Drought and water quality in San Francisco Estuary

P. Lehman
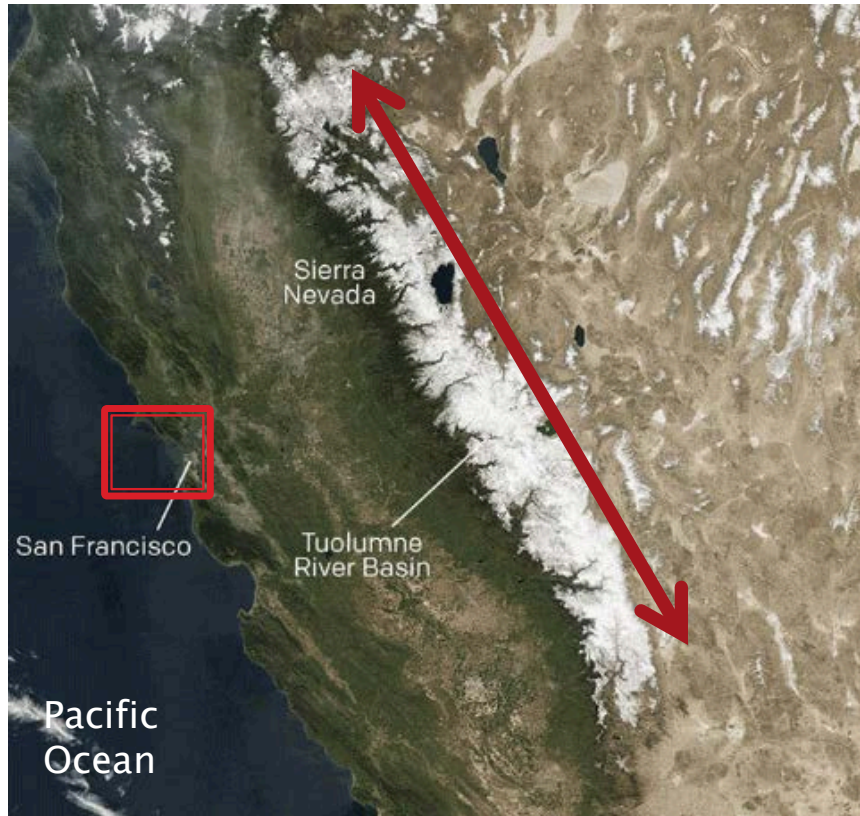### CA Department of Fish and Wildlife

Collaborators:
T. Kurobe, S. Acuna, C. Kendall, S. Lesmeister, K. Ger, S. J. Teh
