Where's the Grass?

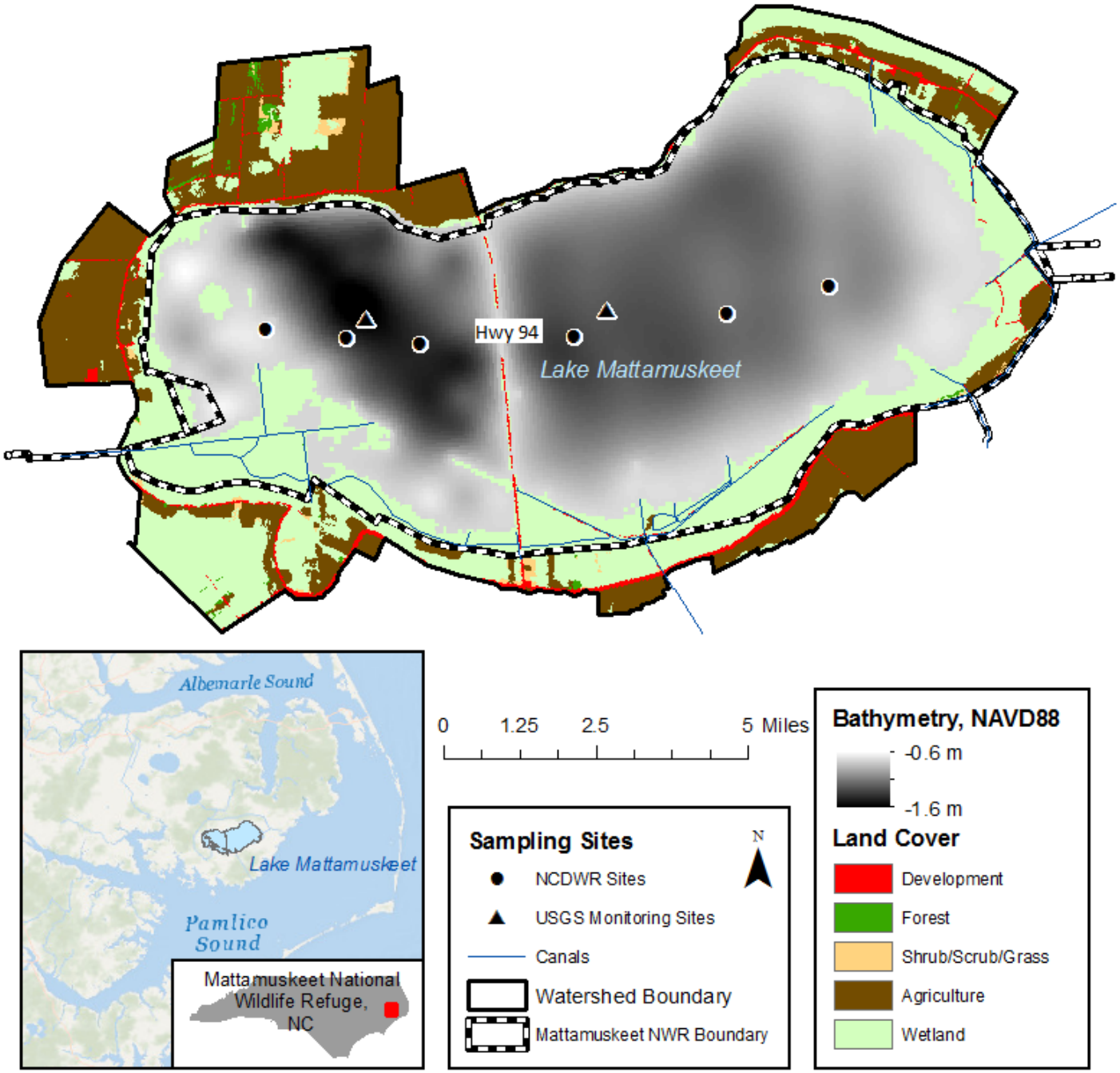
Disappearing Submerged Aquatic Vegetation and Declining Water Quality in Lake Mattamuskeet, Mattamuskeet NWR

Michelle Moorman

Mattamuskeet NWR

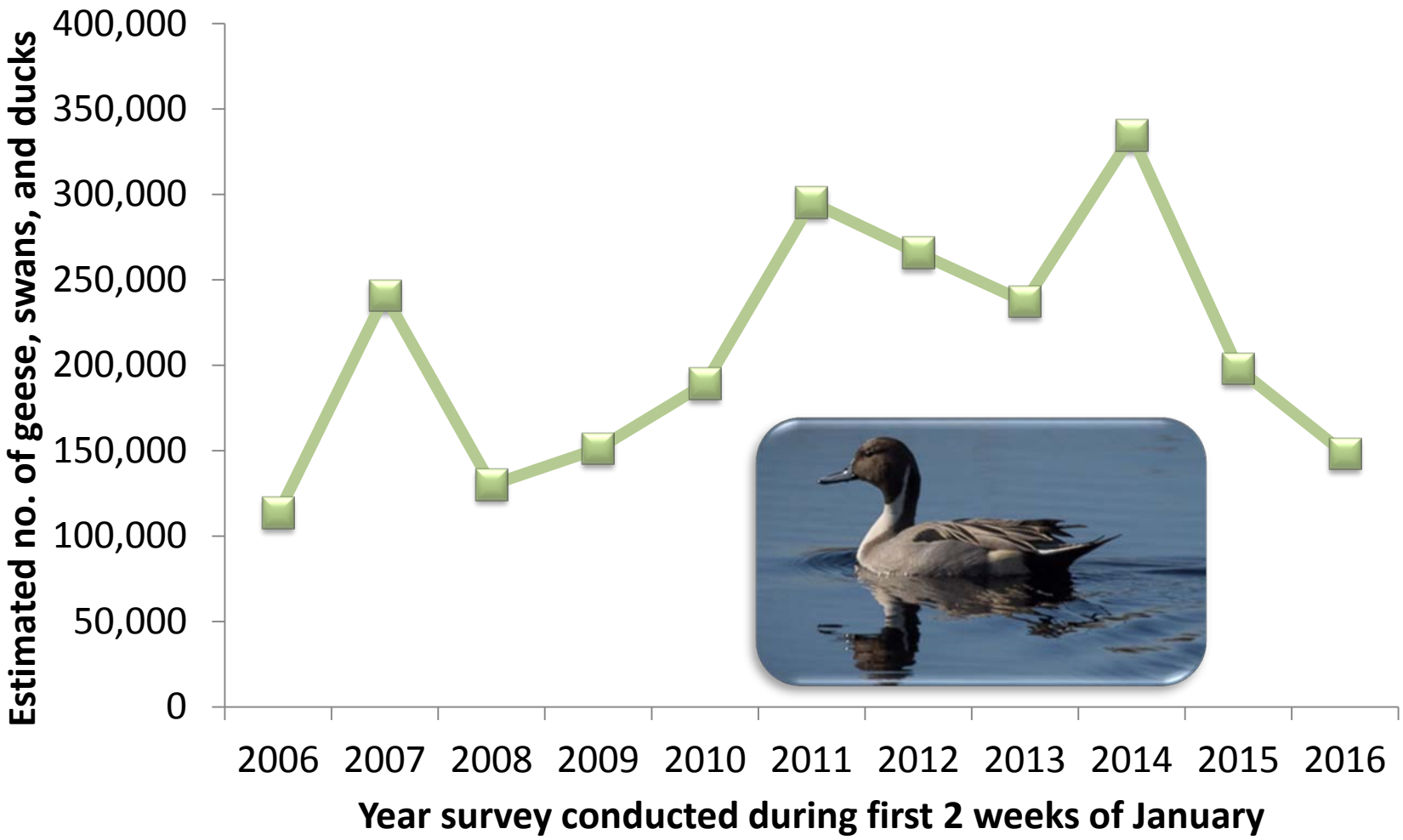
The purpose of Mattamuskeet NWR is to protect and conserve migratory birds and other wildlife resources through the protection of wetlands

