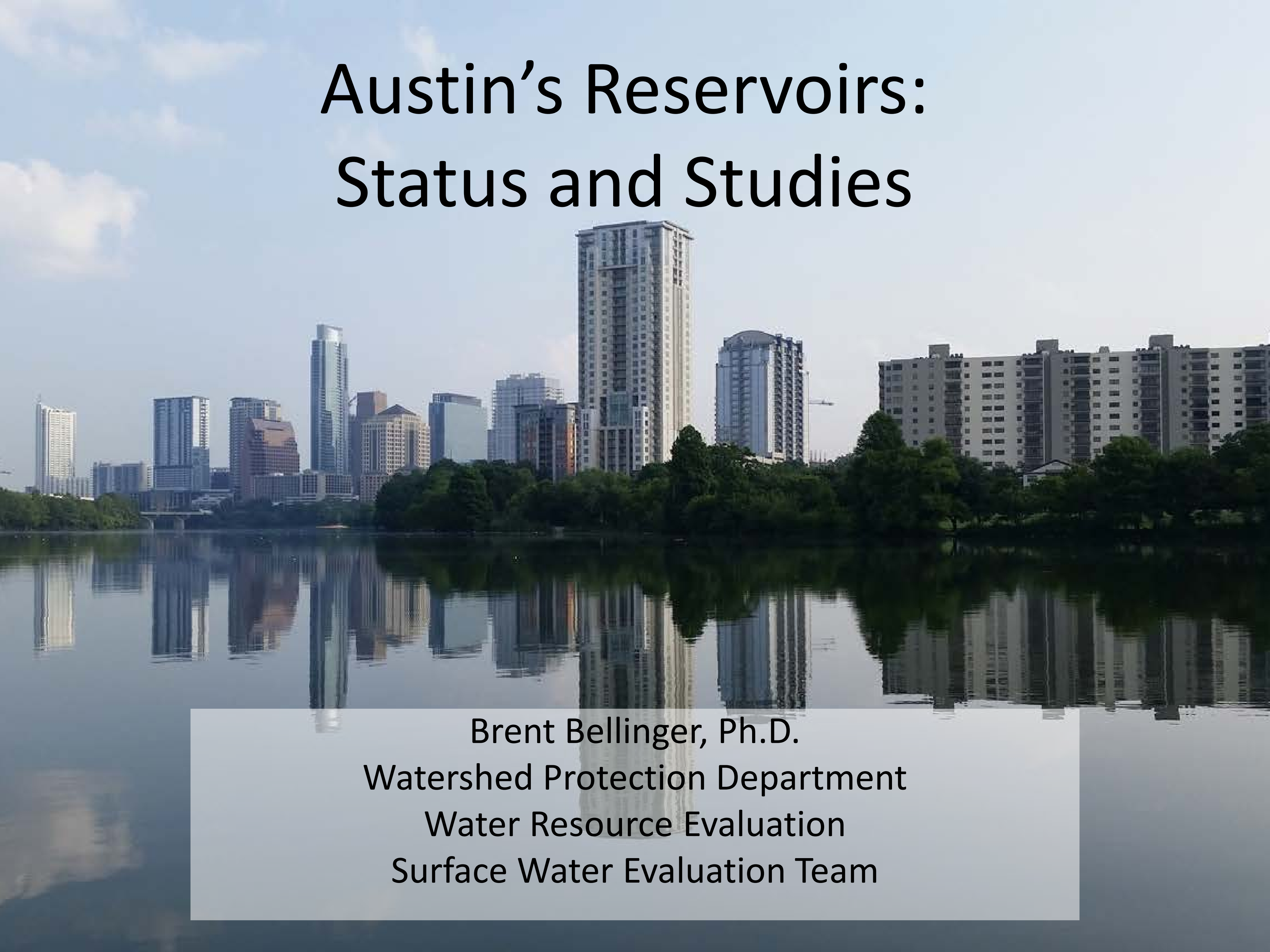
Austin's Reservoirs: Status and Studies



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Reservoir Concerns

- Water quality
  - Drinking water, aesthetics, ecological integrity
- Algal blooms
  - Cyanobacteria, filamentous algae, taste and odor problems
- Non-native species
  - Hydrilla, zebra mussels, sterile grass carp
- Recreational uses
  - Fishing, boating, swimming
- Drought/Flood – A significant influence on all of the above and the most difficult to predict

