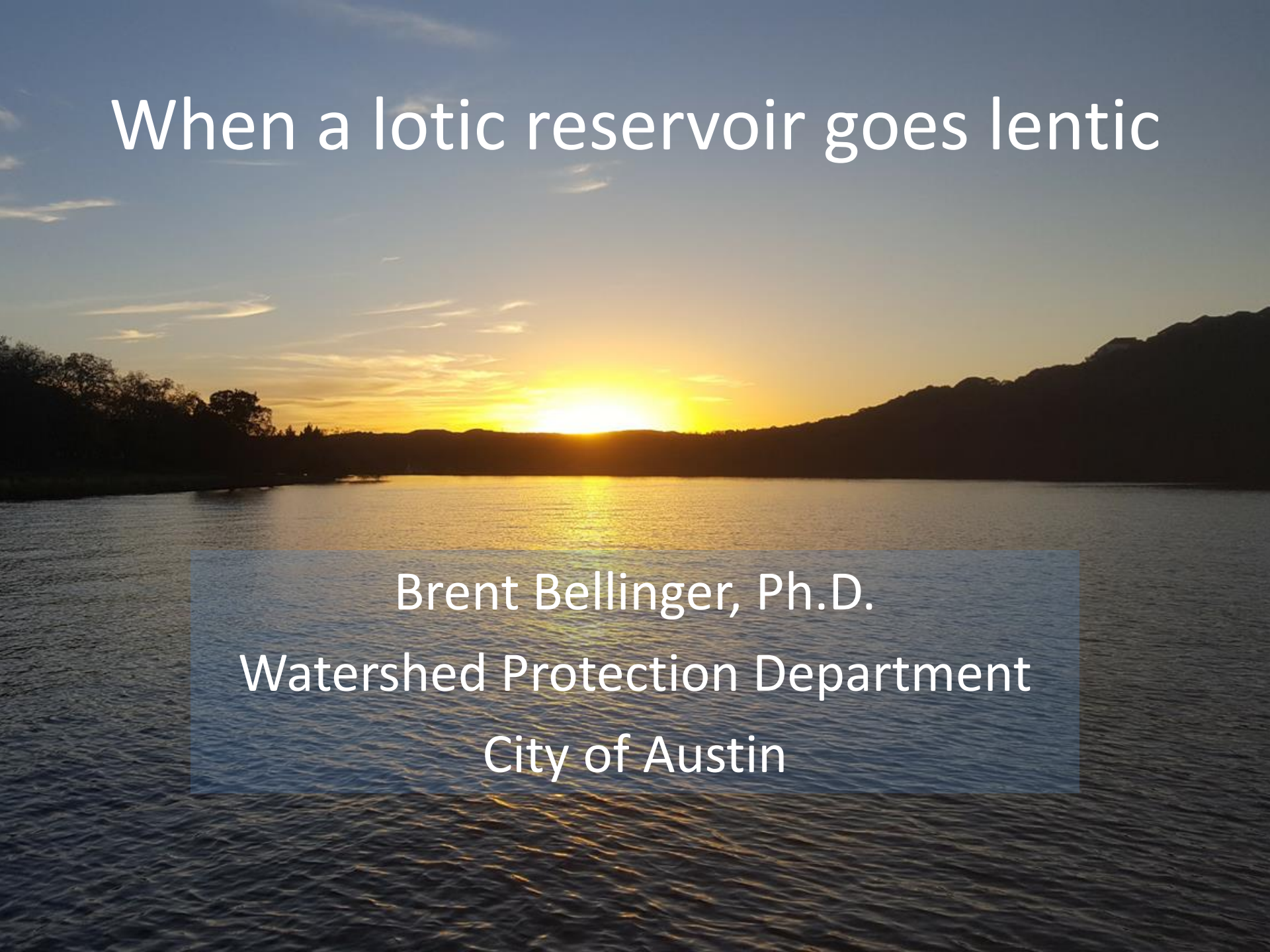
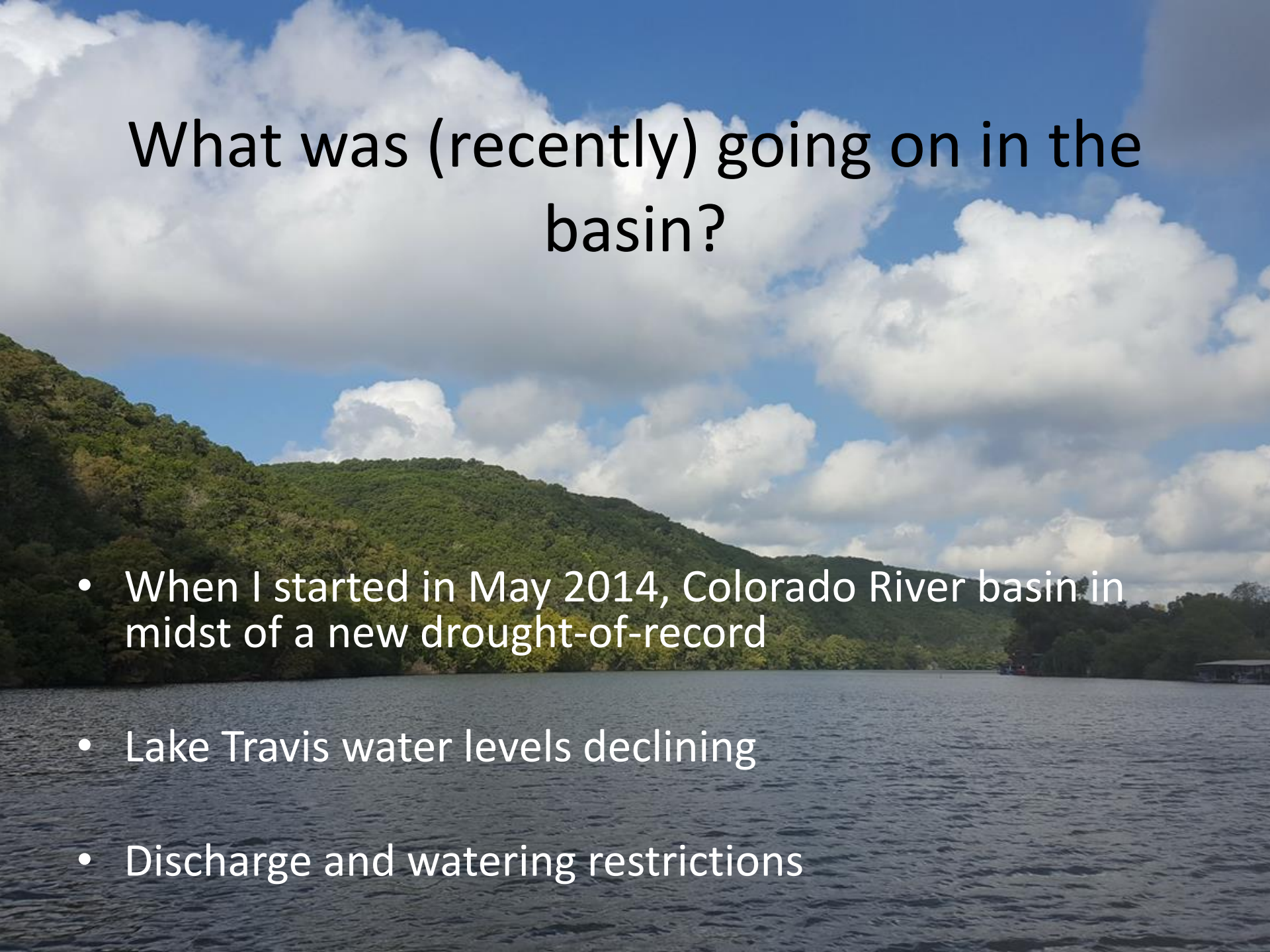
When a lotic reservoir goes lentic



Brent Bellinger, Ph.D.
Watershed Protection Department
City of Austin

What was (recently) going on in the basin?