“The Centerpiece”


Hwy 94
Lake Mattamuskeet
Albemarle Sound
Lake Mattamuskeet
Pamlico Sound
Mattamuskeet National Wildlife Refuge, NC
0 1.25 2.5 5 Miles
Sampling Sites
N
NCDWR Sites
USGS Monitoring Sites
Canals
Watershed Boundary
Mattamuskeet NWR Boundary
Bathymetry, NAVD88
-0.6 m
-1.6 m
Land Cover
Development
Forest
Shrub/Scrub/Grass
Agriculture
Wetland

Lake: Submerged Aquatic Vegetation

Waterfowl Counts, Mid-Winter Aerial Surveys, Lake Mattamuskeet



Economic Benefits of Mattamuskeet NWR in 2006

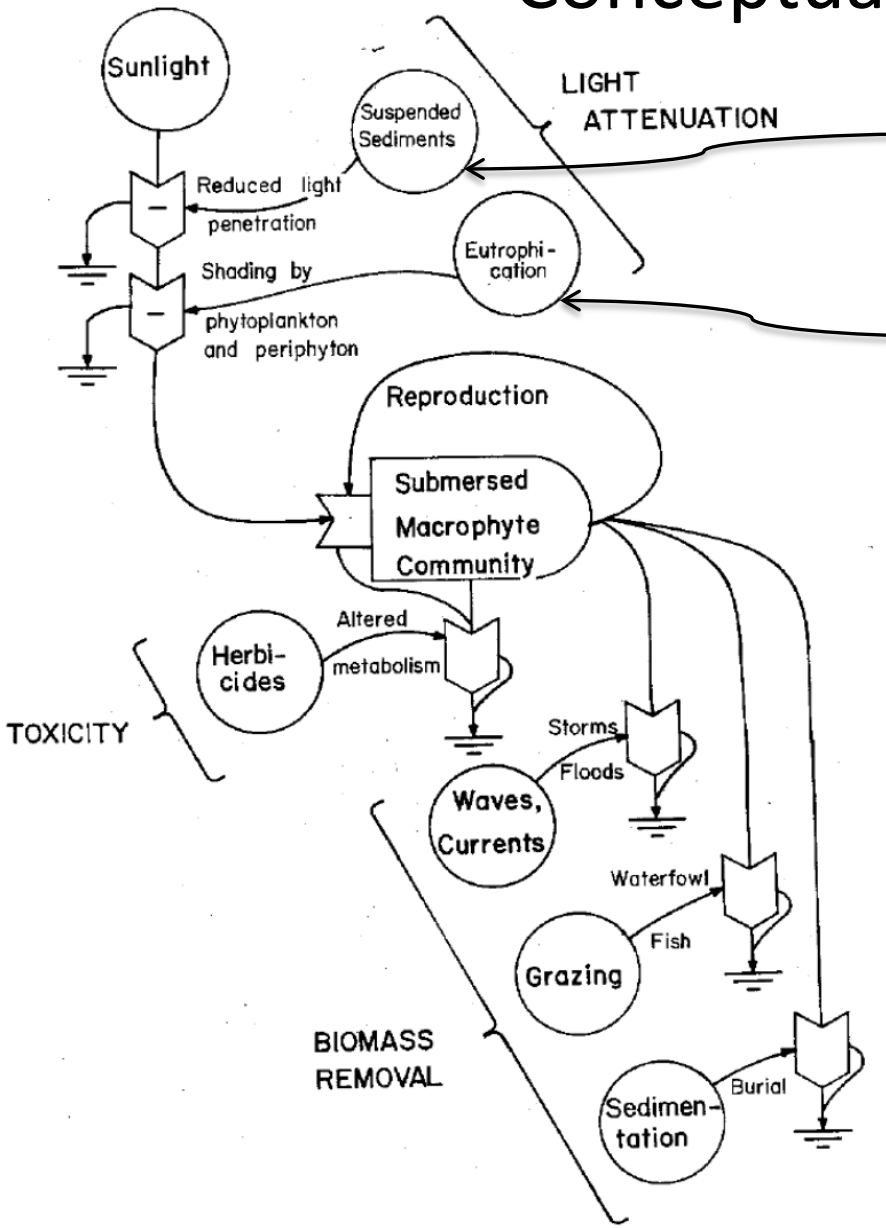
91.6% of Refuge visitors surveyed came to Hyde County to visit the Refuge to primarily fish or observe wildlife

Visitors traveled on average 174 miles

Direct impact of refuge visitors ~ $7 million

Indirect impacts of refuge visitors ~ $4.5 million

SAV Management - SAV Conceptual Model



Excess sediment input, or re-suspension from wind, erosion, benthic foraging

Excess N and P

Light attenuation, toxicity, and biomass removal are three general stressors which can be influenced by other specific factors (from Davis and Brinson 1980)

Obj. How has SAV declined and why?

