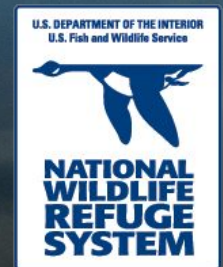
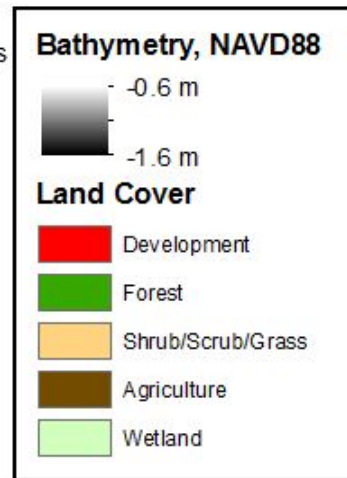
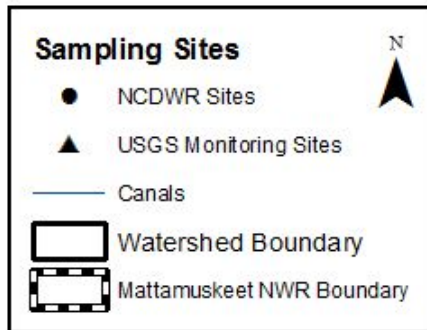
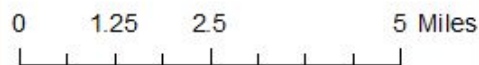
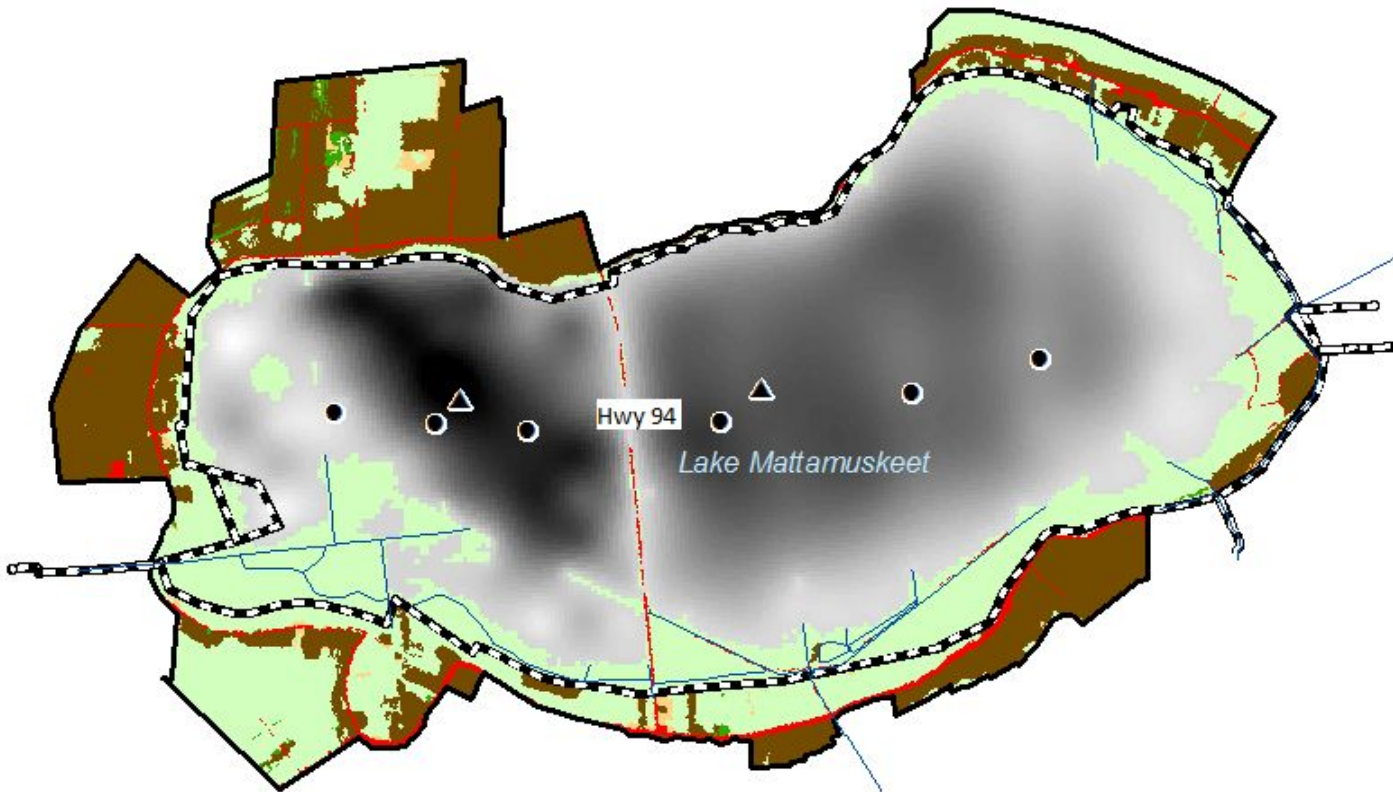


# *Where's has the grass gone?*

Factors impacting submerged aquatic vegetation  
bring together partners at Lake Mattamuskeet