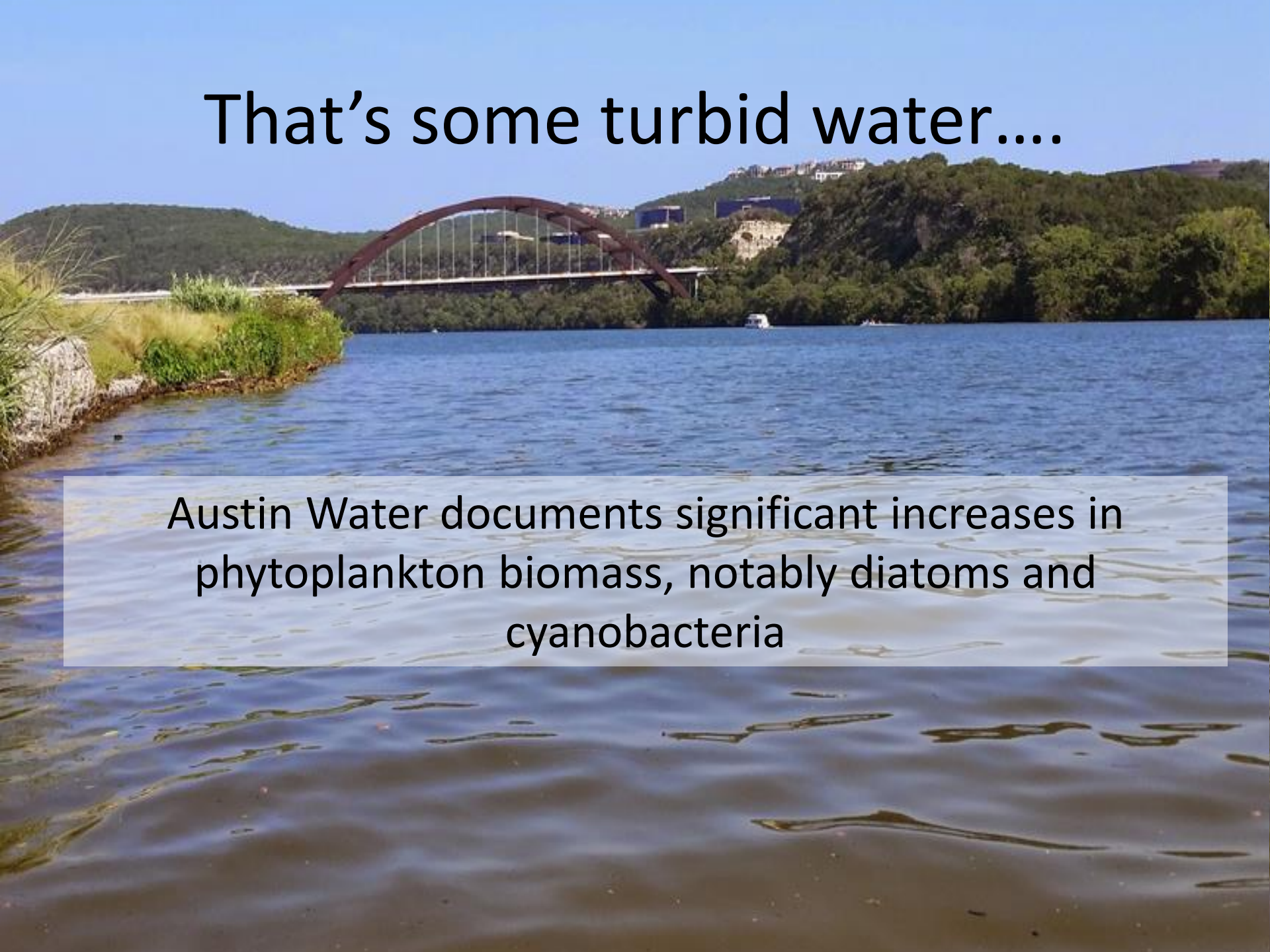


- When I started in May 2014, Colorado River basin in midst of a new drought-of-record
- Lake Travis water levels declining
- Discharge and watering restrictions

What about Lake Austin specifically?

Lake Austin devoid of hydrilla and all other vegetation (and here I thought that was going to be a problem to work on)

That’s some turbid water….



Austin Water documents significant increases in phytoplankton biomass, notably diatoms and cyanobacteria

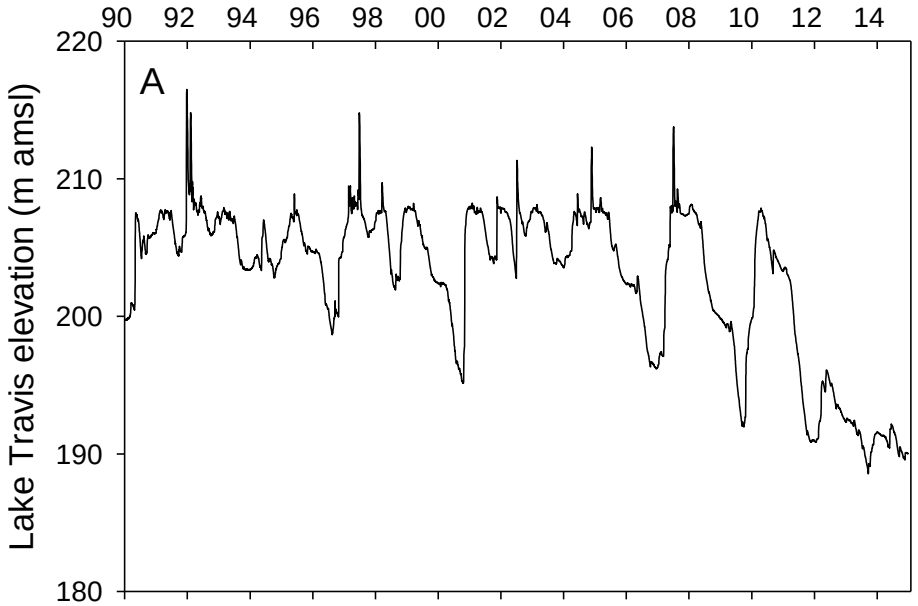
Let’s dig into this

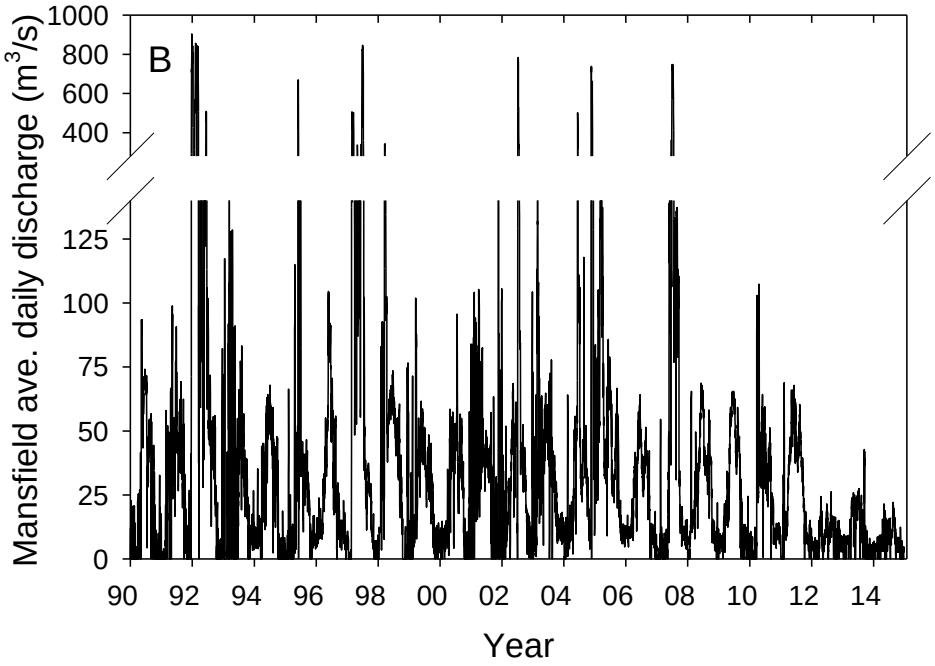
- Obviously the hydrology of Lake Austin changed in the drought; can we quantitatively link the hydrology with water quality?

- Compiled data from AW, TPWD, LCRA, and WPD to look at trends, relationships, and drivers of water quality and biological (i.e., plant and algae) communities from 1990–2014