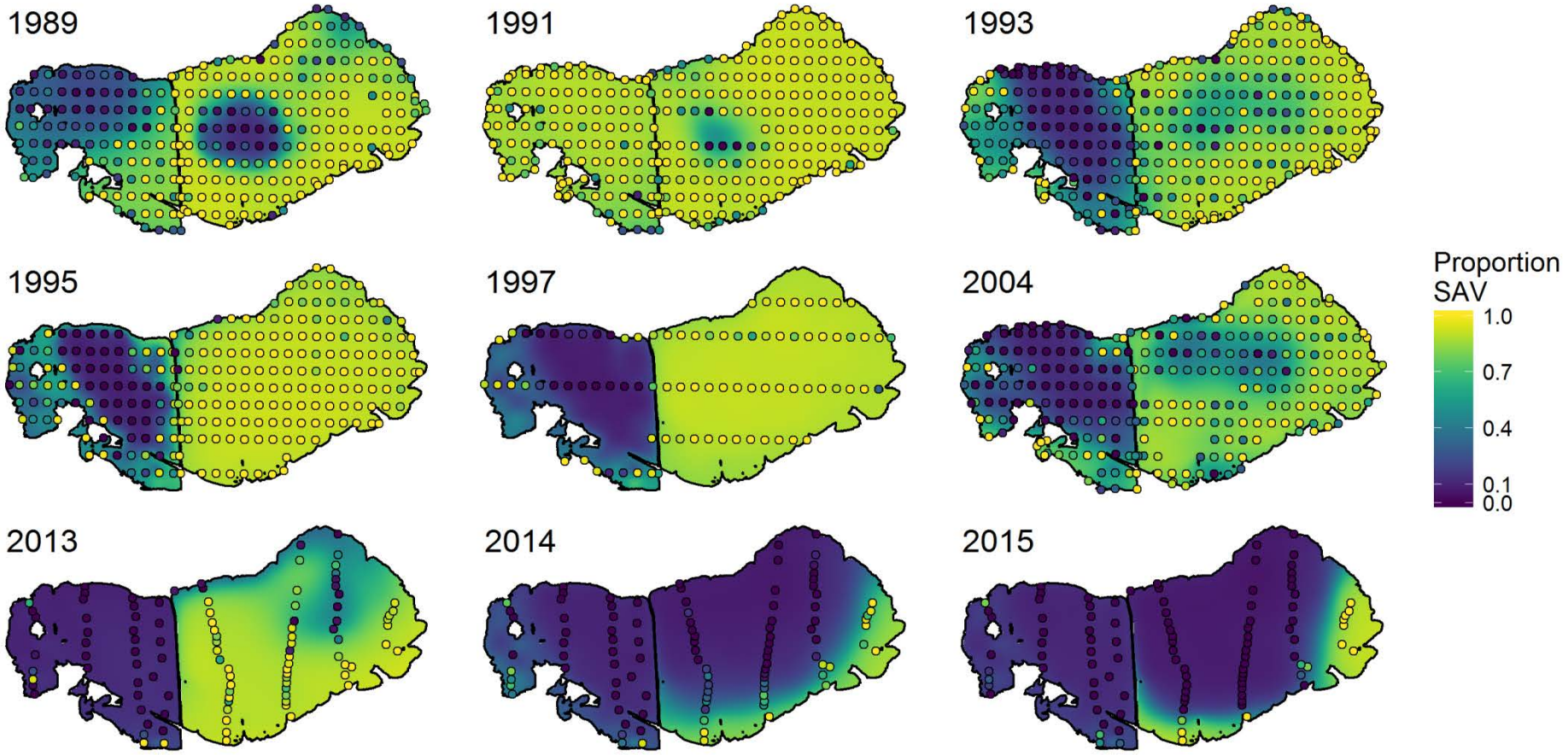
SAV surveys

- SAV density surveyed at 1m^2 plots throughout the lake, 1989-2015
- Percent cover of each species and water depth recorded
- Generalized additive models estimated the distribution of SAV in the lake through time

Water-quality surveys

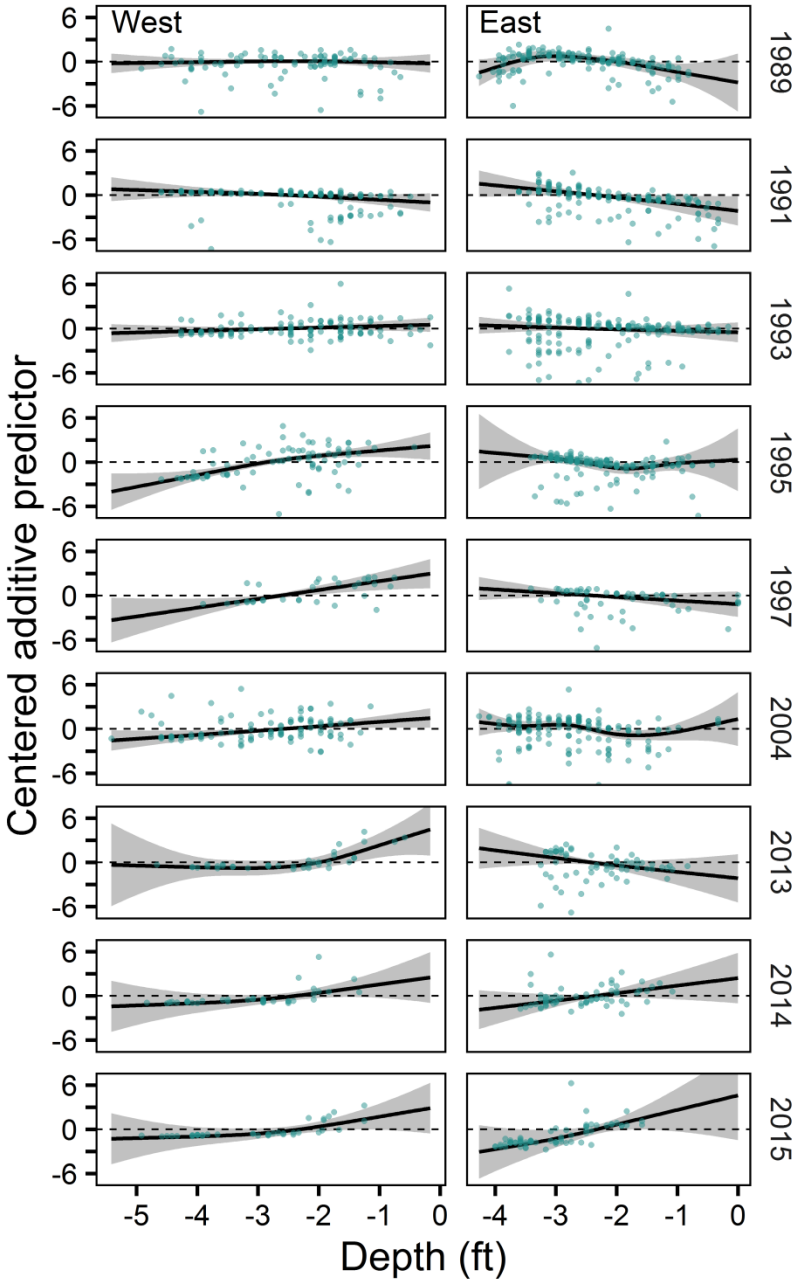
- Water-quality data collected historically by NC DWR, 1981-2012
- Starting in 2012, two continuous water-quality monitors installed and monthly water-quality measurements collected
- Kendall's Tau trend test conducted on summer water-quality data
- Water-quality data compared to state standards and guidelines

The decline of SAV at Lake Mattamuskeet is concerning



Depth predicts SAV declines

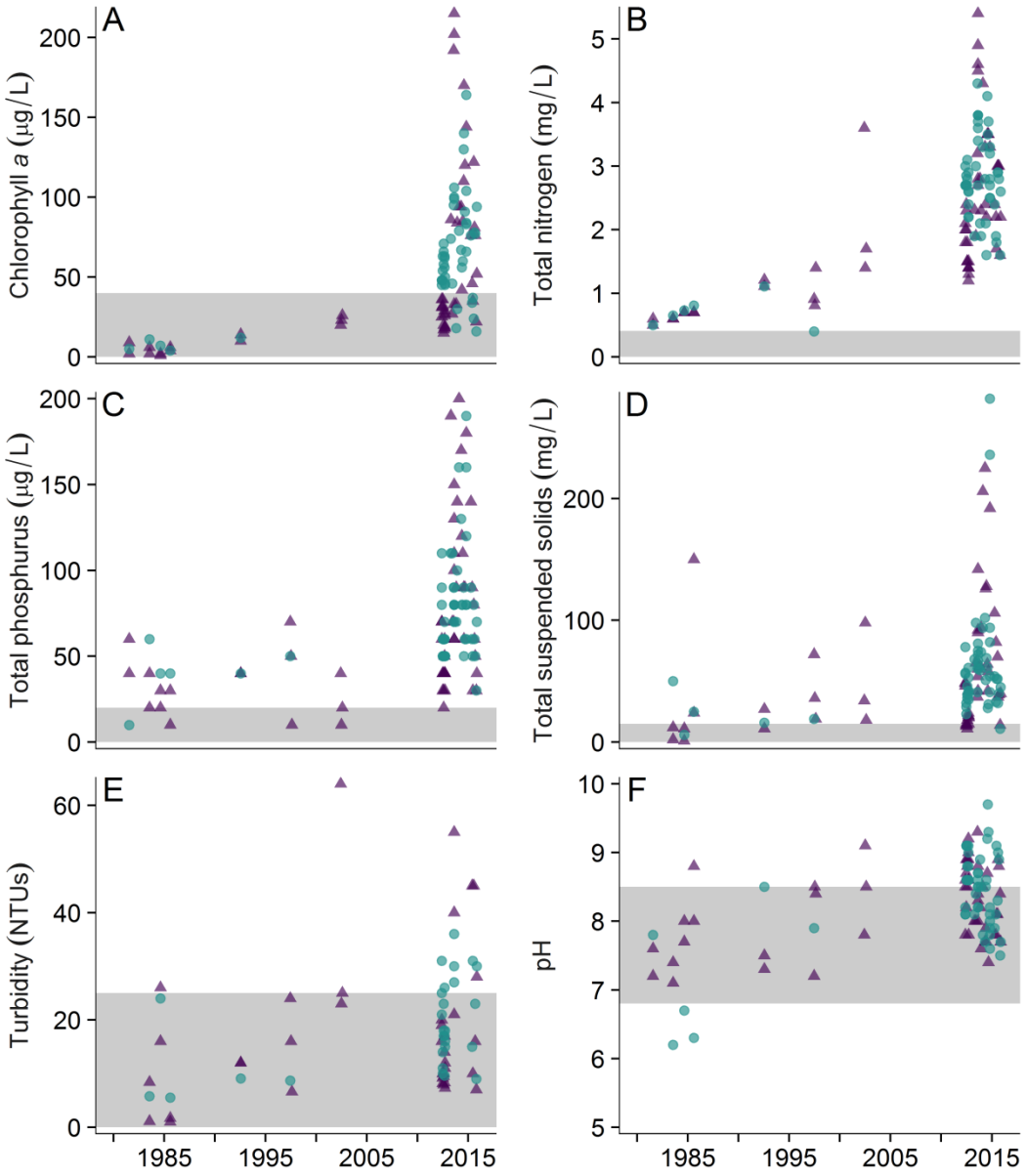
- Depth, one of the few parameters available for the period 1989-2015, became a significant predictor of SAV at the same time SAV declines were observed
- Depth assumed to be related to water clarity



