT tag Array



AEM Conclusion and Discussion

- Water surface elevation and water temperature used together tells a more complete story
- Two year flood elevation is a good footprint for a project but not a good measure of fish opportunity

AEM Conclusion and Discussion

- Soil scrape down projects are showing mixed results
- Strong positive correlation between native species richness and native species cover
- Strong negative correlation between native species richness and non-native species cover

AEM Conclusion and Discussion

An aerial photograph of a wetland restoration site. A winding waterway, possibly a stream or canal, flows through the center of the image. The water is a murky brown color. On either side of the waterway, there is a mix of green grasses and brown, dried-out vegetation, indicating a transition in the ecosystem. The background shows more green fields and trees under a clear sky.

- What would you monitor if you were designing a monitoring plan today for your restoration site?

Fin



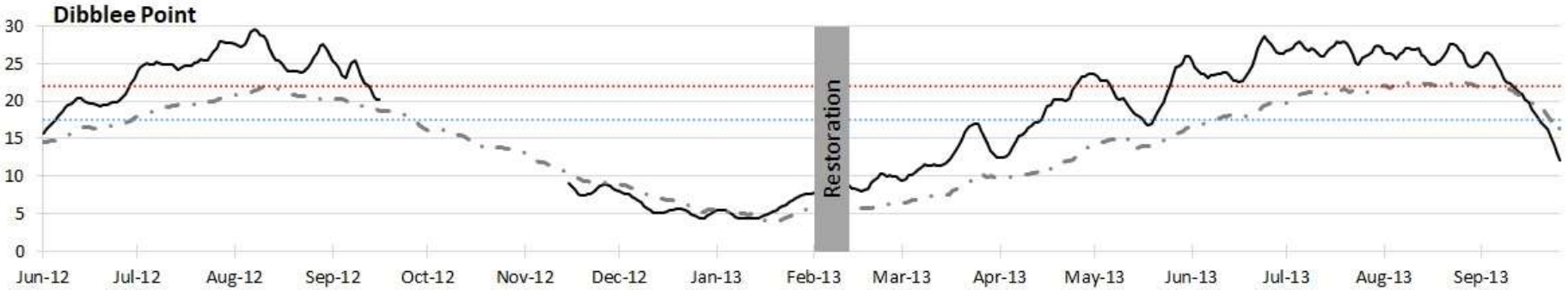
A light purple, wavy, abstract shape that starts at the top left, curves down and right, then loops back up and right, and finally curves down and right again towards the bottom right corner. It has a soft, painterly appearance.

Extra Slides

AEM Questions and Discussion

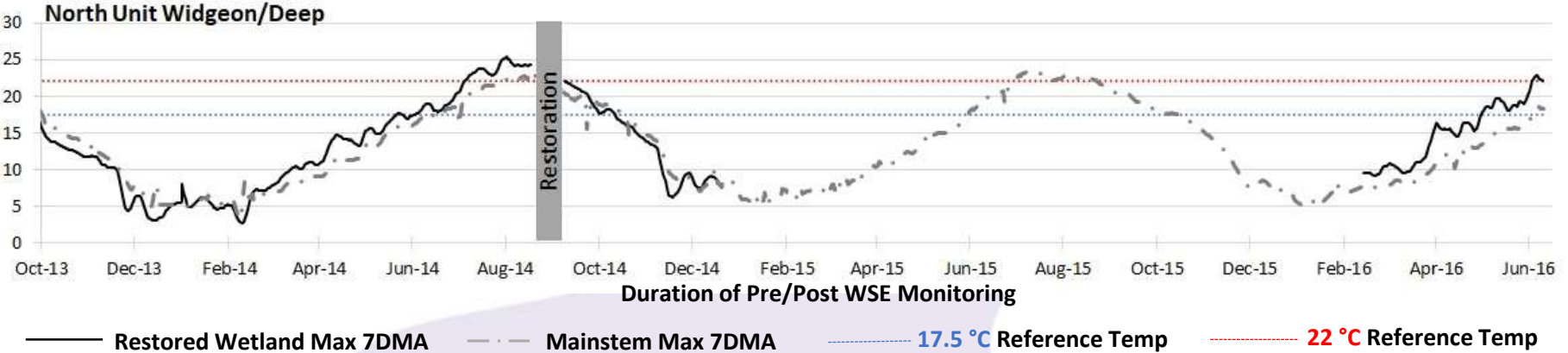
- Level 3 monitoring metrics – What’s working?
 - Are we monitoring the right ecological responses to restoration actions?
- “End points” for monitoring of restoration projects
 - What are the benchmarks we should be using to continue monitoring at restoration projects?