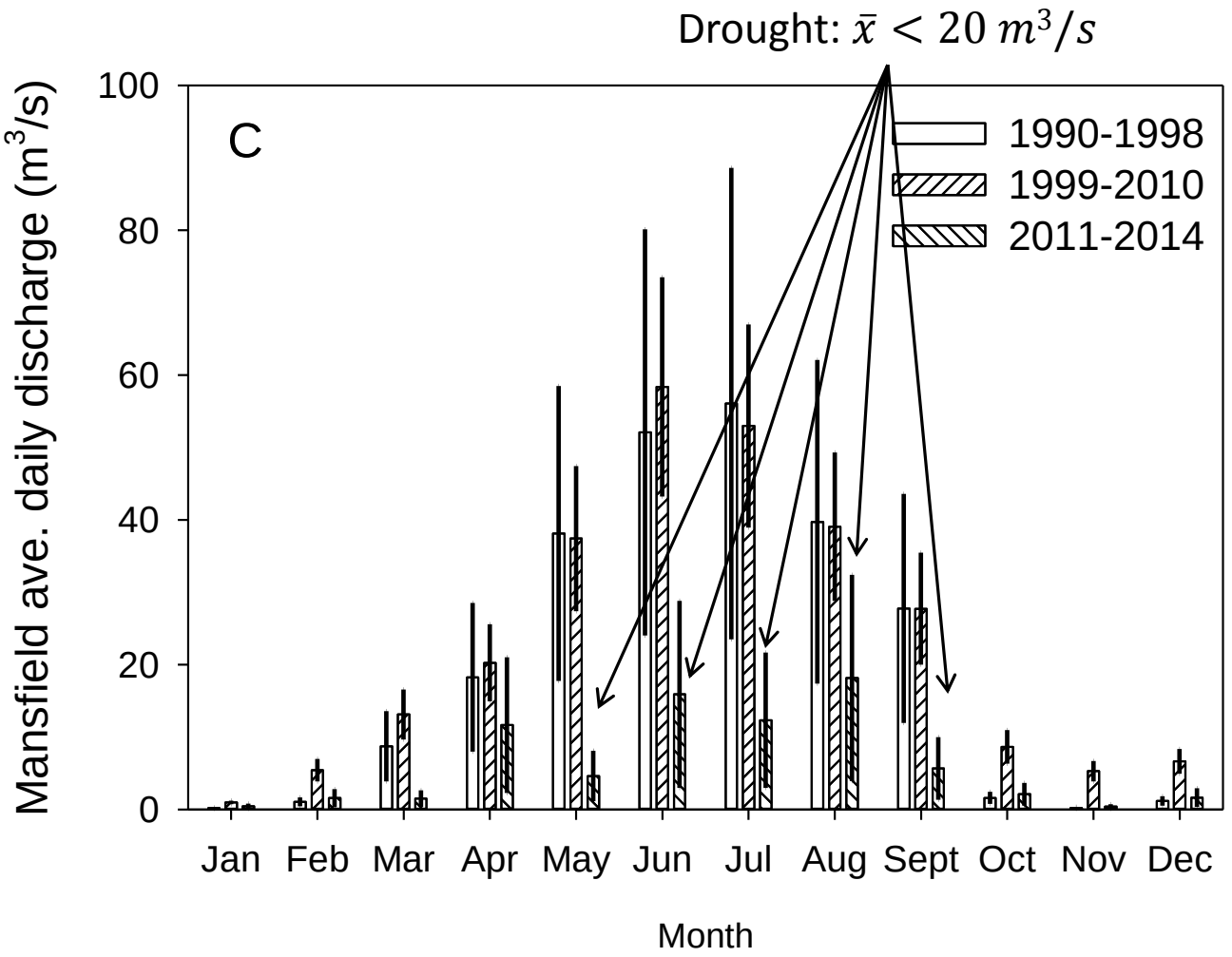
The (brief) story of Lake Travis

- Elevation
- Discharge

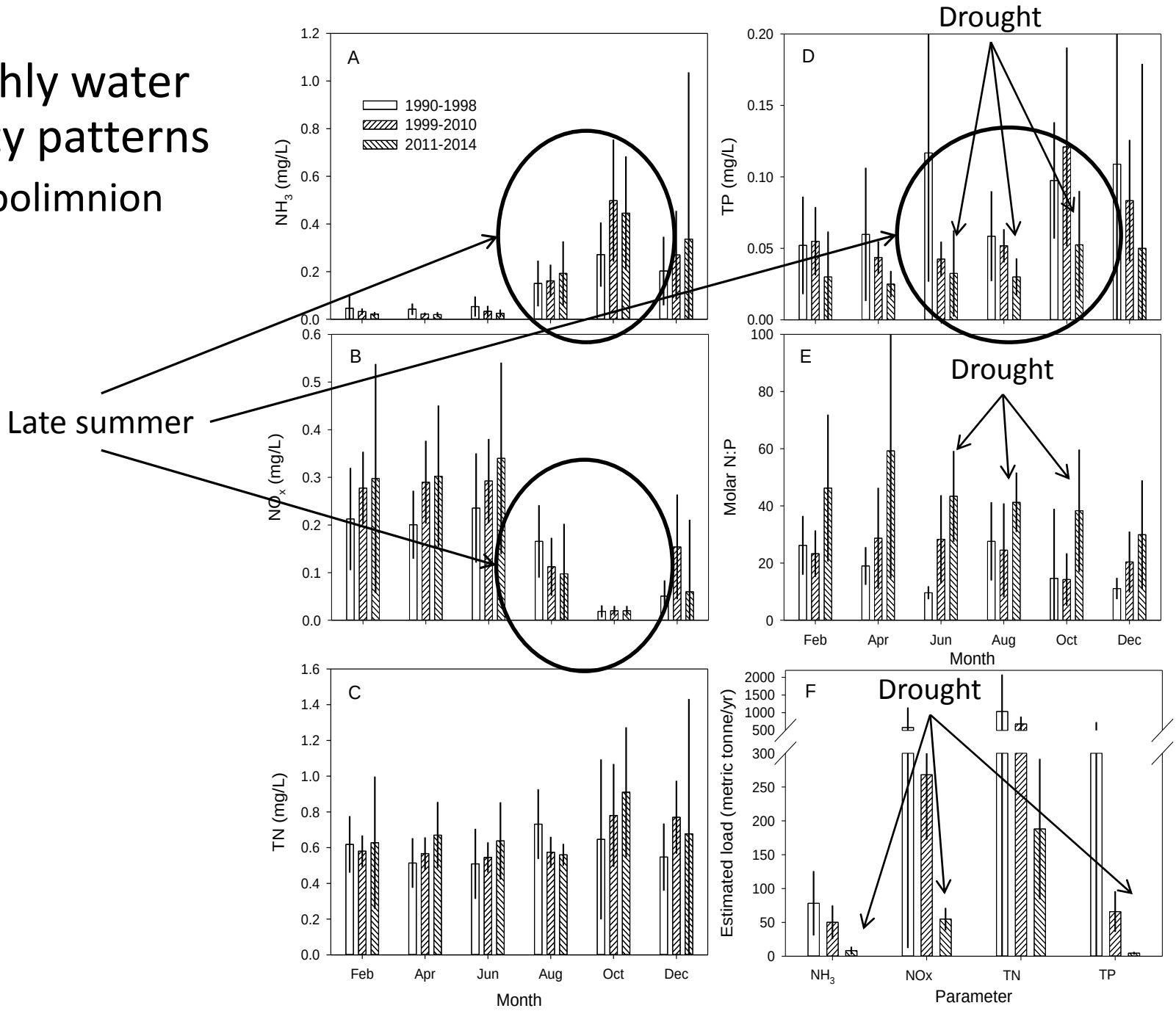




- Monthly discharge pattern

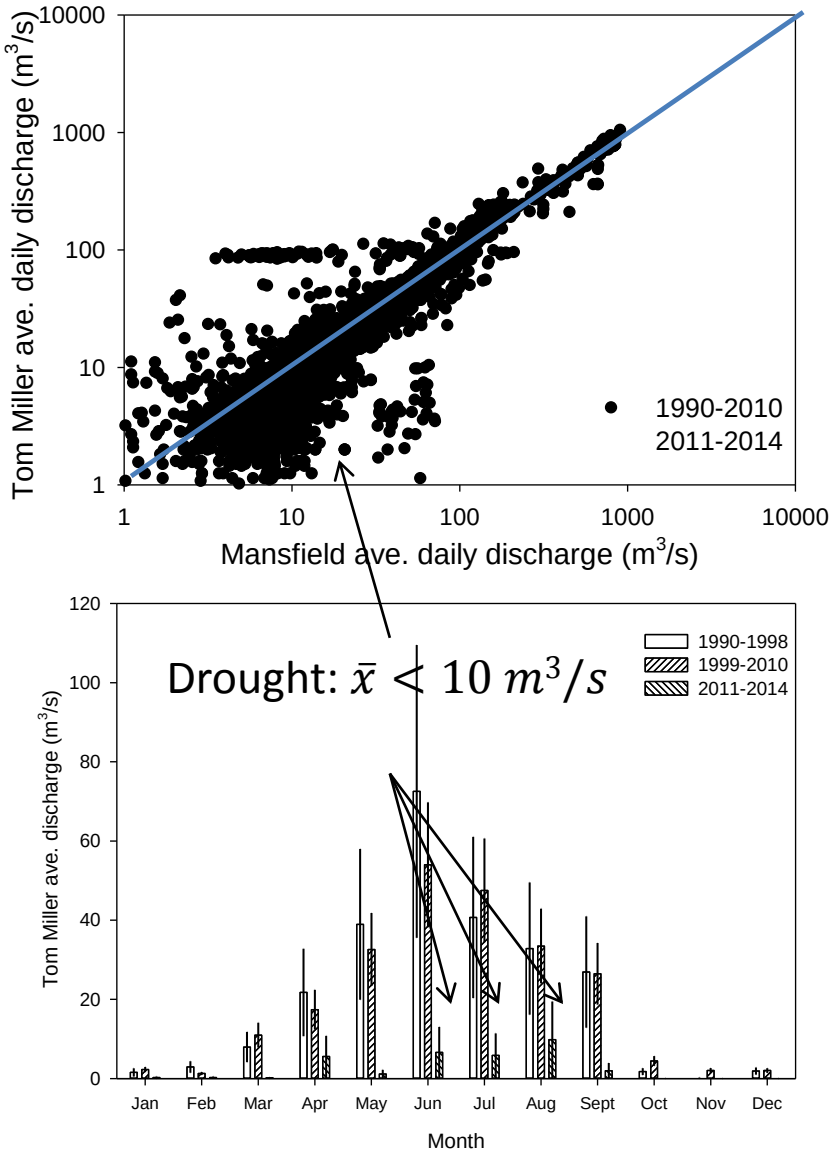


- Monthly water quality patterns
  - hypolimnion



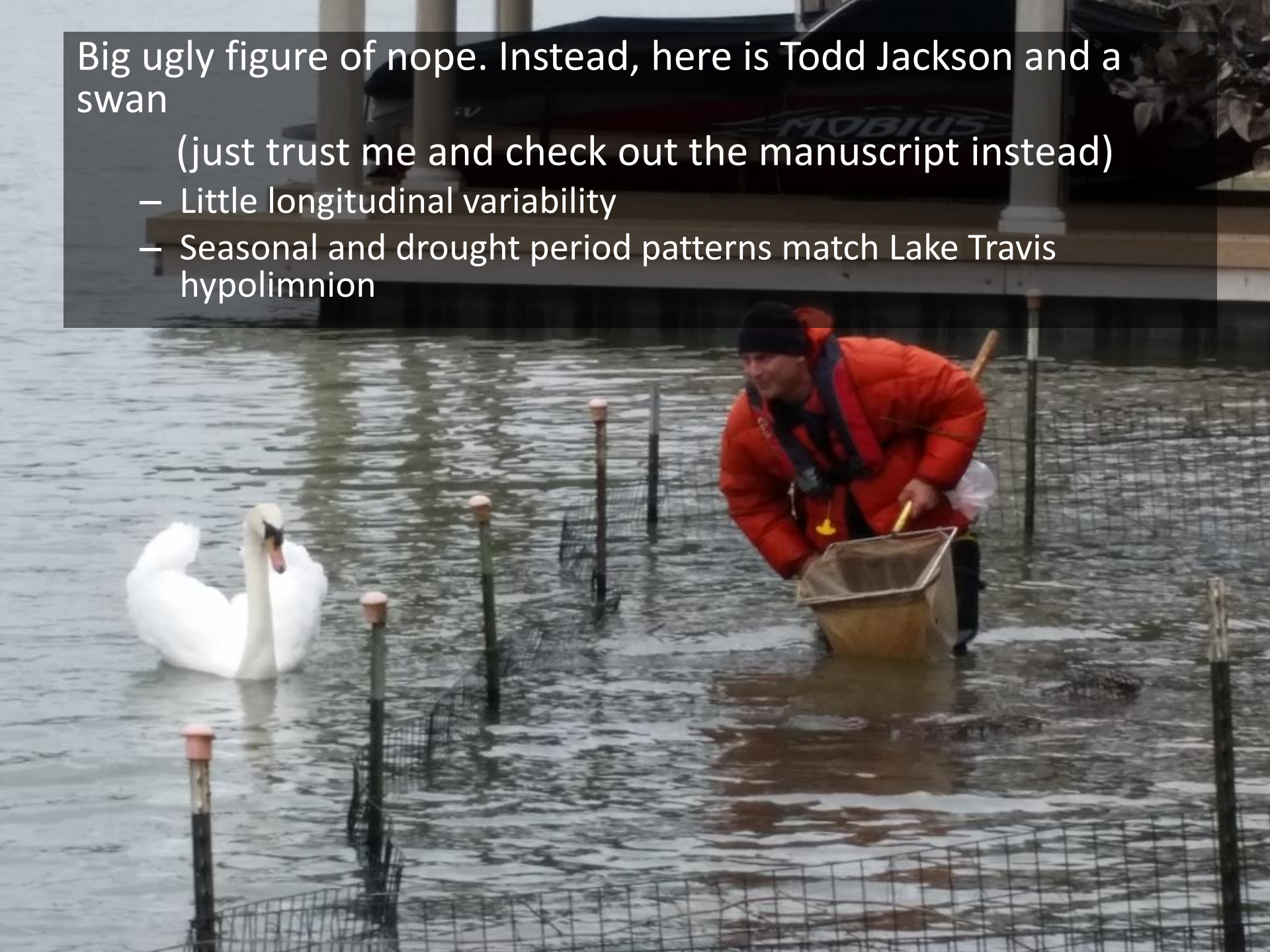
Onto Lake Austin!

- Stable water levels (obviously); discharges typically similar to those from Lake Travis