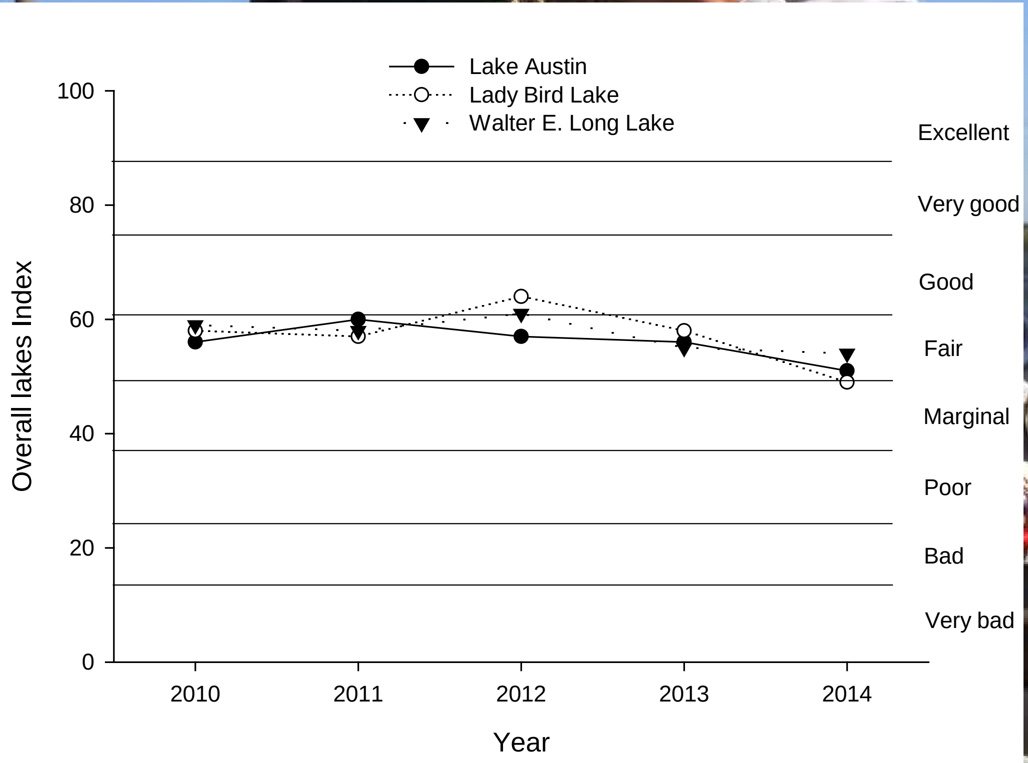
It is not just Austin

- Increased pressure and demands on our water resources are a global phenomena
  - Top concerns identified by the US EPA were lakeshore habitat condition and development; nutrient management; natural vegetation
  - Precipitation uncertainty, impacts on water availability and quality increasingly recognized and considered (e.g., 2012 Australian government Initiative Report)

- As a municipality, Austin is proactive in terms of their management, monitoring, research, remediation, and restoration efforts