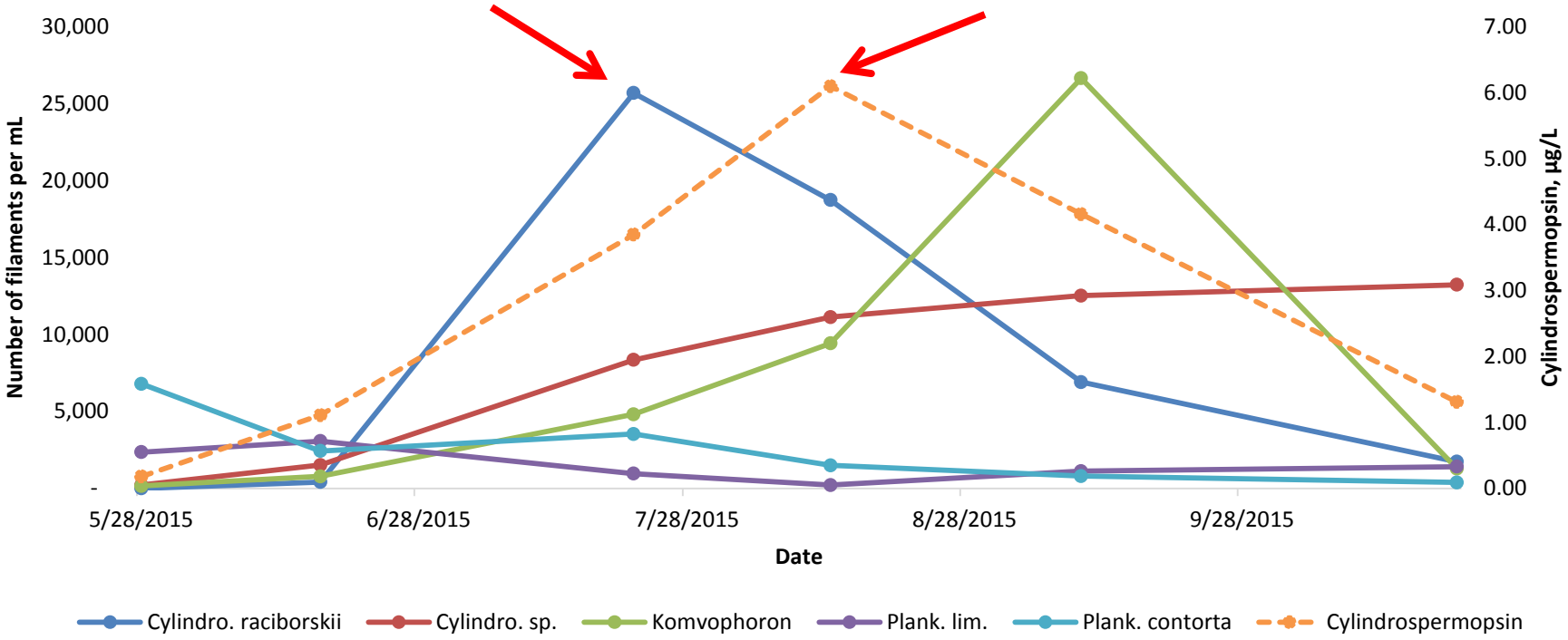
Lake has become more eutrophic since the 1980s

West Basin

East Basin



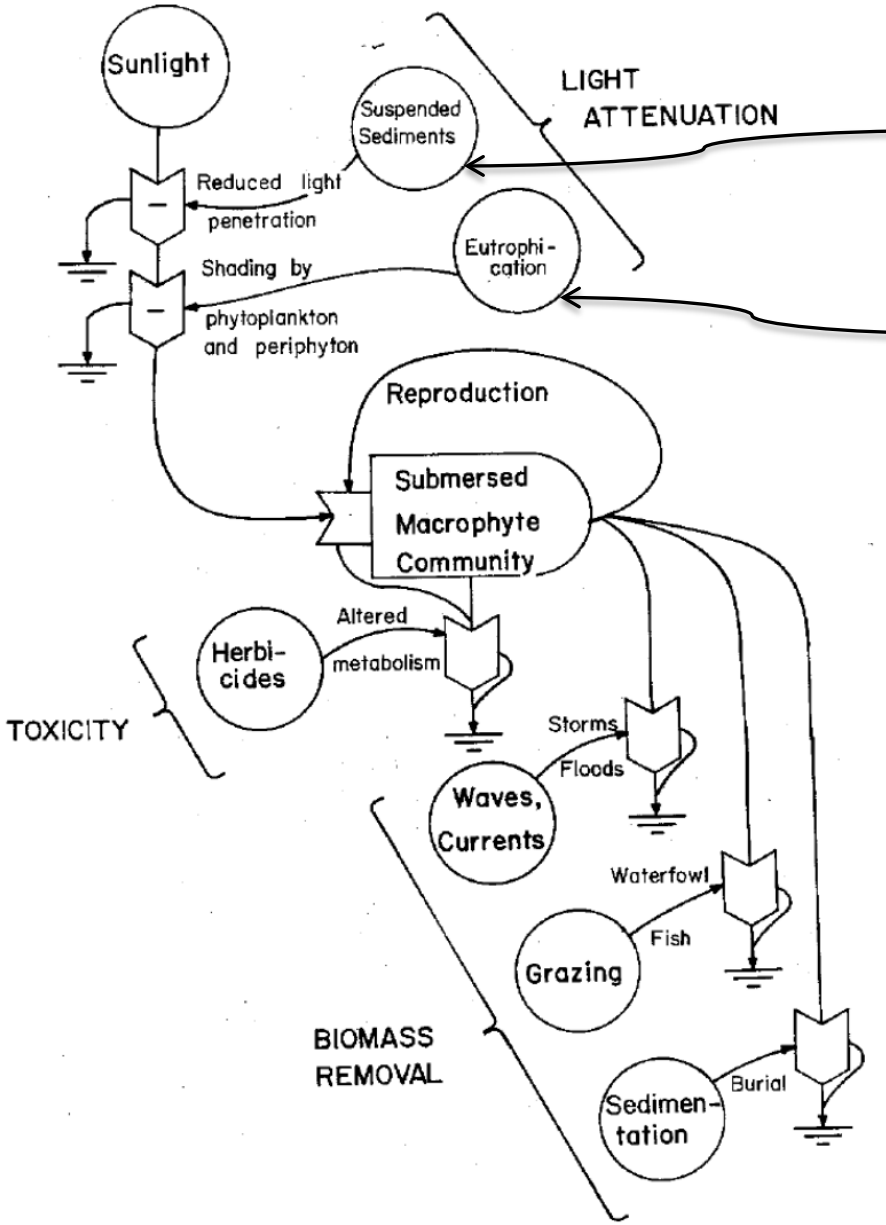
High counts of *Cylindrospermopsis raciborskii* correlated with production of cyanotoxin, Cylindrospermopsin, in summer