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





Redhead grass



Wild Celery



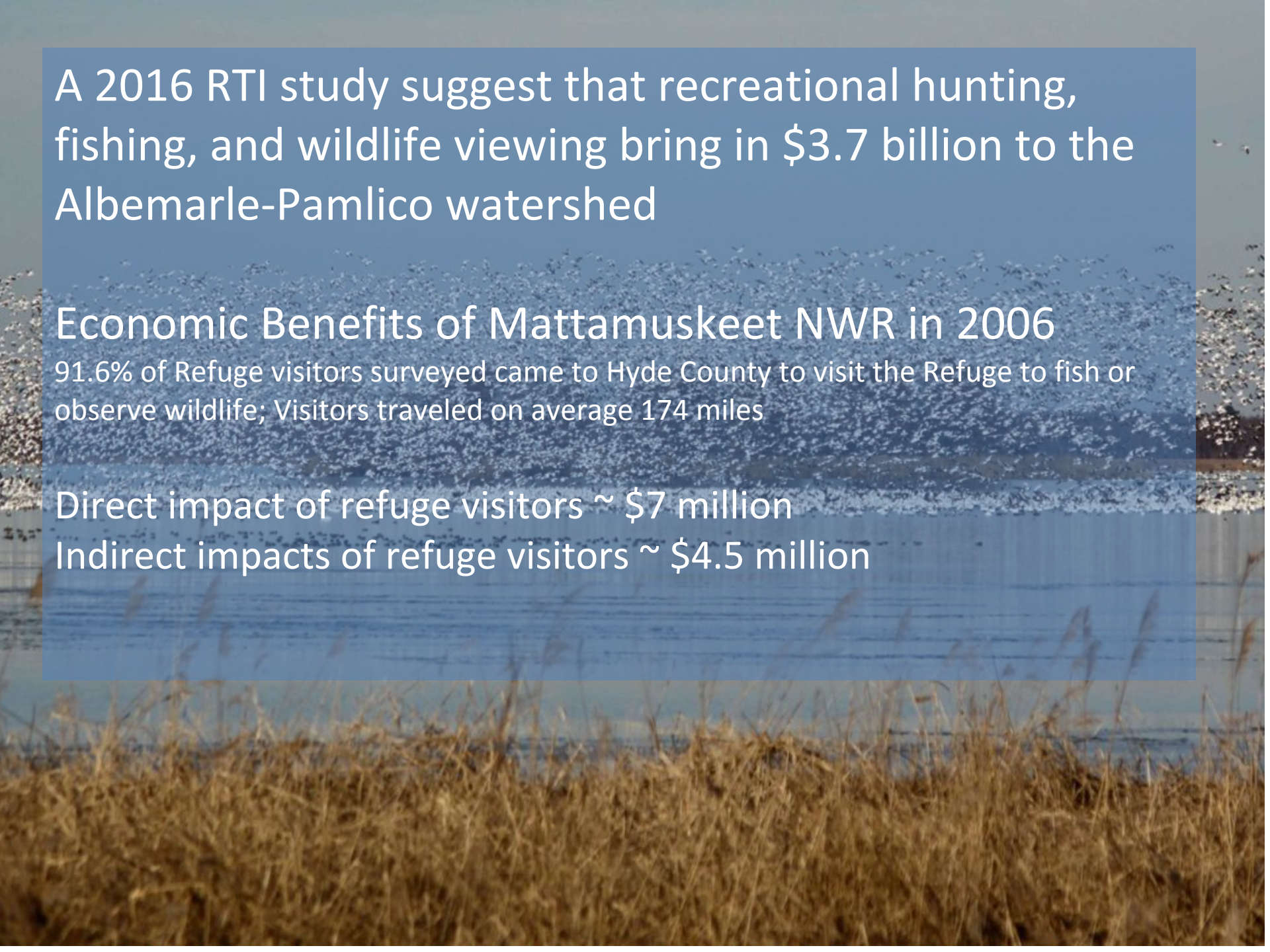
SAV: Submerged Aquatic Vegetation



Muskgrass



Southern Naiad



A 2016 RTI study suggest that recreational hunting, fishing, and wildlife viewing bring in \$3.7 billion to the Albemarle-Pamlico watershed

## Economic Benefits of Mattamuskeet NWR in 2006

91.6% of Refuge visitors surveyed came to Hyde County to visit the Refuge to 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

## *It takes a village...*

A team of partners is committed to restoring SAV at Lake Mattamuskeet because of the lake's cultural, economic, and environmental values



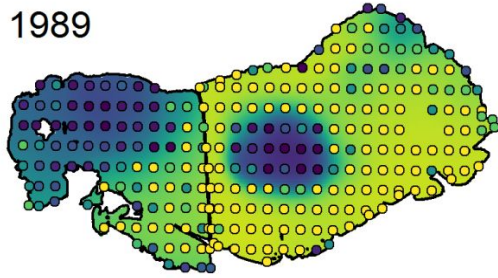
- Hyde County Citizens
- APNEP
- NC Division of Water Resources
- North Carolina State University
- East Carolina University
- UNC-Chapel Hill
- Duke University
- USGS
- Representatives from Senators Richard Burr and Thom Tillis, and Congressmen Walter Jones