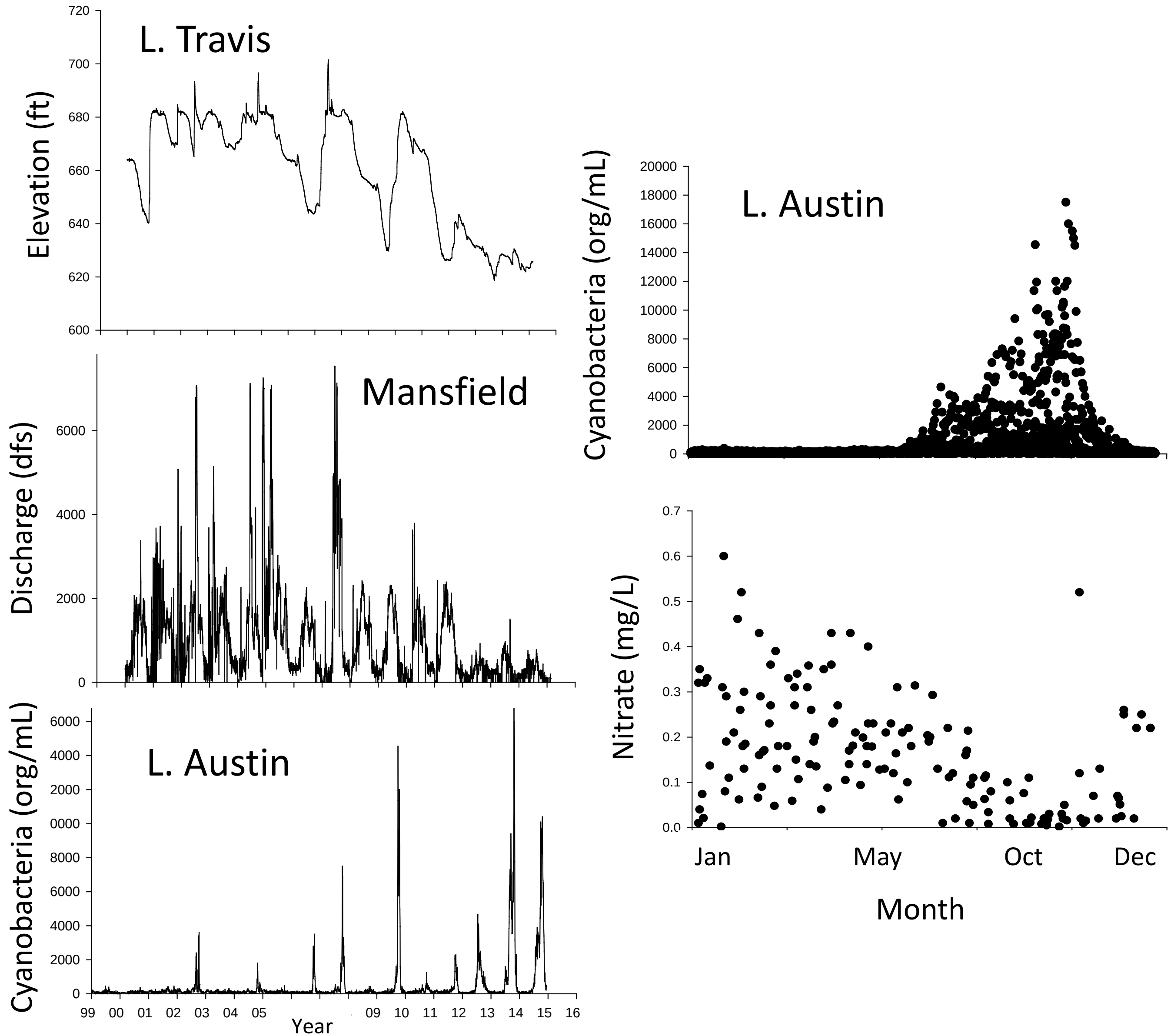
Monitoring and Special Studies

- Austin Lakes Index (ALI) (www.austintexas.gov/lakesindex)
  - Water chemistry, Chl *a*, and phytoplankton community
  - Invertebrates, sediments, habitat characteristics
  - Vegetation coverage and composition (TPWD)



Monitoring and Special Studies

- Data mining and analyses are assessing algal bloom timing, magnitude, drivers



Monitoring and Special Studies

- Screening for toxins associated with algal blooms of L. Austin
  - We have 5 potential toxin producing species)
- EPA has recently established Microcystin conc. criteria for drinking waters

Table 1. Potentially toxic cyanobacteria present at AVM sites.