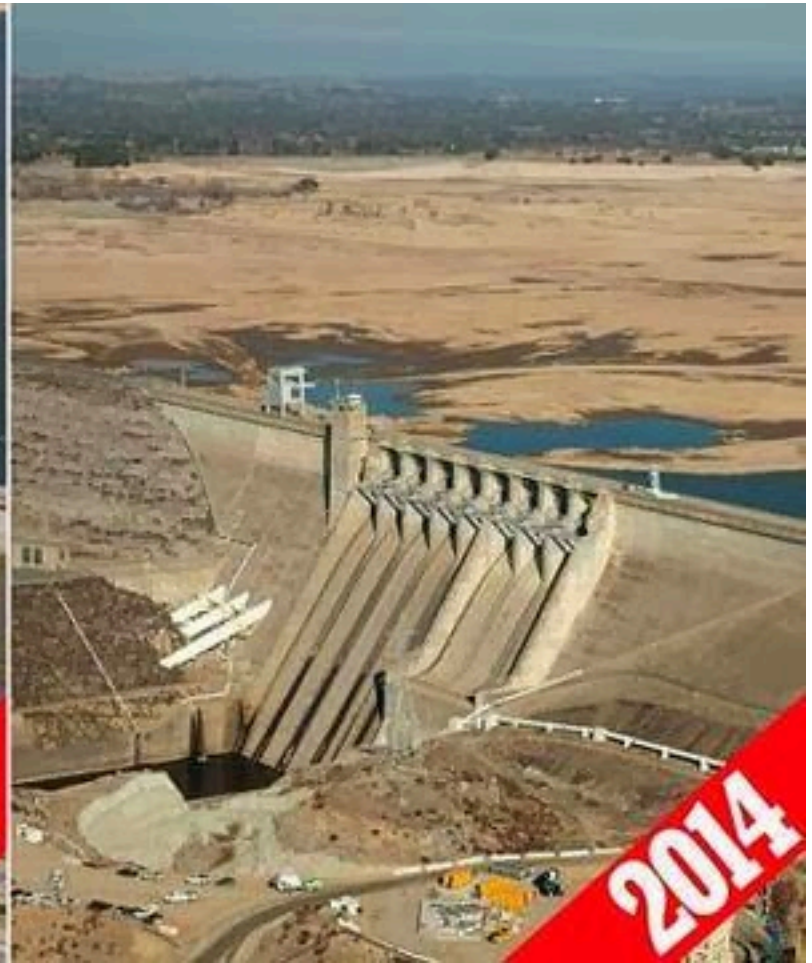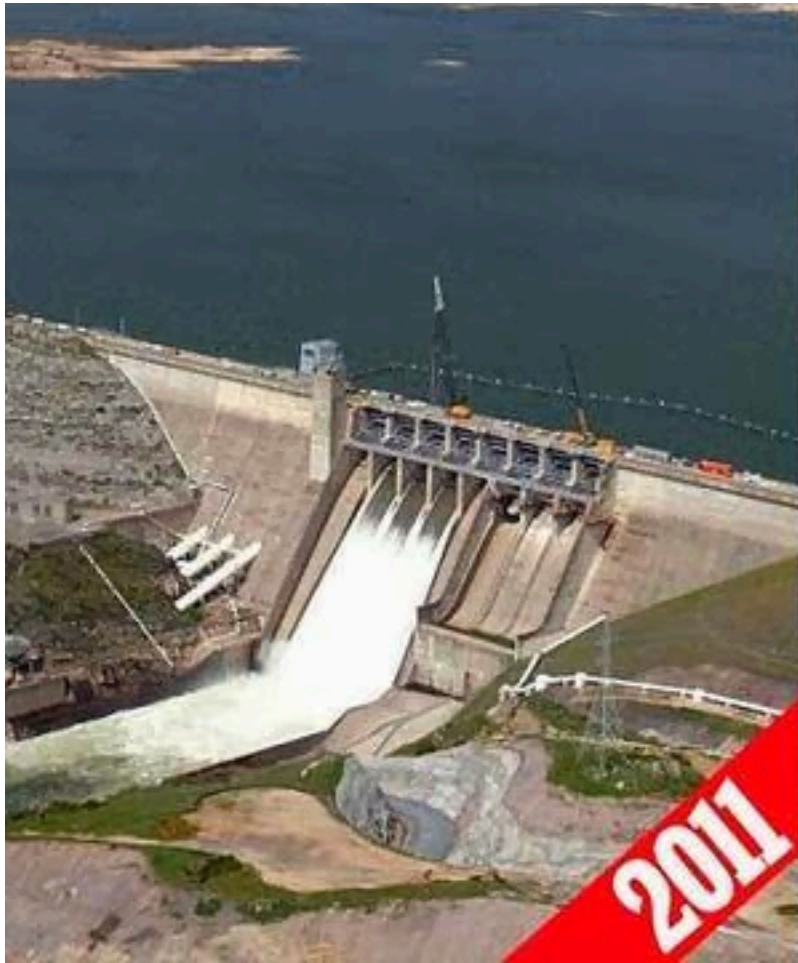
Drought and the Delta 2016
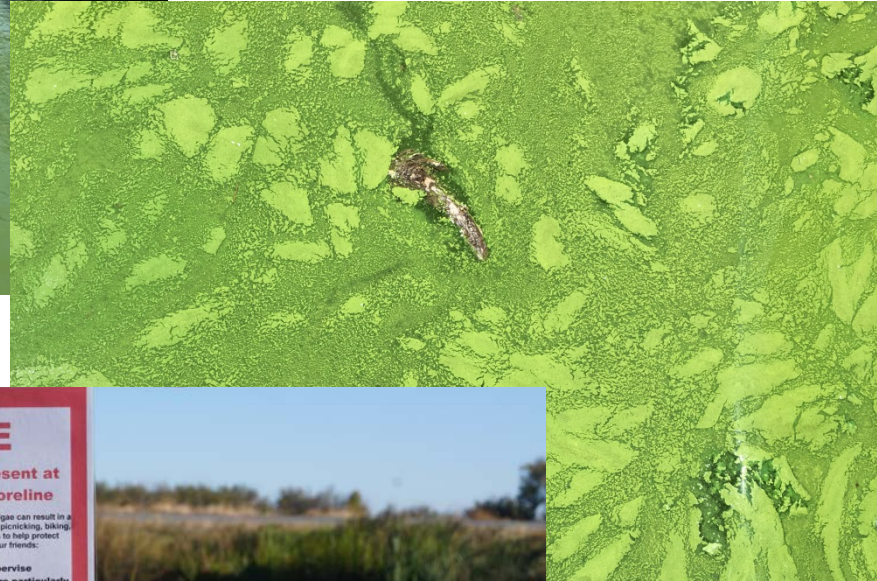
Drought in California