Water Temperature



| Year | | 2012 | | | | | | | 2013 | | | | | | | | |
|-------------|----------|------|------|------|------|------|------|-----|------|-------------|------|------|------|------|------|------|------|
| Month | | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep |
| Restoration | n (days) | 23 | 31 | 31 | 23 | | 9 | 31 | 31 | Restoration | 31 | 30 | 31 | 30 | 31 | 31 | 30 |
| | Mean | 18.9 | 24.0 | 26.6 | 24.2 | | 8.0 | 6.6 | 5.0 | | 11.9 | 16.4 | 20.6 | 24.1 | 26.9 | 26.4 | 22.3 |
| | SE | 0.3 | 0.3 | 0.3 | 0.5 | | 0.2 | 0.2 | 0.1 | | 0.4 | 0.5 | 0.4 | 0.2 | 0.2 | 0.1 | 0.6 |
| Main Stem | n (days) | 23 | 31 | 31 | 30 | 31 | 30 | 31 | 31 | Restoration | 31 | 30 | 31 | 30 | 31 | 31 | 30 |
| | Mean | 15.8 | 18.7 | 21 | 19.5 | 15.6 | 11.5 | 7.8 | 4.9 | | 7.4 | 10.5 | 14.2 | 17 | 20.7 | 22.0 | 21 |
| | SE | 0.2 | 0.2 | 0.1 | 0.1 | 0.2 | 0.3 | 0.2 | 0.1 | | 0.2 | 0.1 | 0.1 | 0.2 | 0.1 | 0.1 | 0.3 |

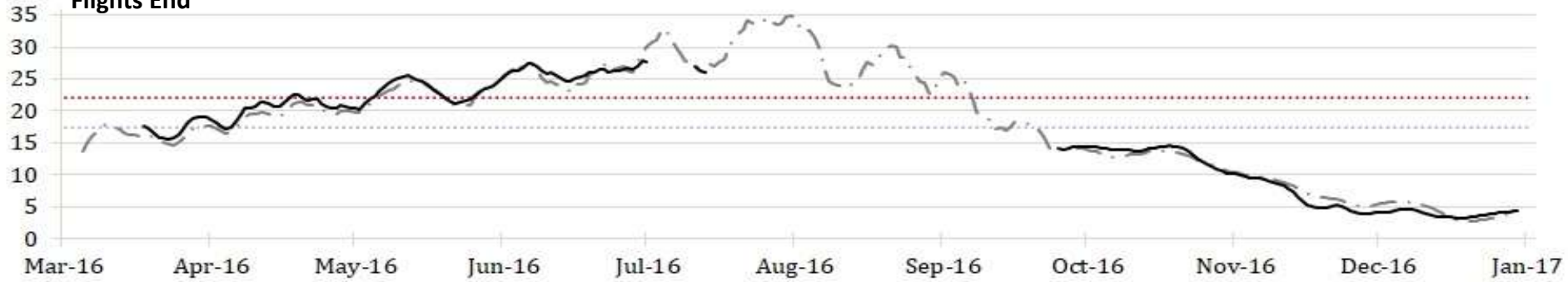
Water Temperature



| Year | | 2013 | | | | 2014 | | | | | | | | 2016 | | | | | | | | | |
|-------------|----------|------|------|------|-----|------|-----|-----|------|------|------|------|-------------|------|------|------|-----|-----|-----|------|------|------|------|
| Month | | Sep | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun |
| Restoration | n (days) | 18 | 31 | 30 | 31 | 31 | 28 | 31 | 30 | 31 | 30 | 31 | Restoration | 23 | 31 | 30 | 19 | | 17 | 31 | 30 | 31 | 10 |
| | Mean | 19.2 | 13.0 | 8.9 | 4.6 | 5.4 | 5.5 | 9.9 | 13.5 | 16.3 | 18.6 | 23.2 | | 20 | 16.4 | 9.6 | 8.3 | | 9.7 | 11.2 | 15.7 | 18.9 | 22.2 |
| | SE | 0.5 | 0.2 | 0.5 | 0.2 | 0.1 | 0.3 | 0.2 | 0.2 | 0.2 | 0.2 | 0.1 | | 0.2 | 0.3 | 0.2 | 0.5 | 0.1 | | 0.1 | 0.3 | 0.1 | 0.1 |
| Main Stem | n (days) | 18 | 31 | 30 | 31 | 31 | 27 | 31 | 30 | 31 | 30 | 31 | Restoration | 28 | 31 | 30 | 31 | 31 | 29 | 31 | 30 | 31 | 10 |
| | Mean | 20.2 | 14.9 | 10.6 | 5.8 | 5.5 | 5.9 | 8.1 | 11.0 | 14.7 | 17.5 | 20.7 | | 20 | 17.3 | 11.0 | 8.0 | 6.0 | 7.5 | 8.7 | 12.2 | 15.2 | 18 |
| | SE | 0.3 | 0.2 | 0.4 | 0.2 | 0.1 | 0.2 | 0.1 | 0.2 | 0.2 | 0.2 | 0.1 | | 0.2 | 0.2 | 0.3 | 0.4 | 0.1 | 0.2 | 0.1 | 0.1 | 0.2 | 0.1 |