Cyanobacterial genus/species	Potential toxins produced by these species
Anabaena sp.	Anatoxins, Microcystins, Saxitoxins, LPS's
Aphanizomenon sp.	Anatoxins, Saxitoxins, Cylindrospermopsins, LPS's
Lyngbya wollei	Aplysiatoxins, Lyngbiatoxin-a, LPS's
Nostoc sp.	Microcystins, LPS's
Phormidium sp.	*uncharacterized toxin*

TABLE 8.1. CYANOBACTERIAL TOXINS AND THEIR ACUTE TOXICITY[a]

Cyanotoxins	LD_{50} (i.p. mouse)[b] of pure toxin (μg/kg)	Taxa known to produce the toxin(s)	Mechanism of toxicity
Protein phosphatase blockers (cyclic peptides with the amino acid ADDA)			
Microcystins in general (~60 known congeners)	45–>1000	*Microcystis, Planktothrix, Oscillatoria, Nostoc Anabaena, Anabaenopsis Hapalosiphon*	all block protein phosphatases by covalent binding and cause haemorrhaging of the liver; cumulative damage may occur
Microcystin-LR	60 (25–125)		
Microcystin-YR	70		
Microcystin-RR	300–600		
Nodularin	30–50	*Nodularia spumigena*	
Neurotoxins			
Anatoxin-a (alkaloid)	250	*Anabaena, Oscillatoria, Aphanizomenon, Cylindrospermum*	blocks post-synaptic depolarization
Anatoxin-a(s) (unique organophosphate)	40	known only from two species of *Anabaena*	blocks acetylcholinesterase
Saxitoxins (carbamate alkaloids)	10–30	*Aphanizomenon, Anabaena, Lyngbya, Cylindrospermopsis raciborskii*	block sodium channels
Cytotoxin			
Cylindrospermopsin (alkaloid)	2100 in 1 day 200 in 5–6 days	*Cylindrospermopsis raciborskii*	blocks protein synthesis; substantial cumulative toxicity

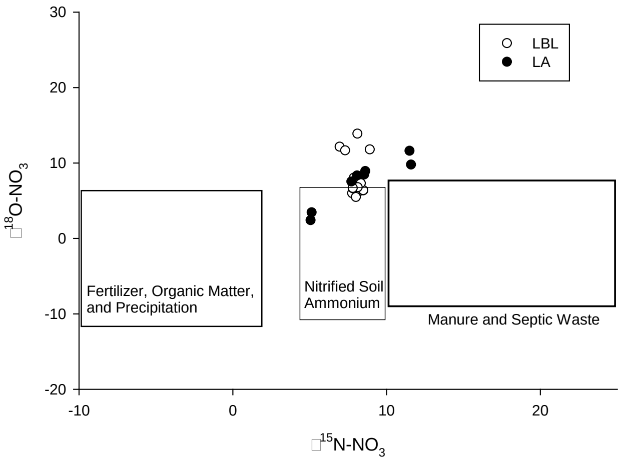
[a] derived from Turner et al., 1990; Kuiper-Goodman et al., 1999; Sivonen & Jones, 1999.

[b] LD_{50} = lethal dose$_{50}$ (the dose of a chemical that will, on average, kill 50% of a group of experimental animals); i.p. = intraperitoneal.

Monitoring and Special Studies

- Stable Isotope food web study of L. Austin and Lady Bird
- Utilizing stable carbon, nitrogen, and oxygen isotopes
- Water quality and biological linkage:
  - As shorelines and watersheds are developed, is the loss of watershed inputs (e.g., leaves) impacting the biological structure of the reservoirs?
  - Development also means more roads and sanitation (e.g., septic); are those anthropogenic inputs (e.g., human-derived nitrate) entering the food web?
- Carbon relates to energy fueling production of the reservoirs
  - Is the carbon primarily derived internally (phytoplankton, aquatic vegetation) or externally (leaf litter inputs)?
- Nitrogen and oxygen provide information on source of this critical nutrient
  - Is the nitrogen in the water and lower trophic levels or an atmospheric, microbial, and/or human origin?