Cylindrospermopsin

- Can impact a wide variety of species
- Bioaccumulation and trophic transfer through the food web is possible
- Can inhibit growth of other phytoplankton and zooplankton grazing
- Human-health effects include flu like symptoms and respiratory problems and adverse impacts on the liver and kidneys
- EPA proposed guideline for recreational waters = 8.0 µg/L

SAV Conceptual Model



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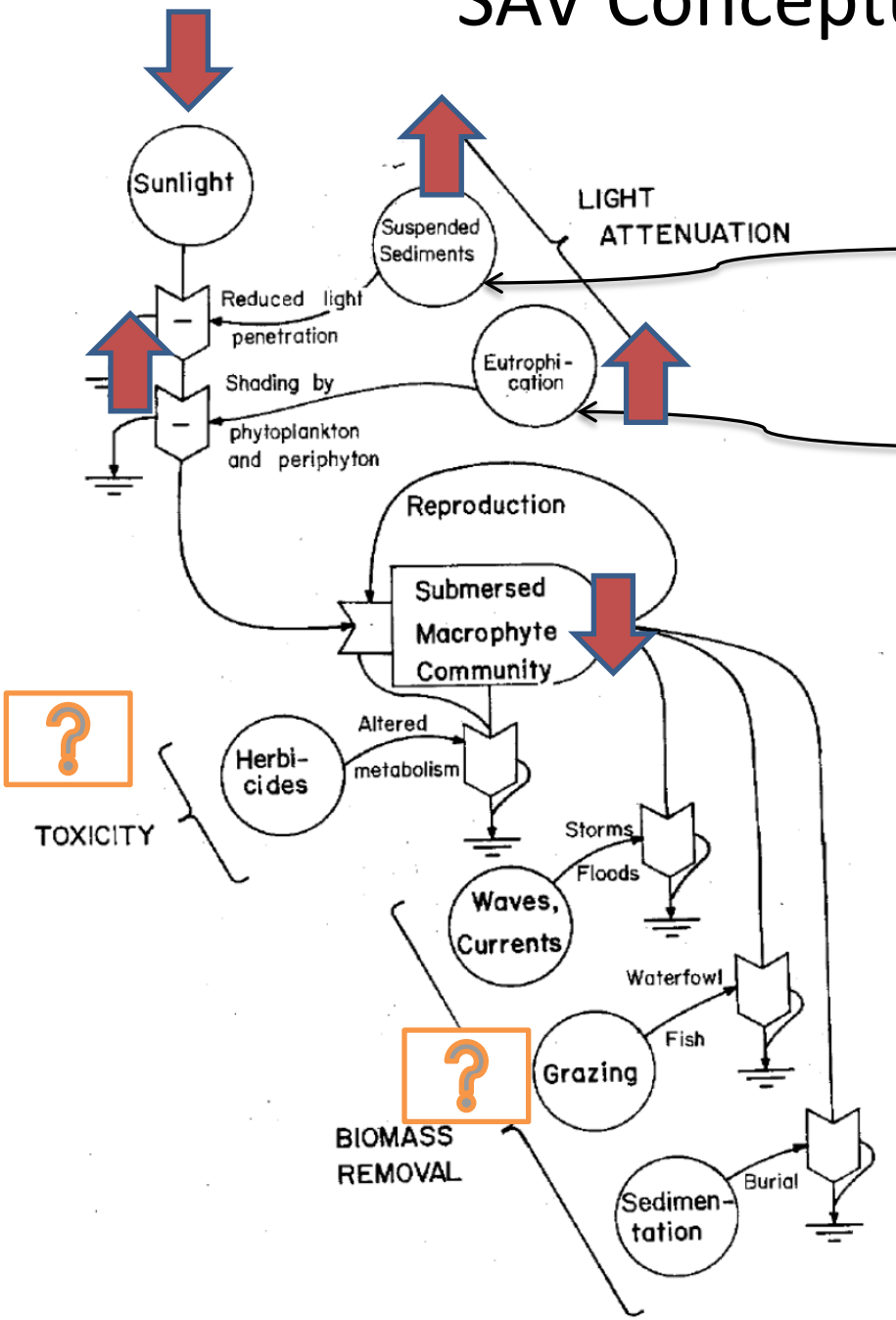
SAV Conceptual Model



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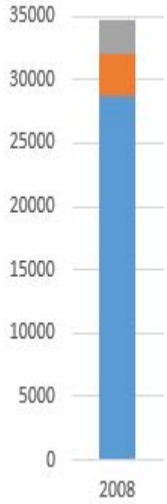
Total Number of Swans Observed
In Various Locations – Unit 5