  - Declined during recent drought period
- Historically very short water residence times



Lake Austin water quality grouped by:

- *Months x years* at each site;
- *Years x sites* bi-monthly
- *Sites x months* for each period

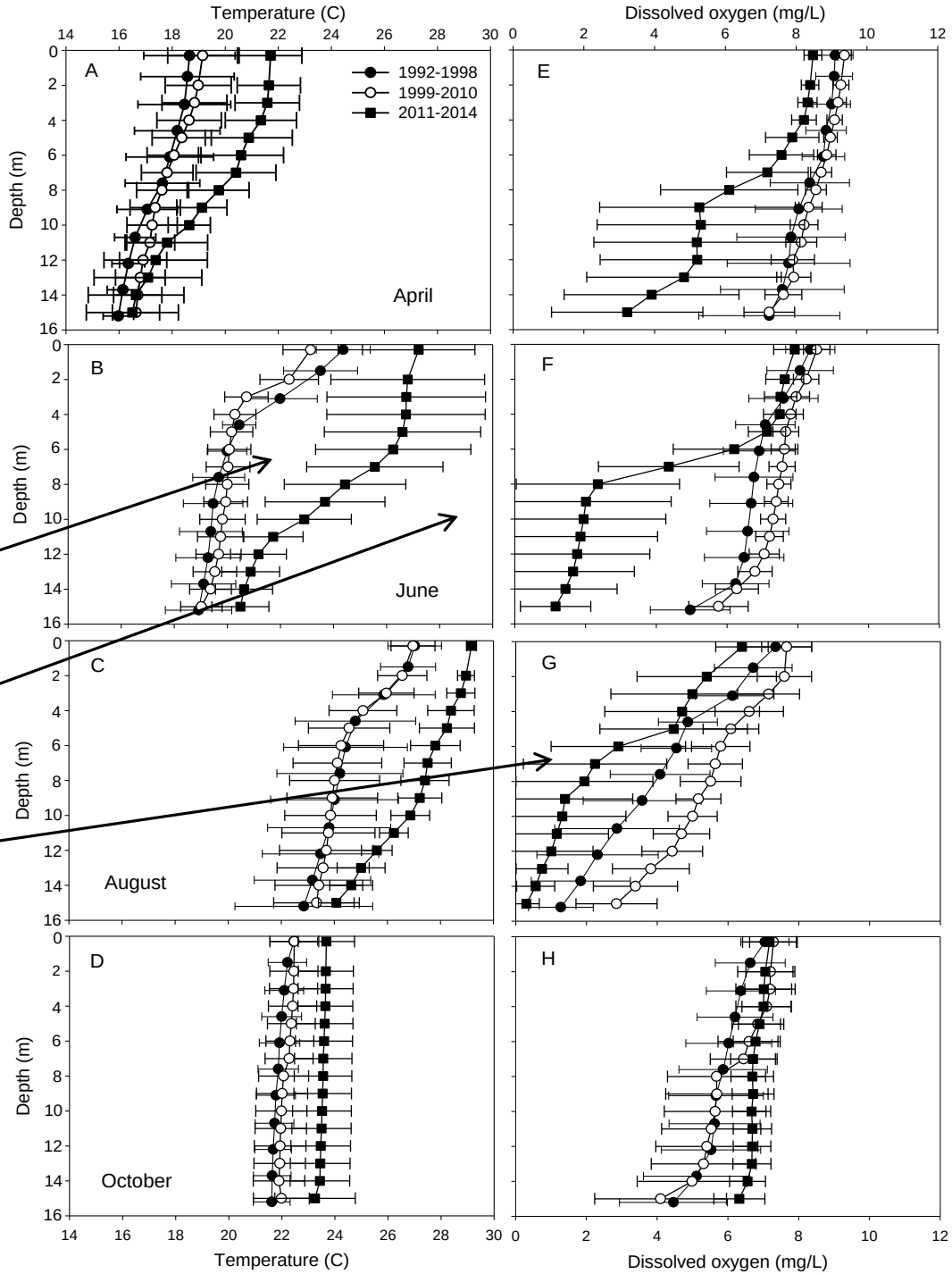


Big ugly figure of nope. Instead, here is Todd Jackson and a swan

(just trust me and check out the manuscript instead)