Water Temperature

Flights End

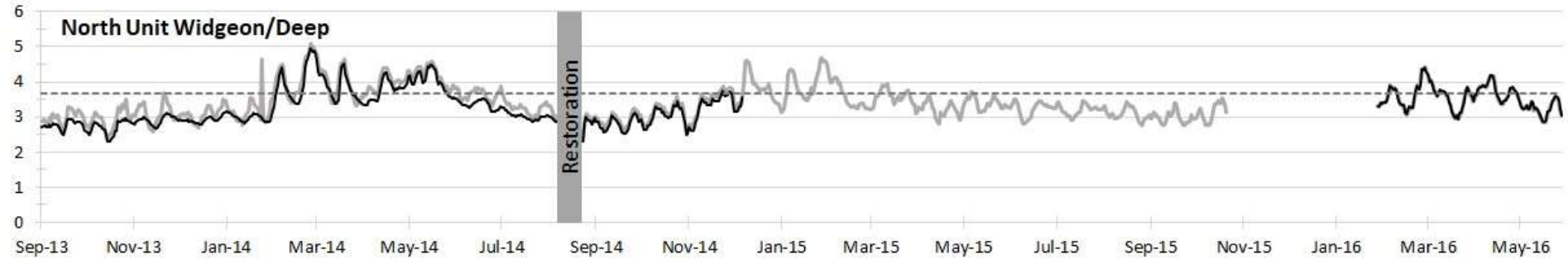


Duration of Pre/Post WSE Monitoring

— Restored Wetland Max 7DMA
 - - - Mainstem Max 7DMA
 ⋯ 17.5 °C Reference Temp
 ⋯ 22 °C Reference Temp

| Year | | 2016 | | | | | | | | | | 2017 |
|-------------|----------|------|------|------|------|------|------|------|------|-----|-----|------|
| Month | | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Jan | |
| Restoration | n (days) | 22 | 31 | 30 | 23 | 3 | | 15 | 30 | 31 | 21 | |
| | Mean | 17.6 | 21.6 | 24.2 | 26.1 | 26.4 | | 14.2 | 12.1 | 5.3 | 3.7 | |
| | SE | 0.3 | 0.2 | 0.4 | 0.2 | 0.3 | | 0.1 | 0.4 | 0.3 | 0.1 | |
| Main Stem | n (days) | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | 24 | |
| | Mean | 12.2 | 15.2 | 18.3 | 20.6 | 21.9 | 19.8 | 15.4 | 12.4 | 6.6 | 2.3 | |
| | SE | 0.2 | 0.1 | 0.1 | 0.1 | 0.1 | | 0.3 | 0.2 | 0.3 | 0.2 | |