# Evolution of a watershed plan

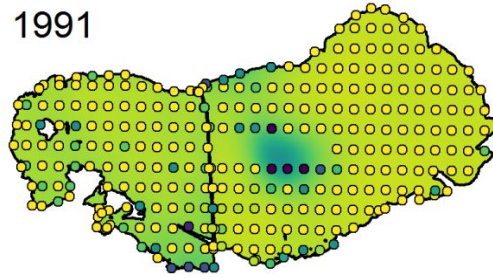
- Concerns over the loss of SAV
  - Local Stakeholders
  - USFWS staff
- USFWS and NCWRC Mattamuskeet Collaborative
  - Executive Committee
  - Steering Committee
  - Technical Working Group
  - Communications Committee
- Financial Support and Technical Information
  - Technical Working Group
  - UNC, ECU, NCSU, Duke, and USGS Researchers
- **Watershed Plan**
  - Stakeholder Process and Technical Synthesis Facilitated by Coastal Federation
  - Supported by Hyde County Stakeholders, NC WRC, USFWS, Hyde County Soil and Water Board, and Hyde County Government

# Maps based on data are an excellent communication tool

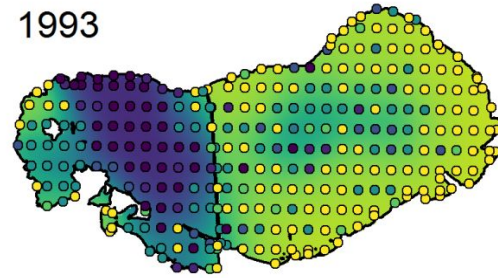
1989



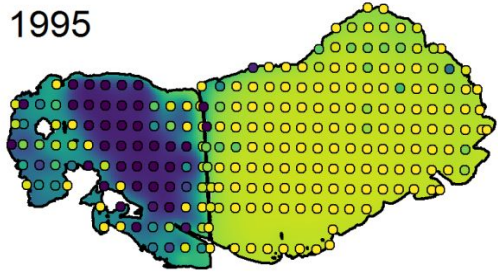
1991



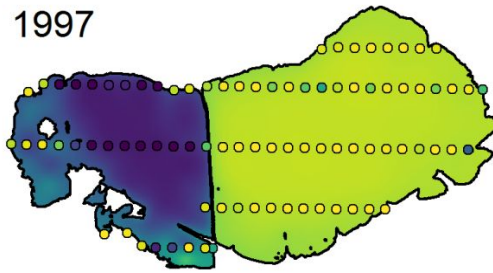
1993



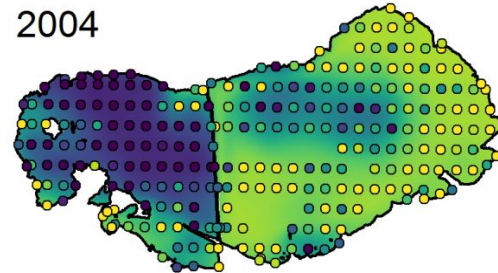
1995



1997



2004



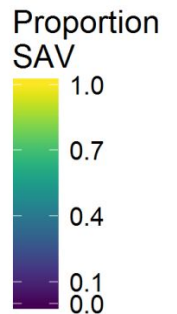
2013



2014

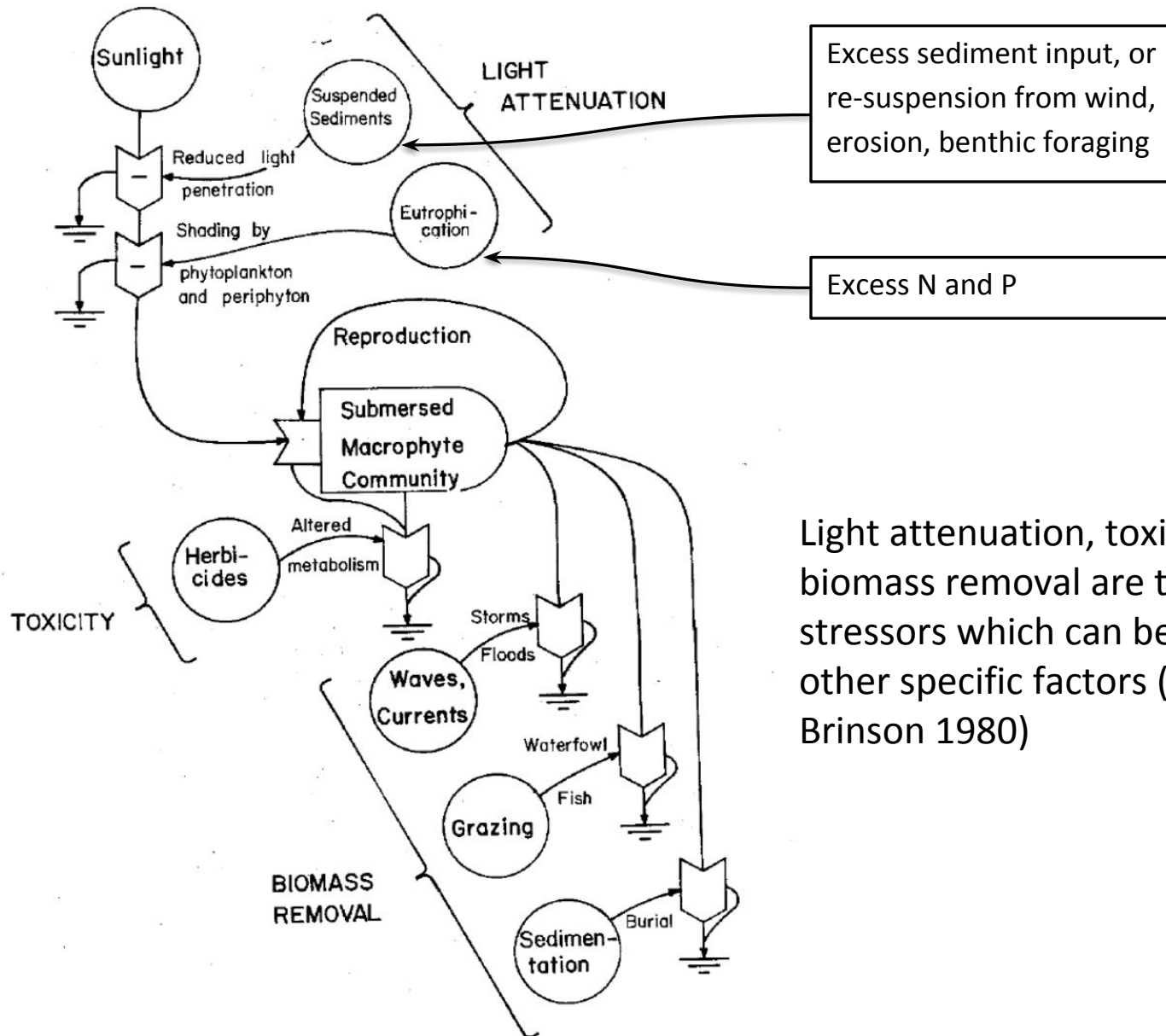


2015



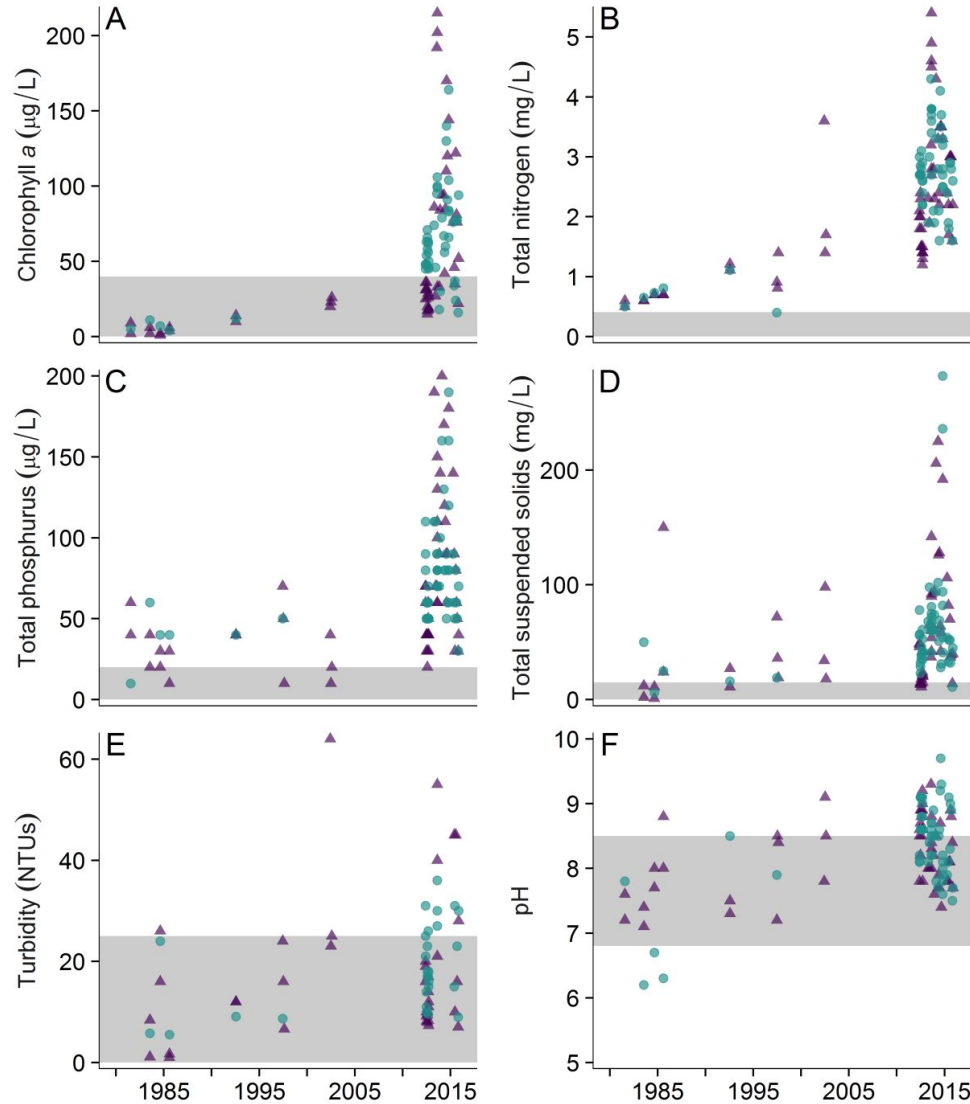
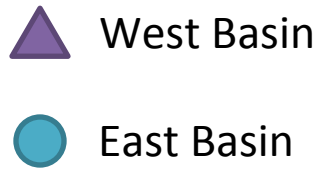