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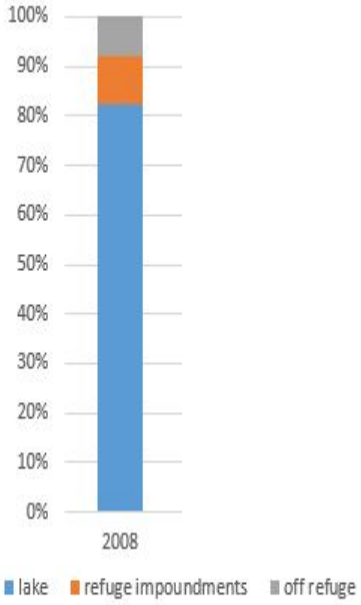
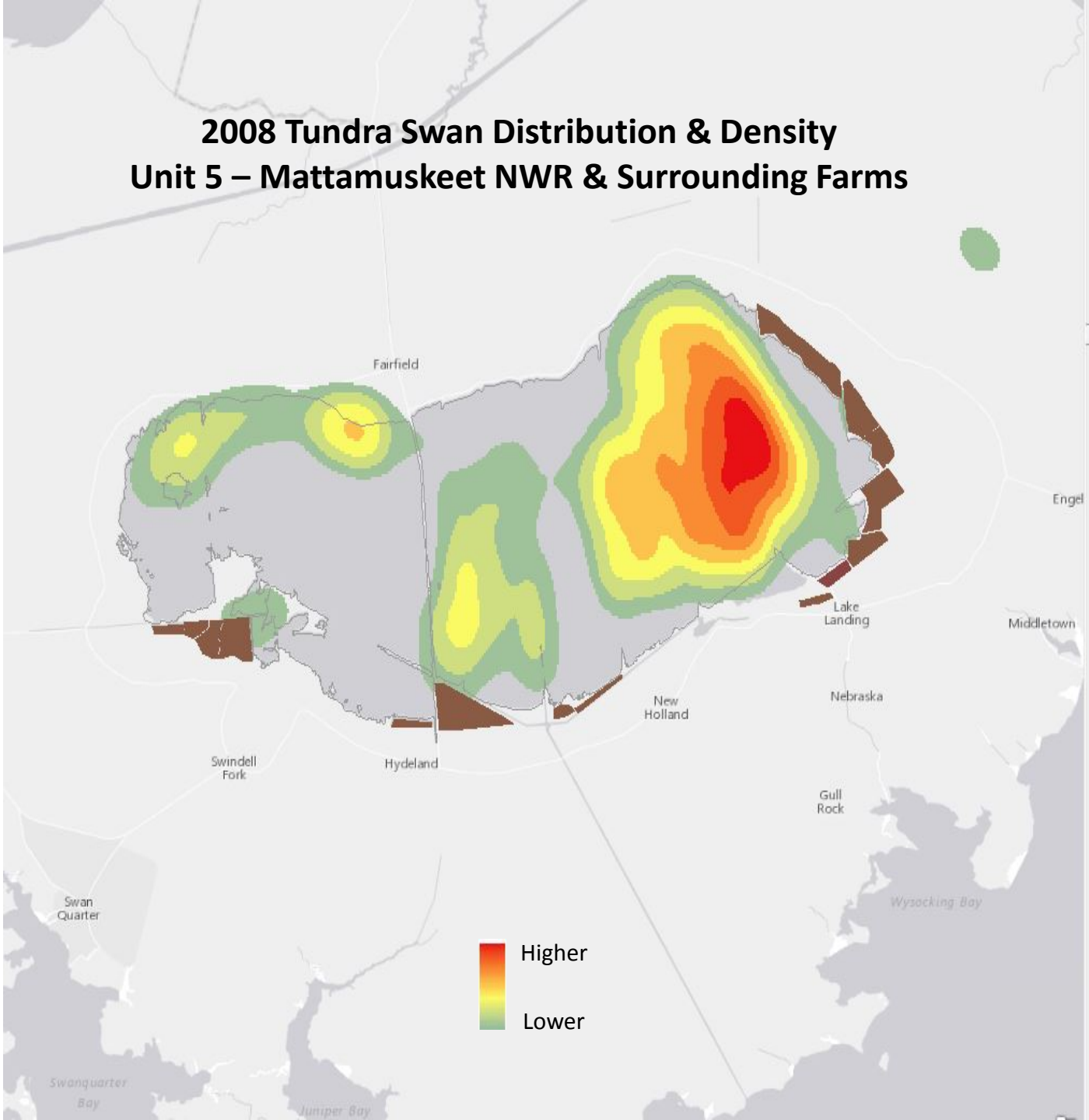


2008 Tundra Swan Distribution & Density
Unit 5 – Mattamuskeet NWR & Surrounding Farms



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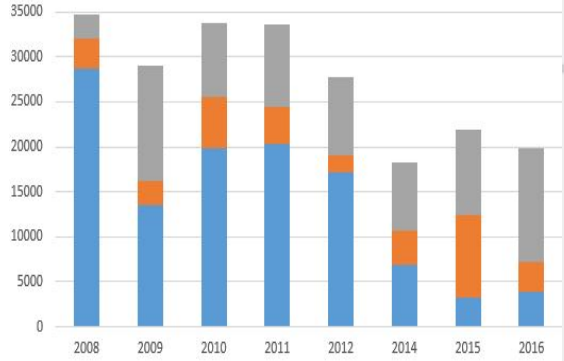

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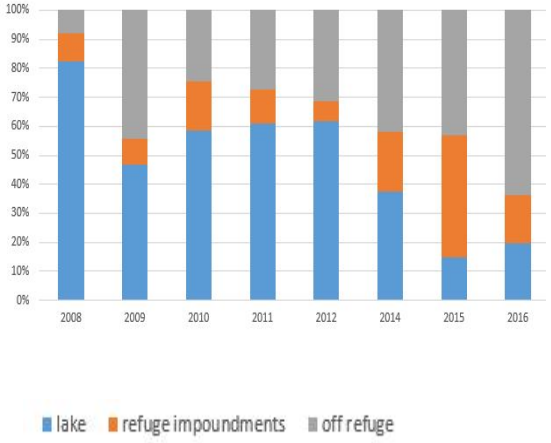
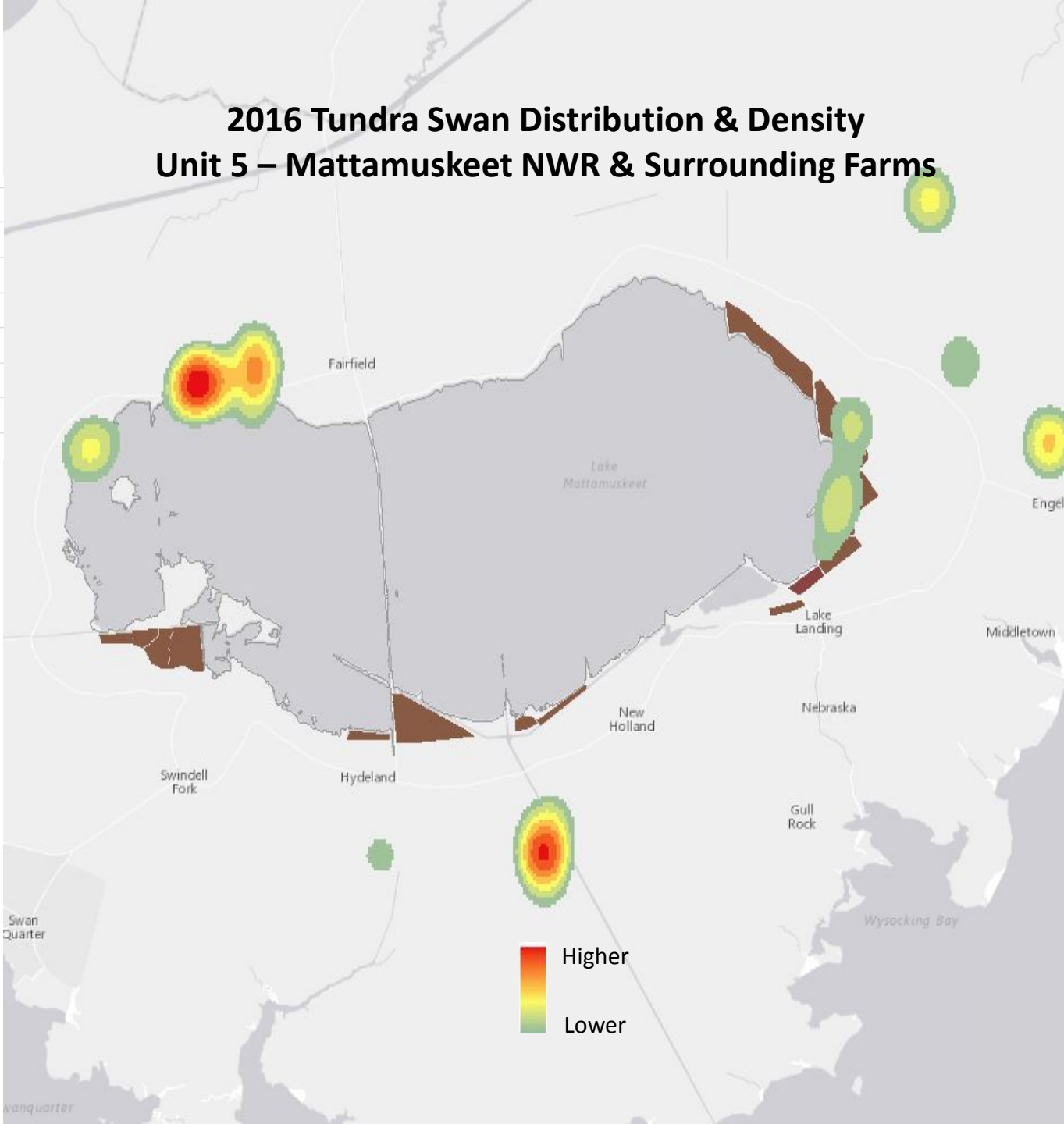
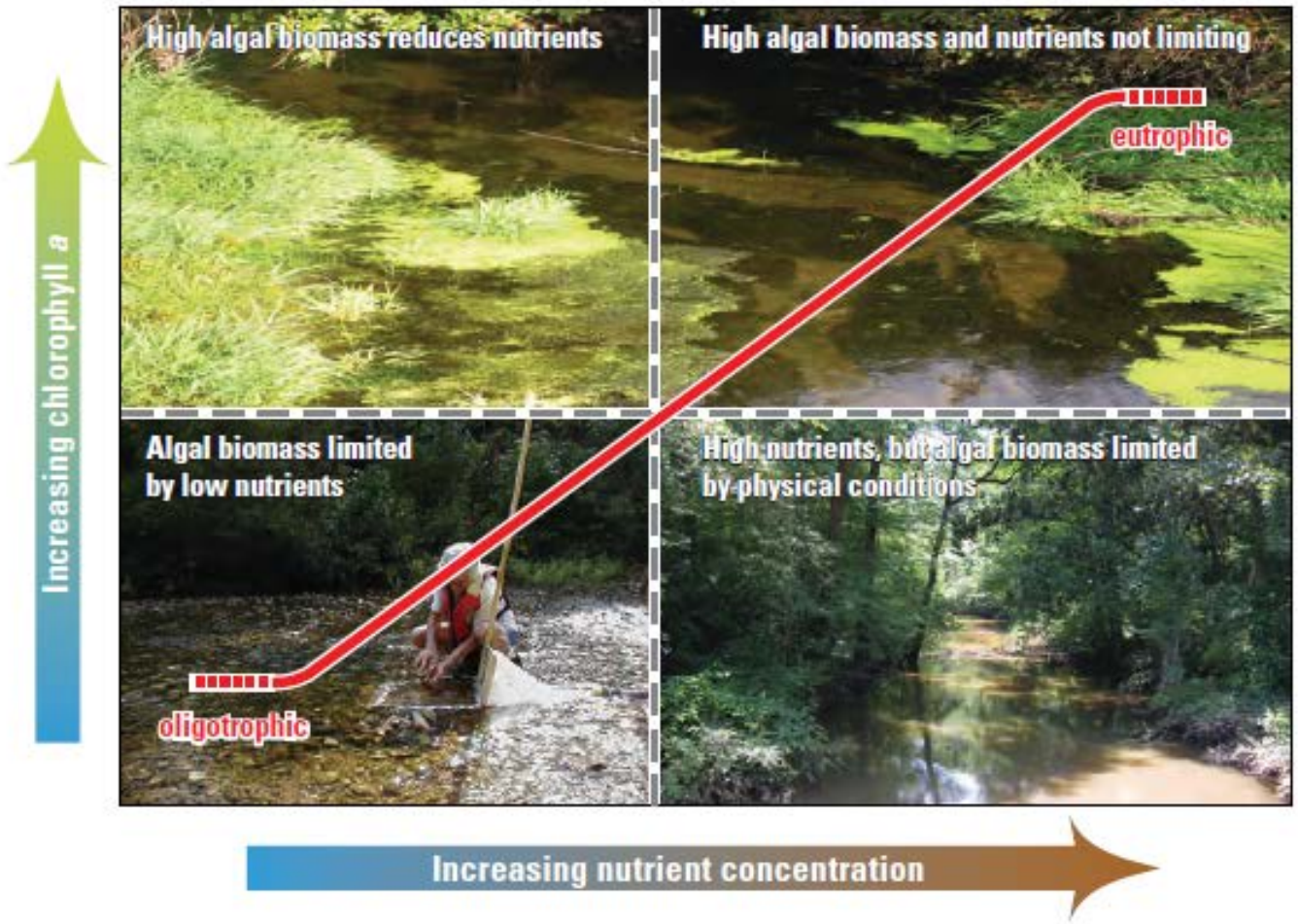