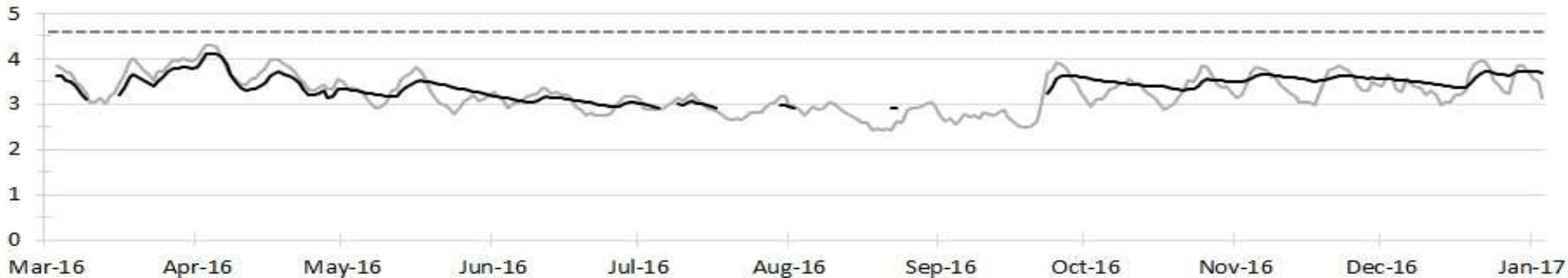
Water Surface Elevation



| Year | | 2013 | | | | 2014 | | | | | | | | 2016 | | | | | | | | | |
|-------------|------------------------------------|------|------|------|------|------|------|------|------|------|------|------|-------------|------|------|------|------|-----|------|------|------|------|------|
| Month | | Sep | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun |
| Restoration | n (days) | 18 | 31 | 30 | 31 | 31 | 28 | 31 | 30 | 31 | 30 | 31 | Restoration | 26 | 31 | 30 | 19 | | 20 | 31 | 30 | 31 | 10 |
| | Mean | 2.72 | 2.68 | 2.85 | 2.93 | 2.99 | 3.41 | 4.09 | 3.71 | 4.08 | 3.55 | 3.17 | | 2.79 | 2.91 | 3.12 | 3.49 | | 3.49 | 3.72 | 3.66 | 3.36 | 3.36 |
| | SE | 0.02 | 0.03 | 0.02 | 0.02 | 0.02 | 0.09 | 0.09 | 0.06 | 0.04 | 0.04 | 0.03 | | 0.03 | 0.04 | 0.06 | 0.04 | | 0.05 | 0.07 | 0.06 | 0.05 | 0.06 |
| | Days Exceeded 2 yr Flood Elevation | 0 | 0 | 0 | 0 | 0 | 8 | 22 | 12 | 31 | 7 | 0 | | 0 | 0 | 0 | 4 | 0 | 6 | 19 | 16 | 5 | 0 |
| Outside | n (days) | 18 | 31 | 30 | 31 | 31 | 28 | 31 | 30 | 31 | 30 | 31 | Restoration | 26 | 31 | 30 | 31 | | 20 | 31 | 30 | 31 | 10 |
| | Mean | 2.90 | 2.91 | 3.06 | 3.09 | 3.17 | 3.61 | 4.24 | 3.86 | 4.23 | 3.78 | 3.43 | | 2.91 | 3.03 | 3.24 | 3.80 | | 3.49 | 3.71 | 3.64 | 3.34 | 3.34 |
| | SE | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.10 | 0.09 | 0.07 | 0.04 | 0.03 | 0.04 | | 0.03 | 0.04 | 0.06 | 0.06 | | 0.05 | 0.07 | 0.06 | 0.05 | 0.06 |
| | Days Exceeded 2 yr Flood Elevation | 0 | 0 | 0 | 1 | 0 | 11 | 27 | 18 | 31 | 23 | 6 | | 0 | 0 | 0 | 22 | 0 | 6 | 19 | 16 | 5 | 0 |

Water Surface Elevation

Flights End



Duration of Pre/Post WSE Monitoring

———— Restored Wetland

———— Outer Reference

- - - - 2 yr Flood Elevation

| Year | | 2016 | | | | | | | | | | 2017 |
|-------------|------------------------------------|------|------|------|------|------|-----|------|------|------|------|------|
| Month | | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Jan | |
| Restoration | n (days) | 26 | 31 | 30 | 28 | 12 | | 18 | 30 | 31 | 24 | |
| | Max Mean WSE | 3.68 | 3.35 | 3.27 | 3.03 | 2.97 | | 3.52 | 3.47 | 3.56 | 3.58 | |
| | SE | 0.05 | 0.03 | 0.03 | 0.01 | 0.01 | | 0.02 | 0.02 | 0.01 | 0.03 | |
| | Days Exceeded 2 yr Flood Elevation | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | |
| Outside | n (days) | 30.0 | 31.0 | 30.0 | 31.0 | 31.0 | | 31.0 | 30.0 | 31.0 | 24.0 | |
| | Mean | 3.76 | 3.46 | 3.21 | 3.02 | 2.91 | | 3.13 | 3.41 | 3.40 | 3.47 | |
| | SE | 0.07 | 0.05 | 0.05 | 0.03 | 0.03 | | 0.08 | 0.05 | 0.04 | 0.06 | |
| | Days Exceeded 2 yr Flood Elevation | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | |

2017 Level 2 AEM