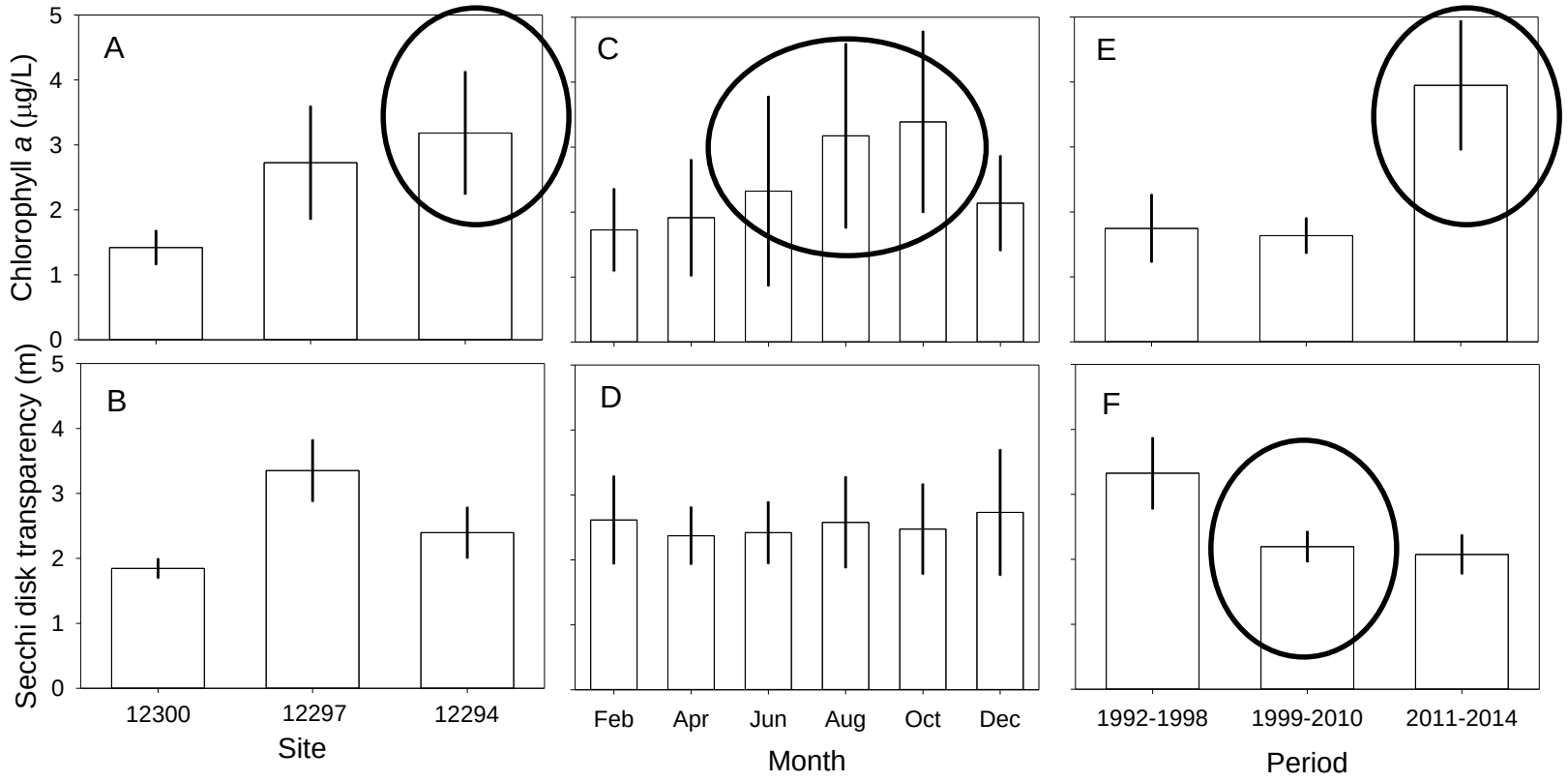
- Little longitudinal variability
- Seasonal and drought period patterns match Lake Travis hypolimnion

- Hydrologic changes impacted temperatures and stratification
  - Warmer
  - Stronger stratification
  - Thick, lower D.O. hypolimnion

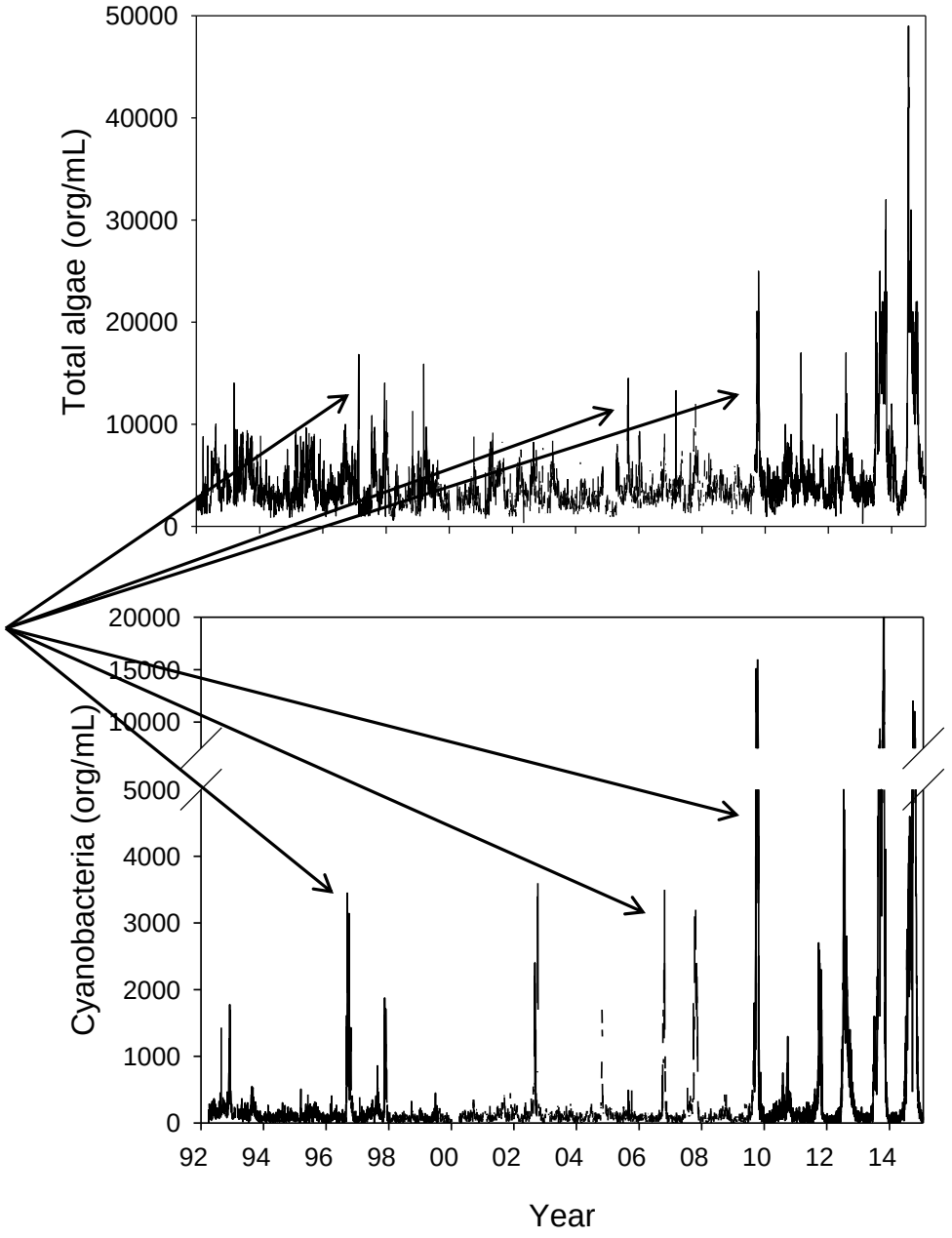


Biological responses

- Changes in algal biomass and clarity

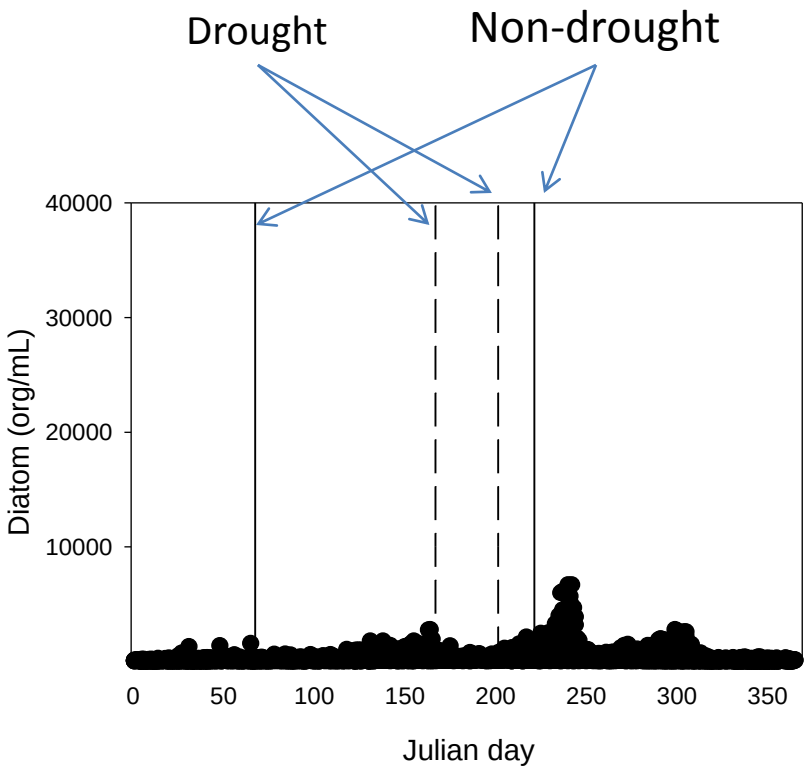


- Algal group temporal changes
  - Note the overlap in biomass spikes and drier years
  - And of course there is the drought period….