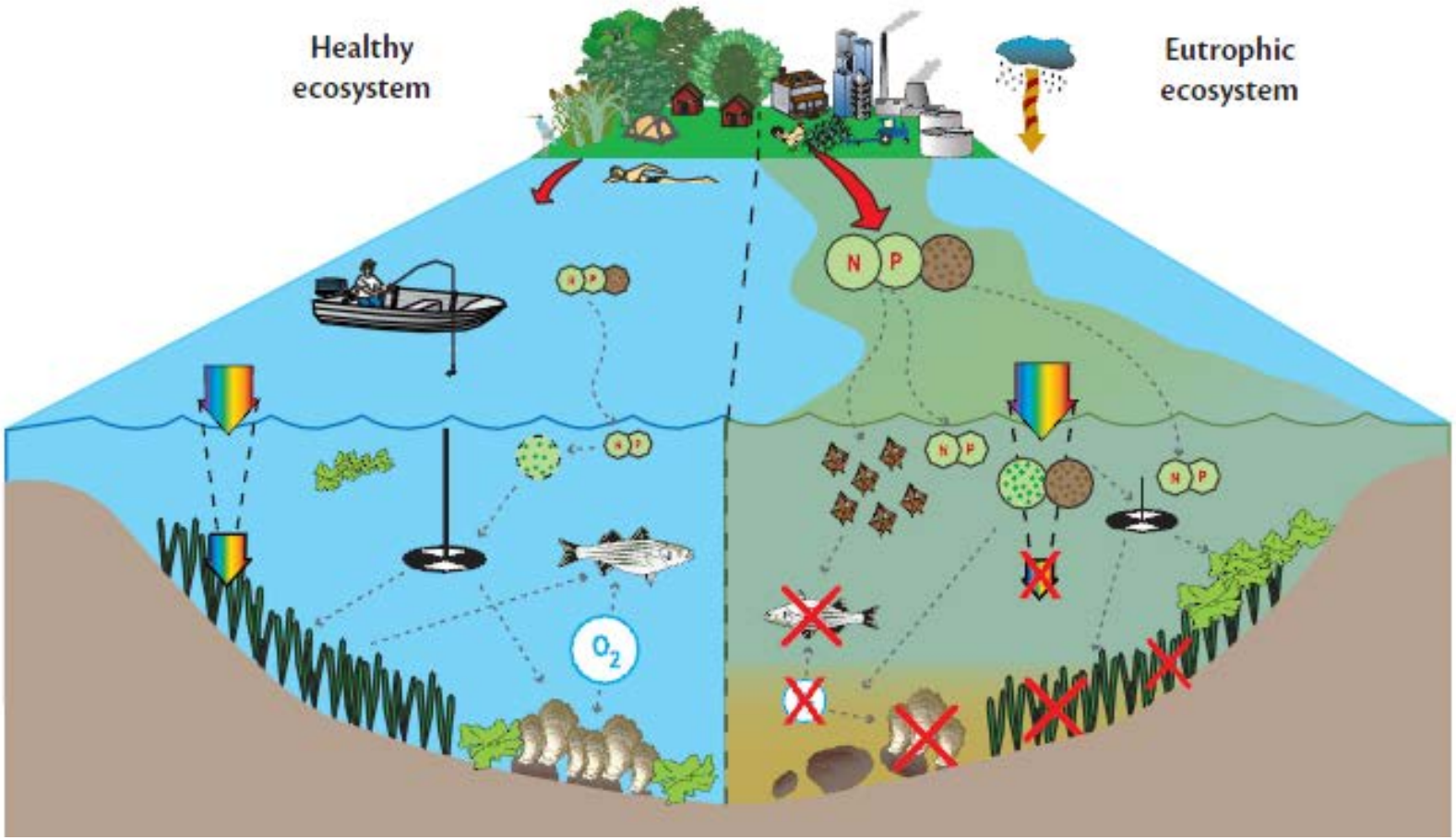
2016 Tundra Swan Distribution & Density
Unit 5 – Mattamuskeet NWR & Surrounding Farms