# SAV Conceptual Model organizes stakeholders

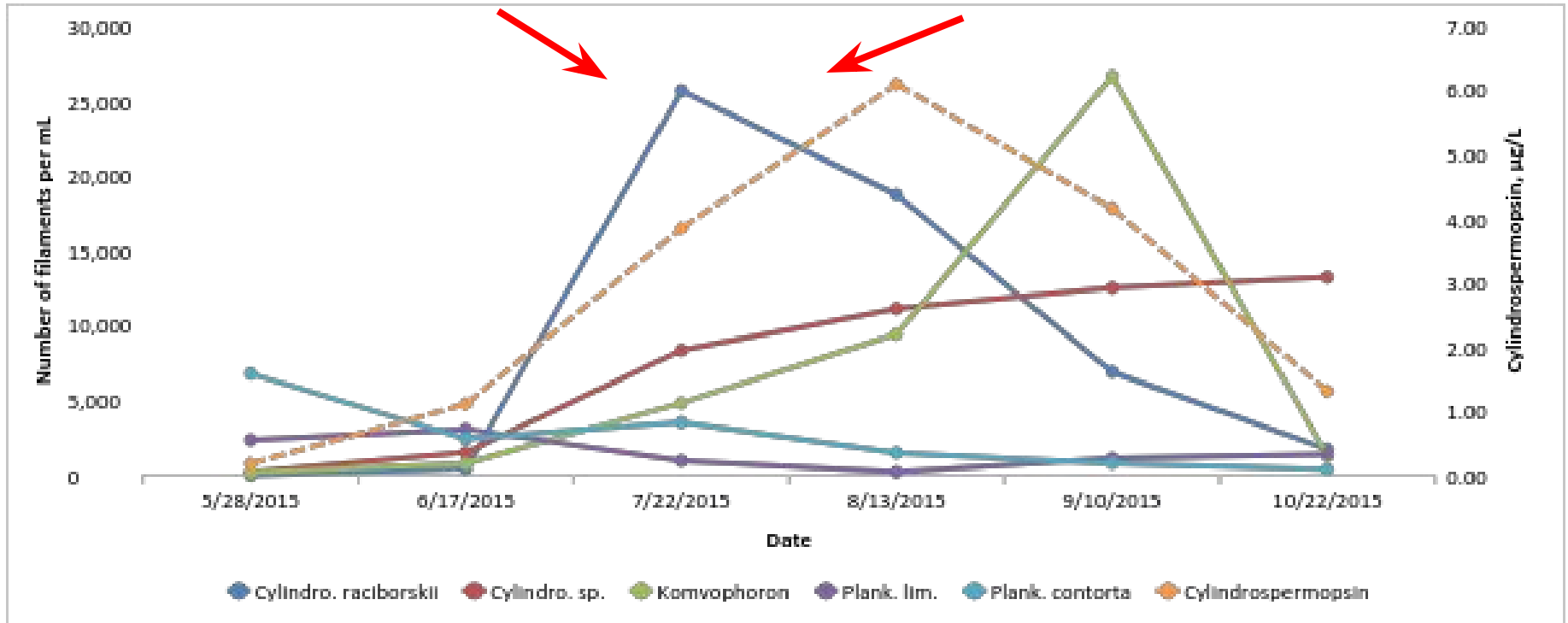


Light attenuation, toxicity, and biomass removal are three general stressors which can be influenced by other specific factors (from Davis and Brinson 1980)

# Water quality data suggests lake has become more eutrophic since the 1980s and puts lake on 303d list for chl *a* and high pH



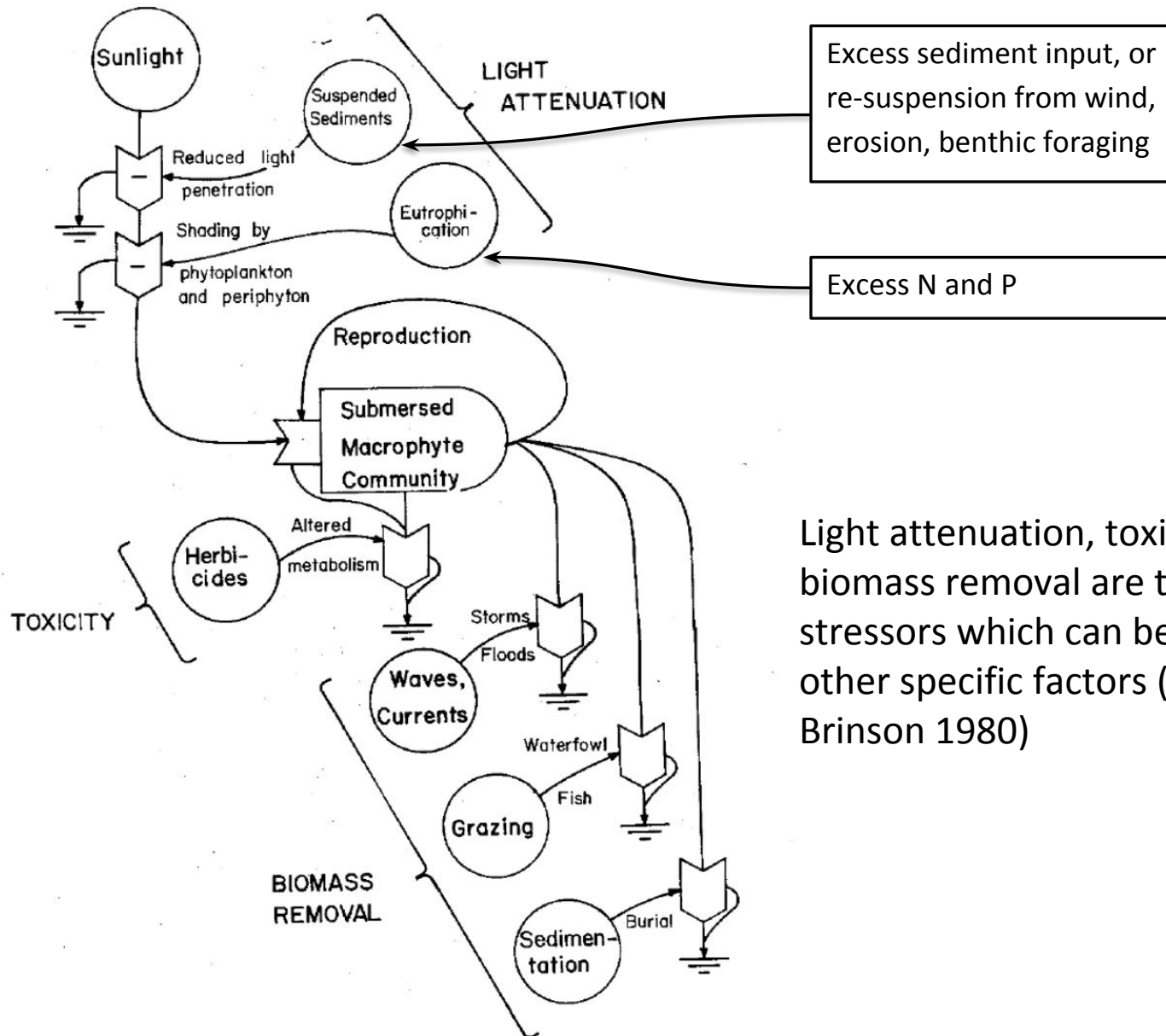
# Cyanobacteria main cause of high chl $a$ , cyanotoxins are a concern