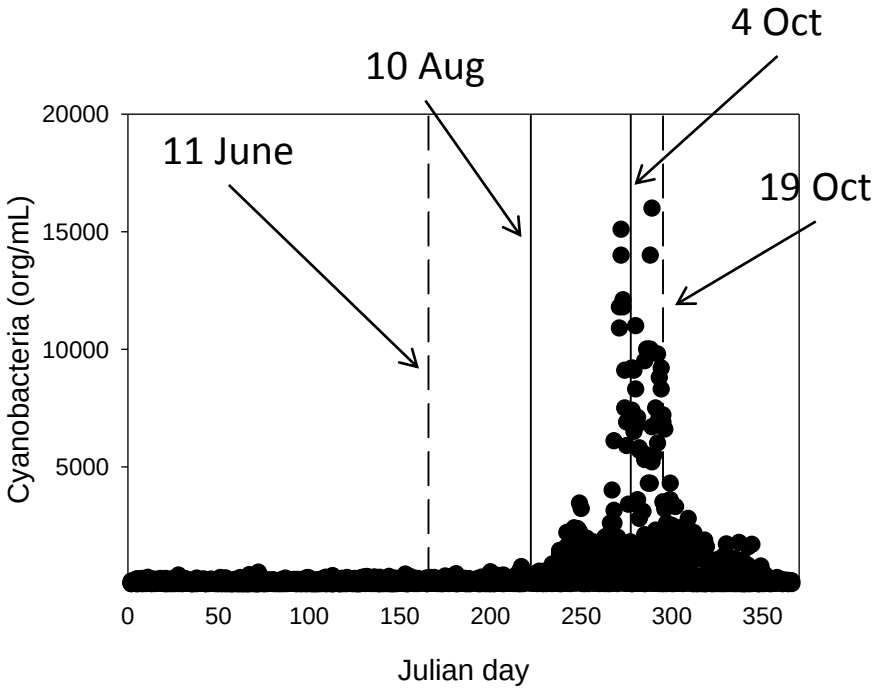


Let's throw some stats at the problem!

Change point analysis to estimate date of bloom initiation and peak



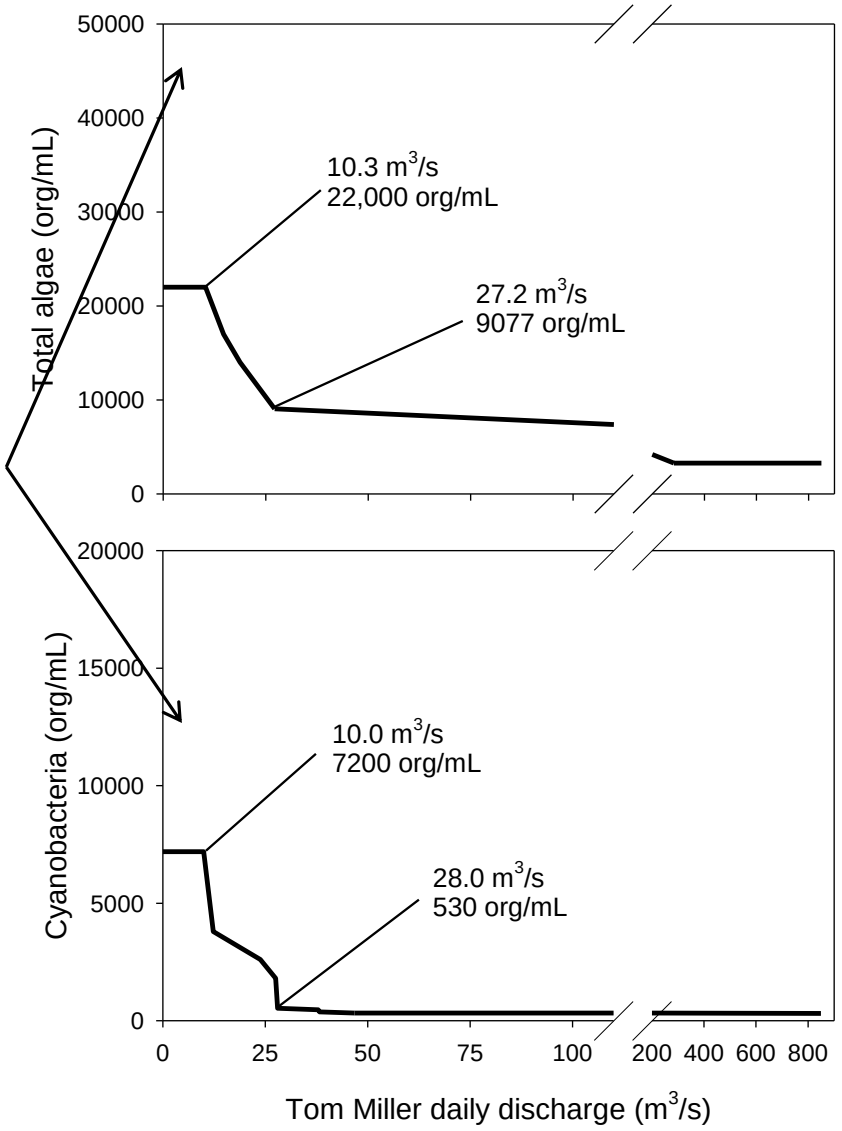
- Diatoms
  - Initiation: d 68 vs. d 167
  - Peak: d 222 vs. d 202
- Cyanobacteria
  - Initiation: d 222 vs. d 162
  - Peak: d 277 vs. d 292



Phyto-Discharge thresholds

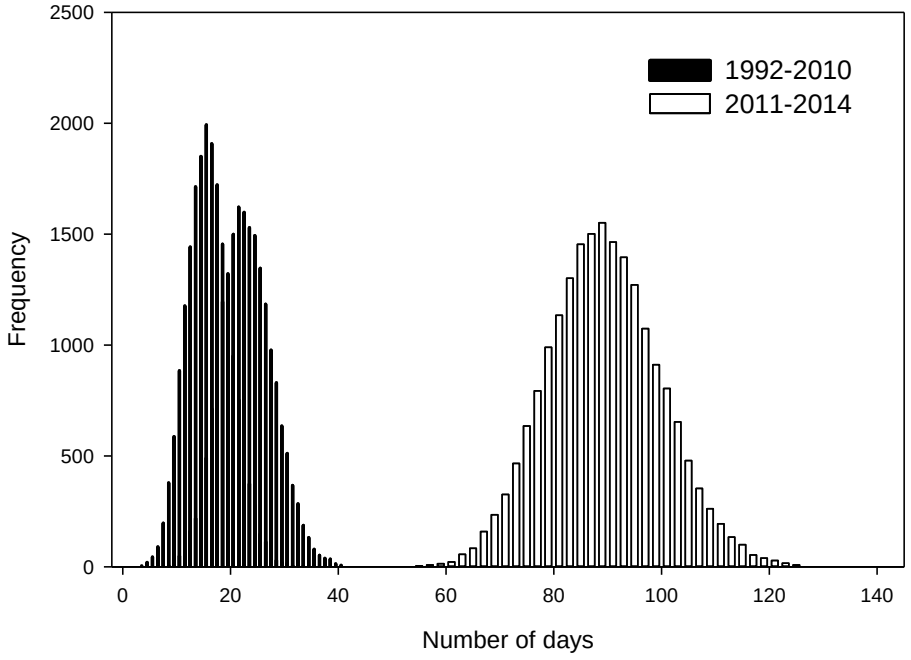
- AW reporting threshold relationships
  - Total algae >10,000 org/mL discharge <27 m^3/S
  - Cyanobacteria >300 org/mL discharge <47 m^3/s
  - Below 10 m^3/s largest bloom events