Monitoring and Special Studies



Nitrate sources

Plankton sampling

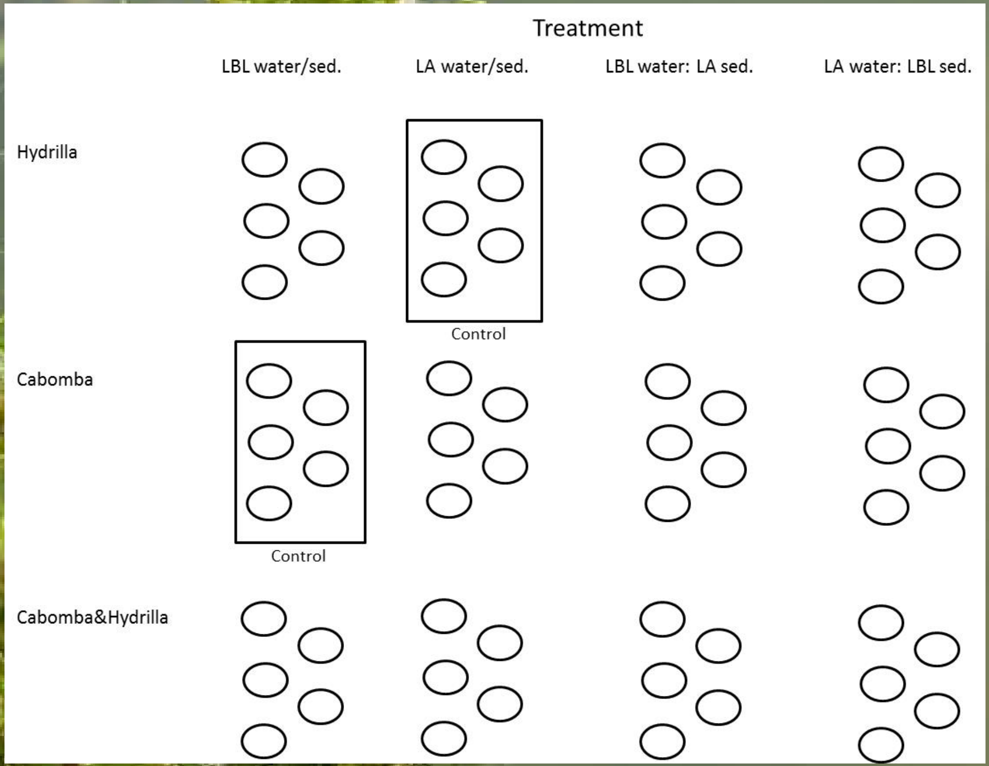


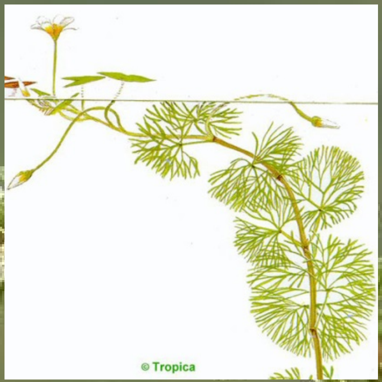
Carbon and nitrogen sources – terrestrial, riparian, aquatic

Direct observation of resources consumed

Monitoring and Special Studies

- Deciphering the lack of Hydrilla in Lady Bird Lake
- Hydrilla has had fifteen years to colonize LBL, yet has only been found in L. Austin and below Longhorn Dam
- Is it related to water and/or sediment composition and chemistry?





Monitoring and Special Studies

- Zebra mussels: Highly invasive organism making its way into Texas reservoirs

- Zebra mussels impact water in many ways:
  - Negatively impact native shellfish
  - Render beaches unusable
  - Clog water intake pipes
  - Increase water clarity
  - Stimulate massive benthic periphyton blooms – after algal die-off may find avian botulism

- Cross-training with LCRA on monitoring protocols; developing educational and outreach materials to supplement LCRA and TPWD efforts

Summary

- With an increasing population and climate uncertainty, it is essential to understand the drivers of aquatic system condition (data is the key to decision making)

- In Austin we can be innovative in our resource management; many other regions are experiencing similar issues that can help inform our decisions

- Our reservoirs are not just about clean drinking water; must study, manage, and protect to ensure "Sustainable and Healthy Communities" (Imagine Austin; new EPA research Program)

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