## Cylindrospermopsin

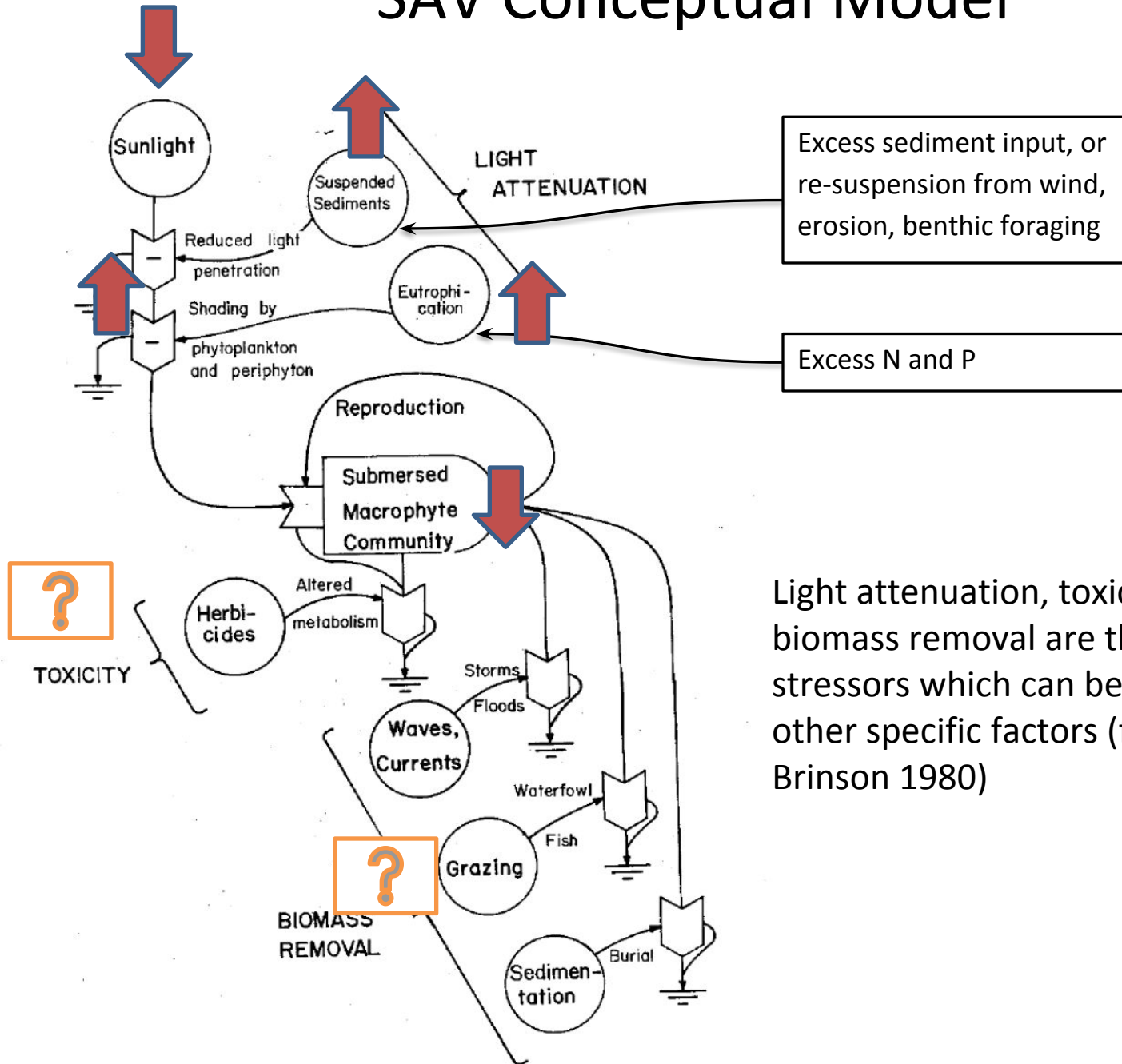
- Can impact a wide variety of species
- Bioaccumulation and trophic transfer through the food web is possible
- Can inhibit growth of other phytoplankton and zooplankton grazing
- Human-health effects include flu like symptoms as well as respiratory problems and adverse impacts on the liver and kidneys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