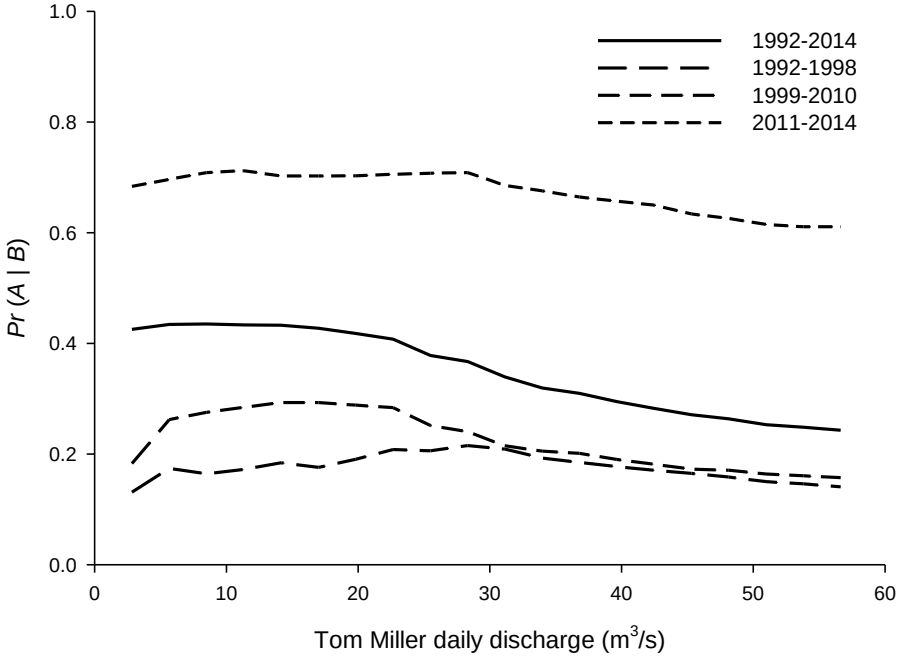
Largest blooms



Duration and probability of bloom days

- Estimated duration (days) of cyanobacteria blooms
- Estimated probability of cyano blooms given particular discharges

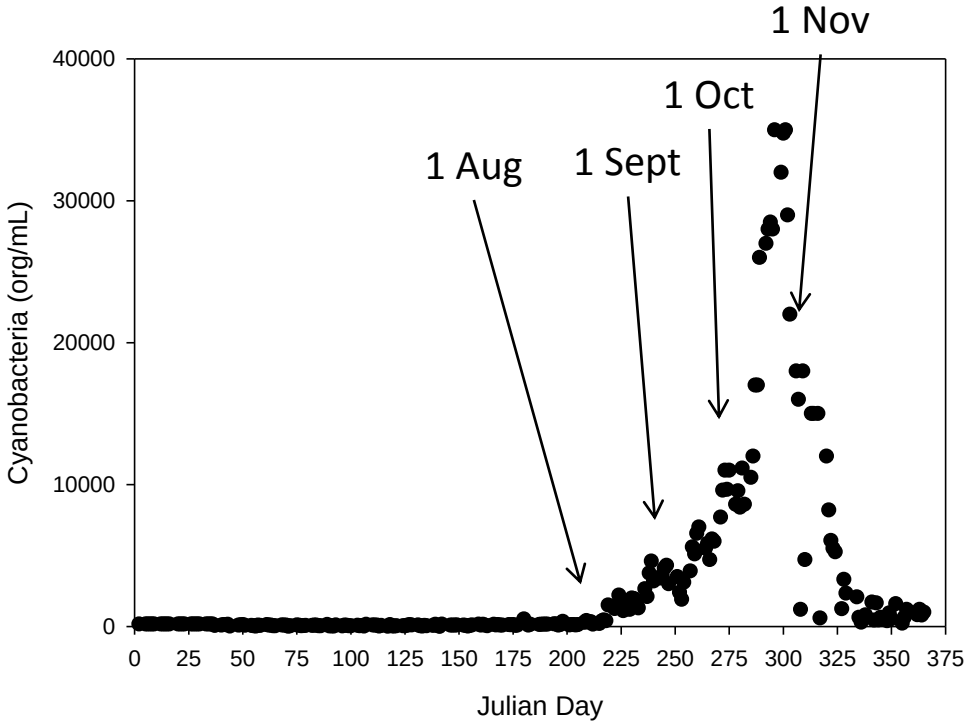




How did 2015 look?

- Monthly average discharges from Tom Miller Dam
  - May 12.1 m^3/s
  - June 2.3 m^3/s
  - July 1.0 m^3/s
  - August 2.1 m^3/s
  - September 0.7 m^3/s
  - October 8.0 m^3/s

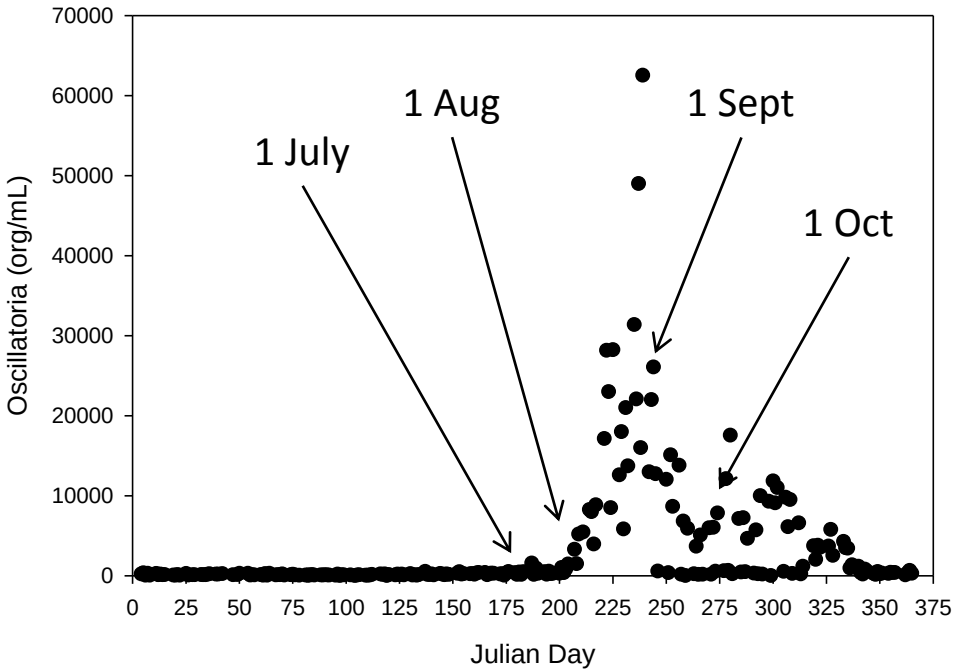
- 121 bloom days; peak biomass ~35,000 org/mL, d 296–300



What about 2016!

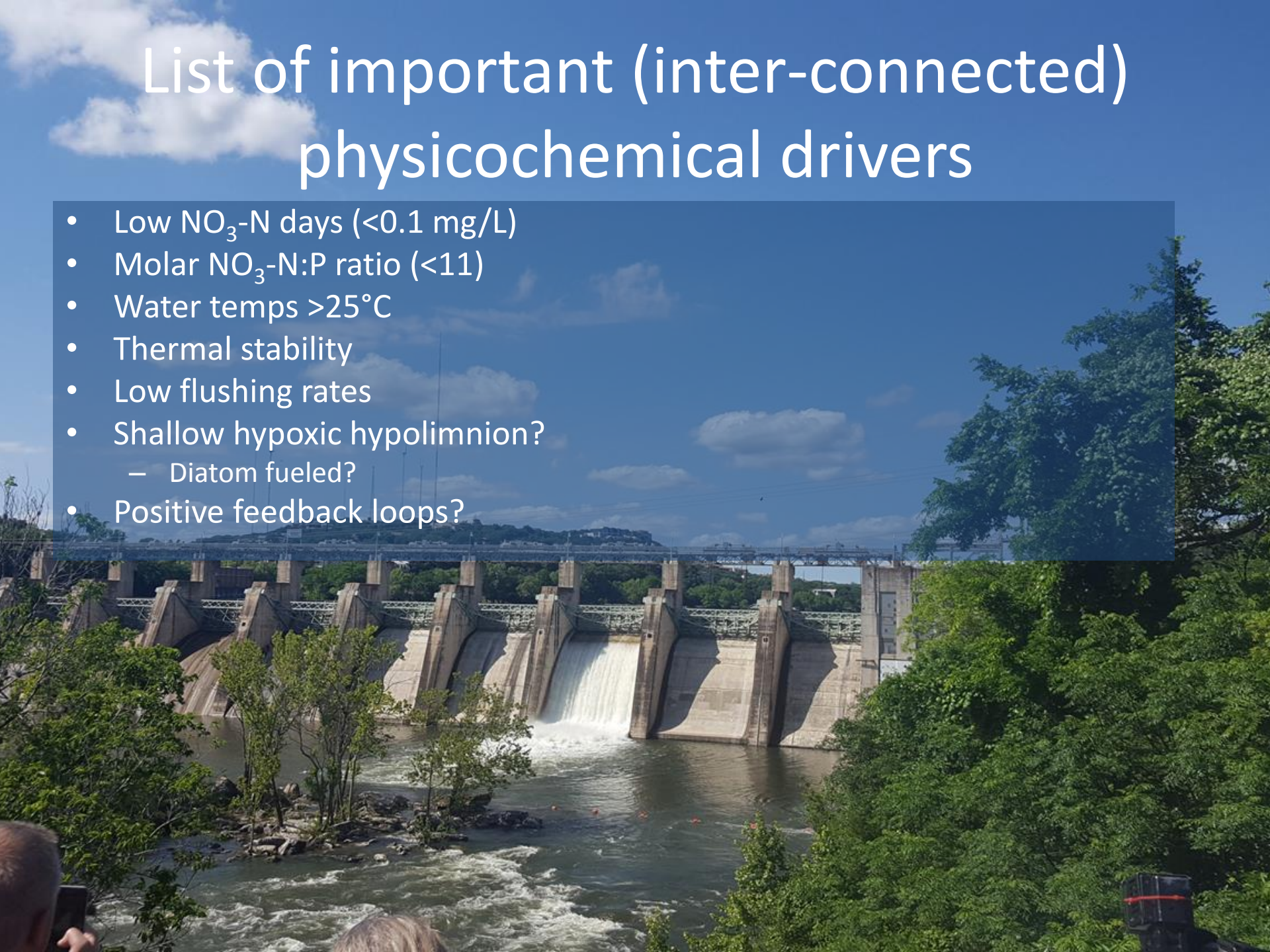
- Monthly average discharges from Tom Miller Dam
  - May 132.7 m^3/s
  - June 368.5 m^3/s
  - July 9.0 m^3/s
  - August 17.2 m^3/s
  - September 7.4 m^3/s
  - October 11.7 m^3/s

- 106 bloom days; peak biomass >60,000 org/mL; d 239??



