Cherokee–Yahara River Estuary Rehabilitation Project:

Water Quality and Aquatic Vegetation

Introduction

Water quality and aquatic vegetation in shallow lakes like the Cherokee-Yahara River estuary are inextricably linked. Increased water clarity from reduced turbidity and free-floating algae (especially cyanobacteria) means more sunlight penetrates the water. This allows submersed aquatic plants as well as American lotus (water lily family) to grow, providing habitat for fish and invertebrates.

Of direct importance to water quality not only in the estuary but in downstream Lake Mendota, the aquatic plants stabilize bottom sediments from resuspension by reducing water velocities from wind-induced turbulence. The aquatic plants also slow runoff water laden with phosphorus-rich sediments entering the estuary from its upstream watershed. This allows sediment and phosphorus to settle in the estuary. Without aquatic plants, runoff sediments either pass directly through the estuary into Lake Mendota, or are later resuspended during wind events to be transported to Lake Mendota during baseflow (dry weather river flow) or during extreme runoff events.

One of the key reasons aquatic plants cannot flourish in shallow lakes is dense carp populations. Over abundant carp increase water turbidity by their bottom feeding activities causing sediments to remain "fluffy" and easily resuspended by water currents.

Shallow lakes often exhibit alternative states (see below), including Lake Wingra when carp were removed in 2008. The Cherokee-Yahara estuary has also responded dramatically after 347,000 pounds of carp were removed during 2014-2017.

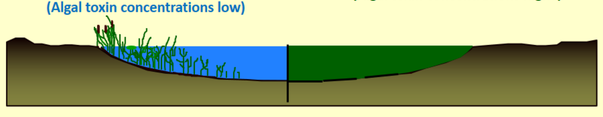
Alternative States in Shallow Lakes:

Clear-Water, Aquatic Plant State

- Clear water
- Carp absent/sparse
- Aquatic plants abundant (with high biodiversity?)
- Bottom sediment resuspension & phosphorus recycling low
- Blue-green algae densities low (Algal toxin concentrations low)

Turbid Algal State

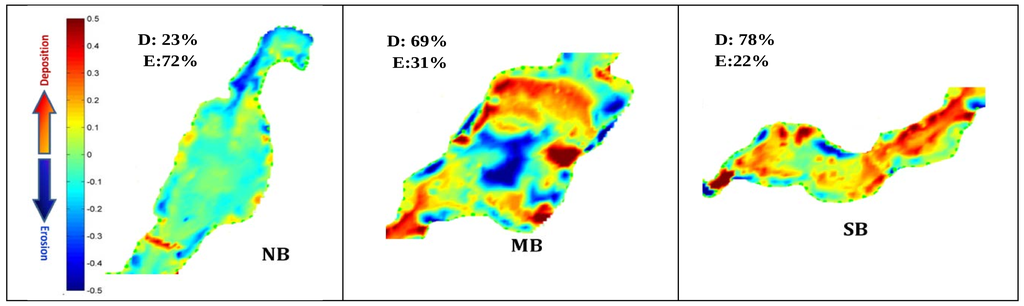
- Turbid green water
- Carp population dense
- Aquatic plants sparse
- Bottom sediment resuspension & phosphorus recycling high
- Blue-green algae densities high (Algal toxin concentrations high?)



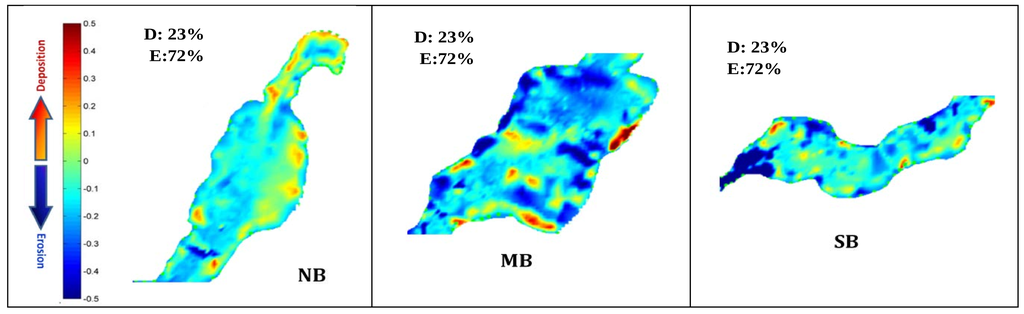
Sediment Transport Without Aquatic Vegetation