# SAV Conceptual Model



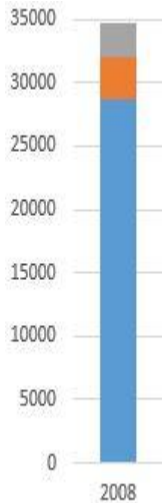
Light attenuation, toxicity, and biomass removal are three general stressors which can be influenced by other specific factors (from Davis and Brinson 1980)

# SAV Conceptual Model

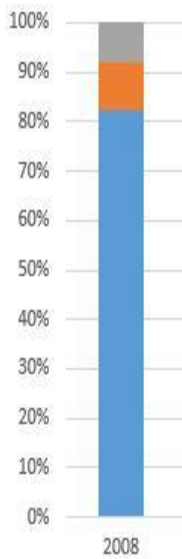


Light attenuation, toxicity, and biomass removal are three general stressors which can be influenced by other specific factors (from Davis and Brinson 1980)

Total Number of Swans Observed In Various Locations – Unit 5

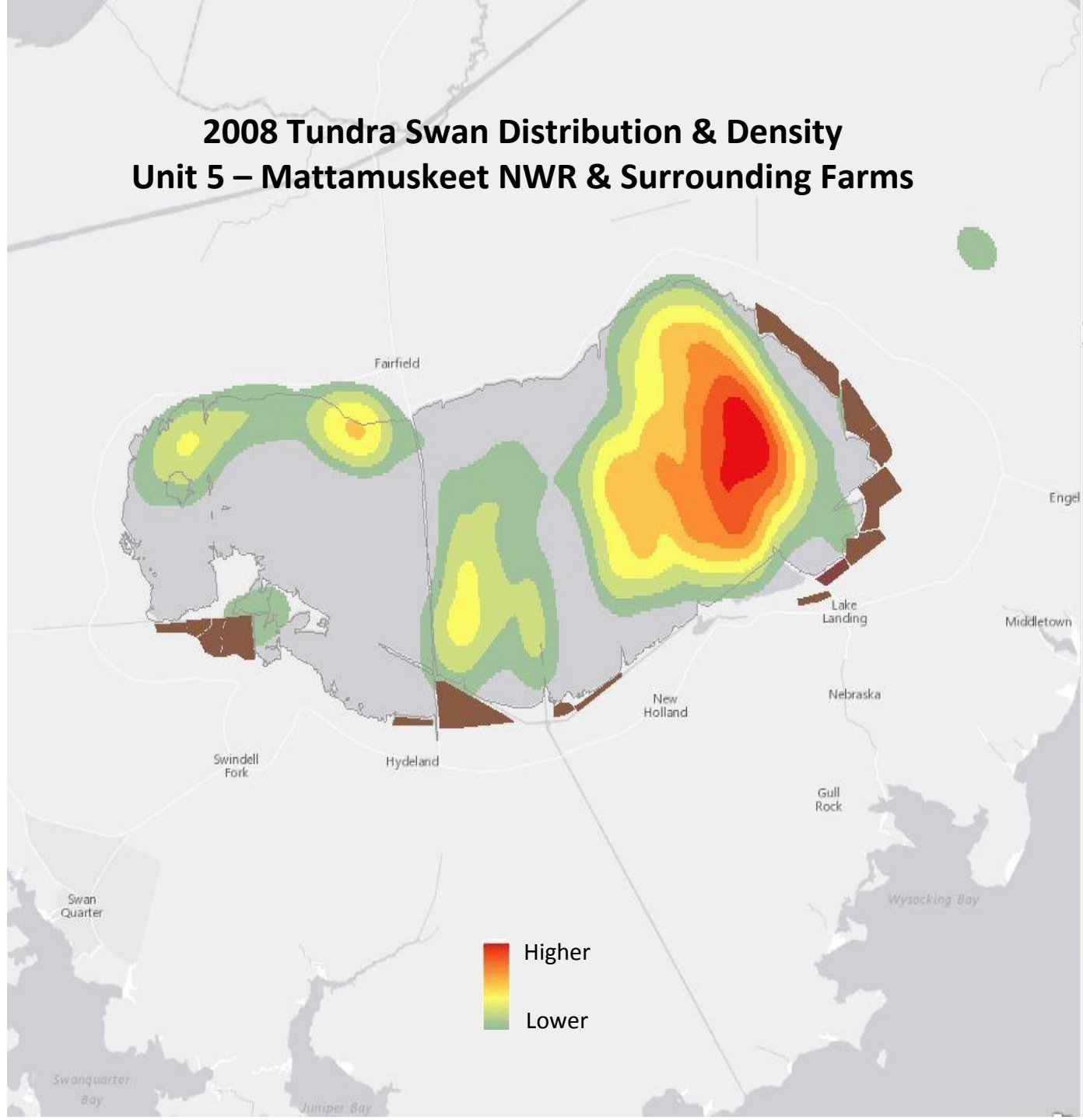


Proportion of Swans Observed In Various Locations – Unit 5

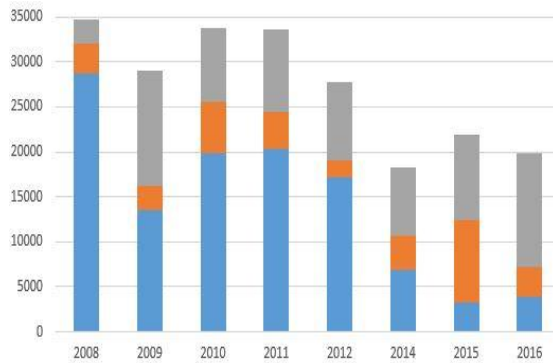


■ lake ■ refuge impoundments ■ off refuge