Excess nutrients can cause eutrophication

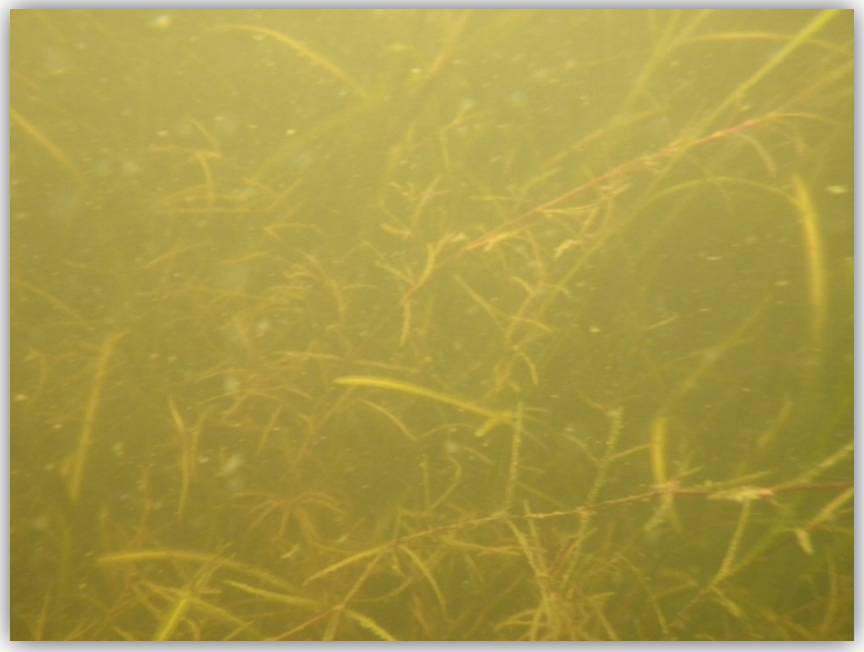


Eutrophication causes healthy ecosystems to provide fewer ecosystem services



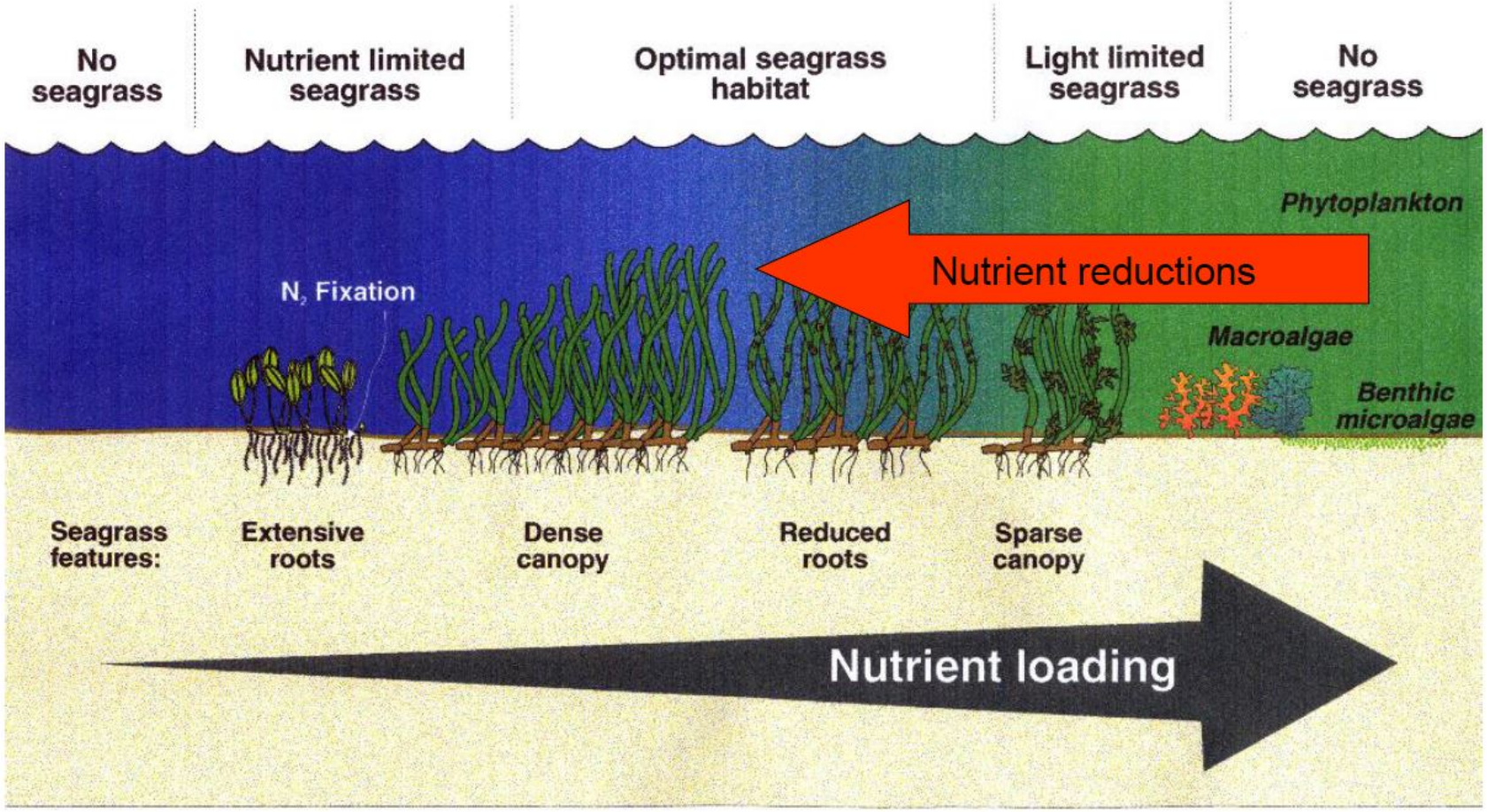
The state of Lake Mattamuskeet has shifted: Water quality is impaired, SAV has disappeared, and cyanobacteria abundant

Current state: Turbid waters dominated by cyanobacteria lacking SAV



Desired state: Heathy SAV community with clear water

How can we reduce nutrients and bring back SAVs with time



The Nine Element Planning Process:

Stakeholder driven and supported by multiple partners

Steps in watershed planning and implementation process (EPA)

- Build Partnerships
- Characterize the watershed
- Finalize goals and identify solutions
- Design an implementation plan
- Implement progress and make adjustments
- Make progress and measure adjustments

What next? Continued Collaboration on Monitoring, Research, Planning, and Management

1. Monitoring: Allows us to assess ecosystem condition by providing data on ecosystem health
2. Research: Allows us to ask specific questions that inform our restoration and management activities
3. Planning: Guides activities related to SAV and water quality restoration and is informed by research and monitoring
4. Management: Oversees plan implementation

Benefits of Collaborative Partnerships at Mattamuskeet NWR

- Sound science has created productive conversations and partnerships
- Transparency and communication are the foundation of the partnerships
- Partnerships are hard work, but the benefits are worth the effort

Questions?

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