Bottom sediment erosion (blue) and deposition (red) in the Cherokee–Yahara River estuary (NB=north basin, MB=middle basin, SB=south basin) between two successive years are shown below. In the first year (June 2009 to June 2010) as much as 0.5 m of sediment was deposited in areas of the middle and south basins. In the following year (June 2010 to July 2011) as much as 0.5 m of sediment was eroded from those same basins and transported to downstream Lake Mendota. (Source: Wu, Lathrop, and Welke, 2013; Data: K. Khan)

June 2009 to June 2010

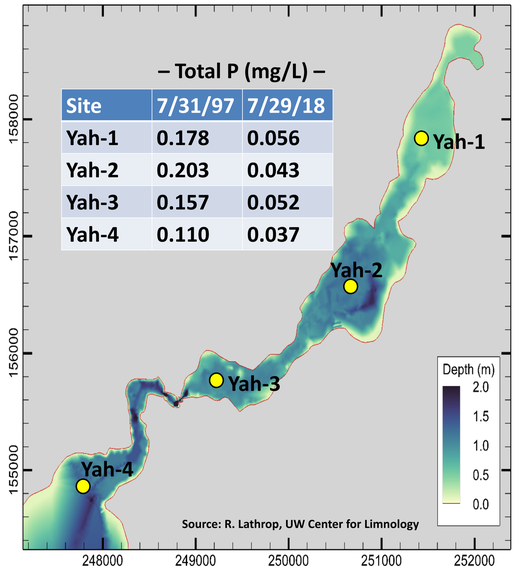


June 2010 to July 2011



Massive amount of sediment and associated phosphorus passed through the Cherokee-Yahara River estuary and entered Lake Mendota during a July 1993 extreme runoff event when the estuary was devoid of aquatic plants.

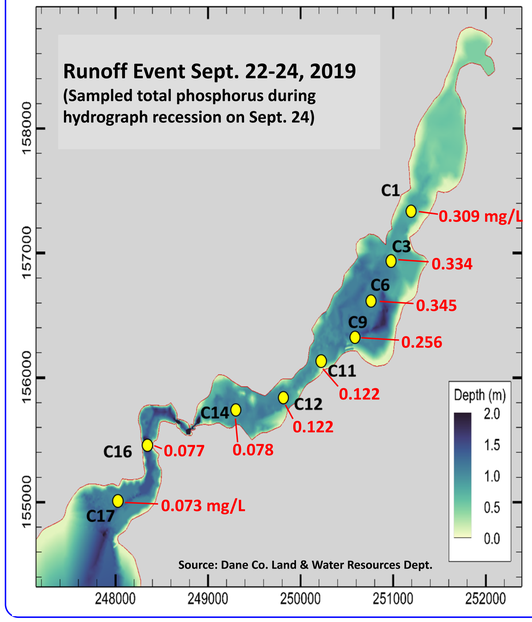
Reduced Phosphorus Transport With Aquatic Vegetation



– Total P (mg/L) –

Site	7/31/97	7/29/18
Yah-1	0.178	0.056
Yah-2	0.203	0.043
Yah-3	0.157	0.052
Yah-4	0.110	0.037

Total Phosphorus concentrations (mg/L) declined 75% in estuary's baseflow entering Lake Mendota between a summer (July 1997) with dense carp and no aquatic plants and a summer (July 2018) after carp removal that allowed clear water with extensive aquatic plants.



Total Phosphorus concentrations (mg/L) in Sept. 2019 runoff event declined by 75% after passing through the estuary's dense aquatic plants before runoff water entered Lake Mendota.