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



Total Number of Swans Observed  
In Various Locations – Unit 5



Proportion of Swans Observed  
In Various Locations – Unit 5



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



The state of Lake Mattamuskeet has shifted:  
Water quality is impaired, SAV has disappeared, and  
cyanobacteria is abundant which is negatively affecting  
waterfowl habitat



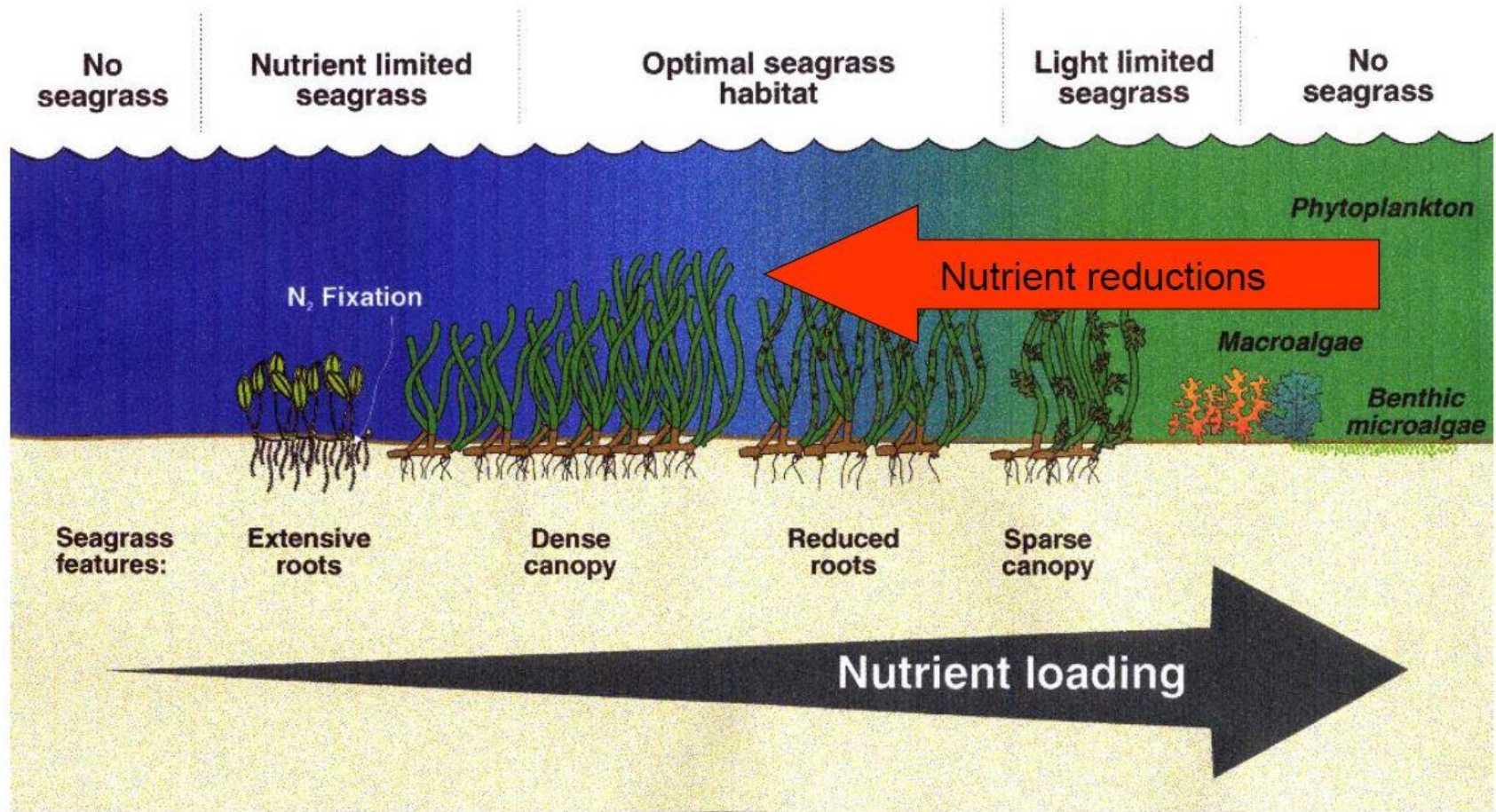
Current state: Turbid waters  
dominated by cyanobacteria lacking  
SAV



Desired state: Healthy 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



# 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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