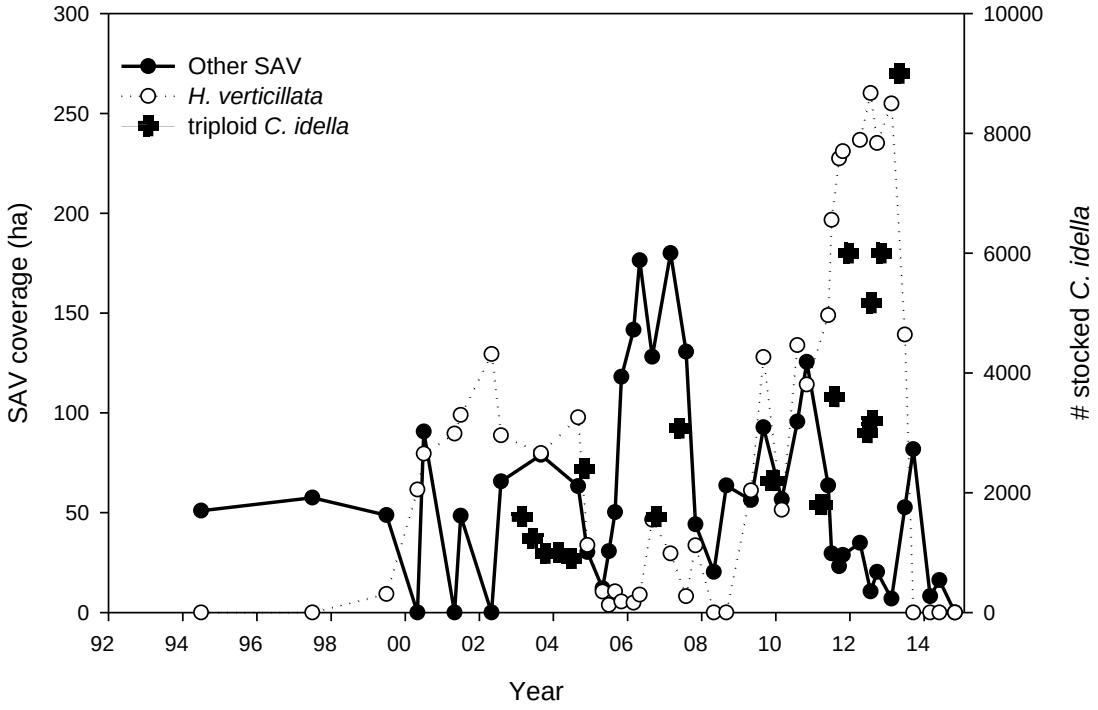
List of important (inter-connected) physicochemical drivers

- Low NO_3-N days (<0.1 mg/L)
- Molar NO_3-N:P ratio (<11)
- Water temps >25°C
- Thermal stability
- Low flushing rates
- Shallow hypoxic hypolimnion?
  - Diatom fueled?
- Positive feedback loops?



Back to vegetation

- What about that loss of SAV?
  - Observing alternative stable state?
- SAV generally limited to upper reservoir; large bloom events occurred regardless of SAV extent
- Clarity throughout reservoir likely suffering due to lack of veg, grass carp activities



Upside-downside

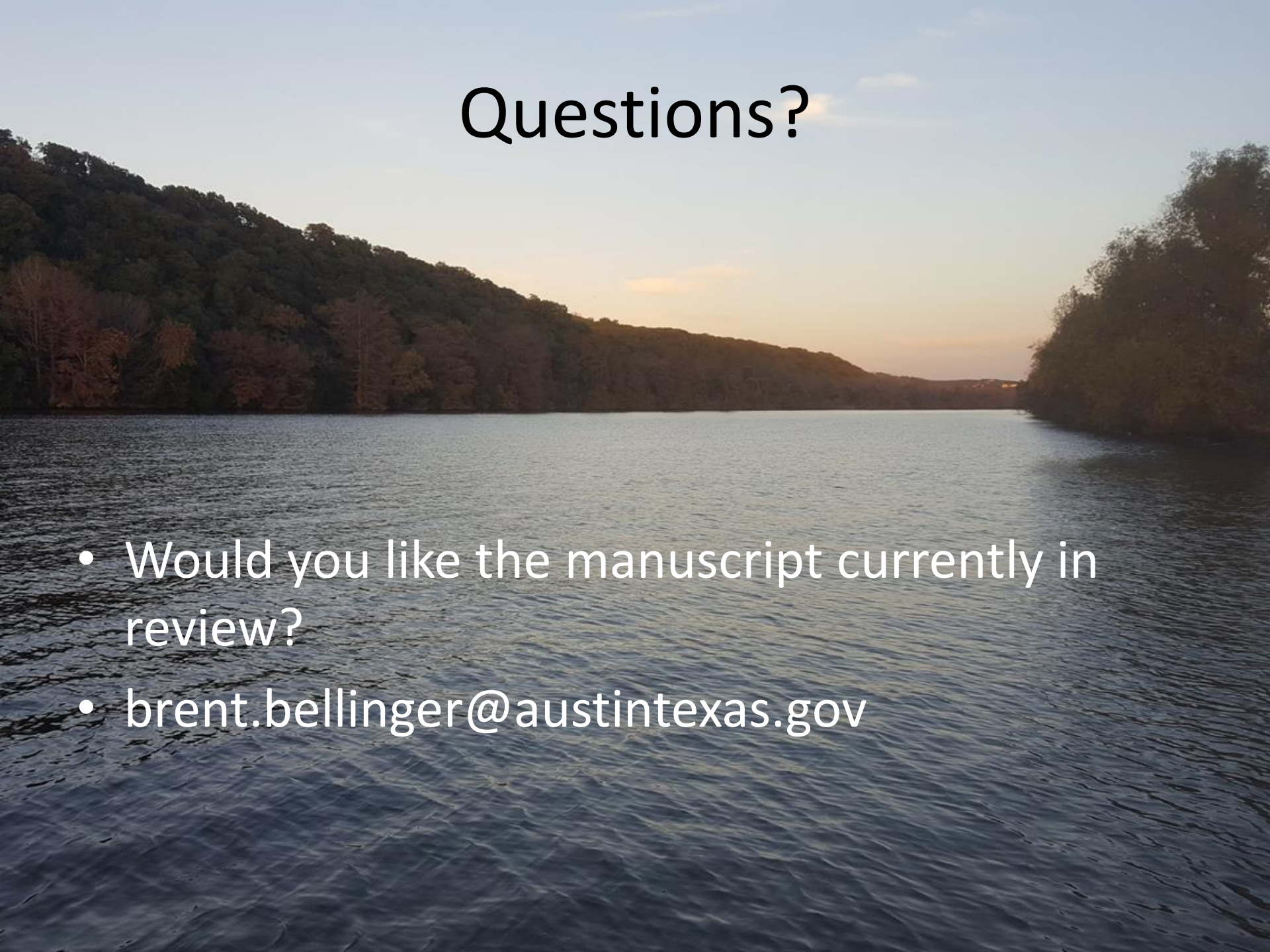
- Despite cyano blooms exceeding 20,000 org/mL (WHO says this is when things can get bad), no toxins have been detected
  - I hypothesize that this is due to P-limitations in Lake Austin
  - What if nutrient (P) loading to the Highland Lakes increases?
  - And, increased treatments/screening needed by AW(?) due to threshold exceedances

- We now have a means of reducing phytoplankton blooms!
  - If water is available and being pushed
  - New reservoirs in lower basin….

Upcoming work

- High frequency monitoring of nitrate, ammonium, temperature
- One more season of screening for cyanotoxins
- Model development with new data

Questions?



- Would you like the manuscript currently in review?
- brent.bellinger@austintexas.gov