March 27, 2010

March 29, 2015

Folsom Lake

Cyanobacteria blooms

Microcystis

- Colonial cyanobacterium (blue-green algae)
- Diameter 6 to 50,000 µm
- Cells contain microcystins that promote liver cancer
- Cell wall contains lipopolysaccharides

Delta

- Blooms began 1999 in Delta
- Peak biomass in August and September
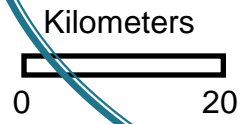- Vertically migrates daily to surface

distribution

California

Sacramento River
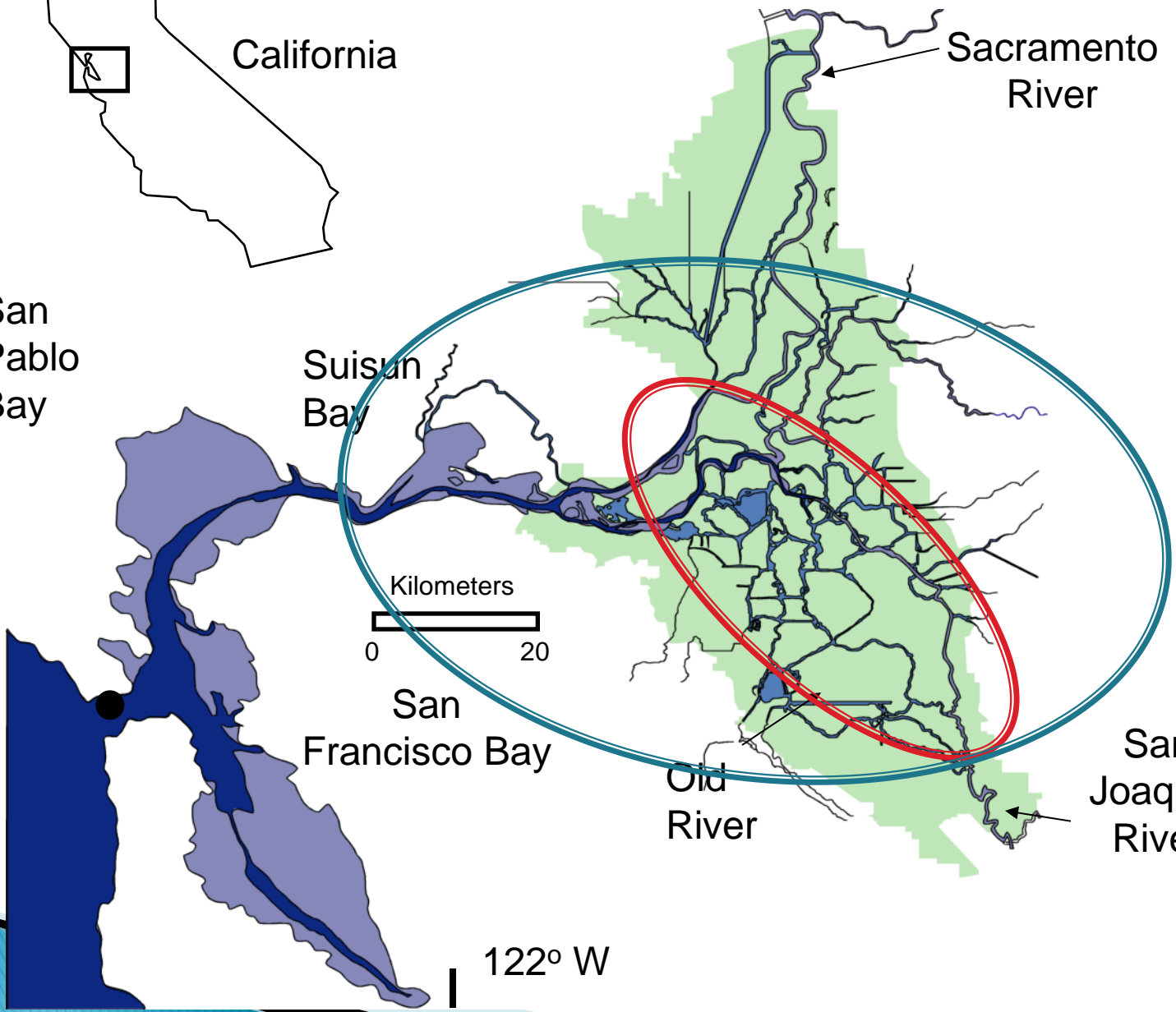
San Pablo Bay

Suisun Bay

Kilometers
0   20

San Francisco Bay

Old River

San Joaquin River

122° W

N

Biomass & toxin concentration
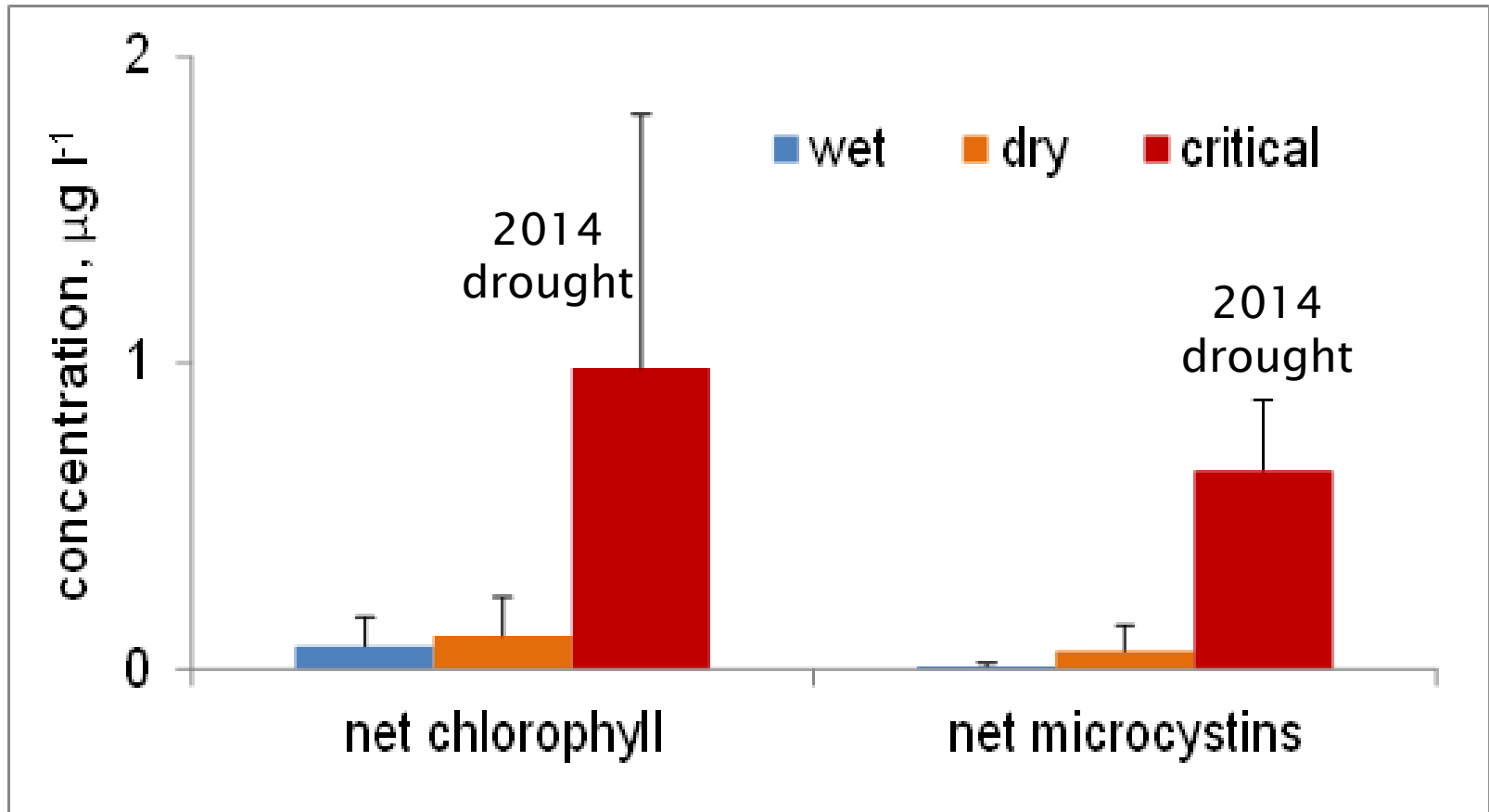
Wet: 2004–2005
Dry: 2007–2008

toxin concentration
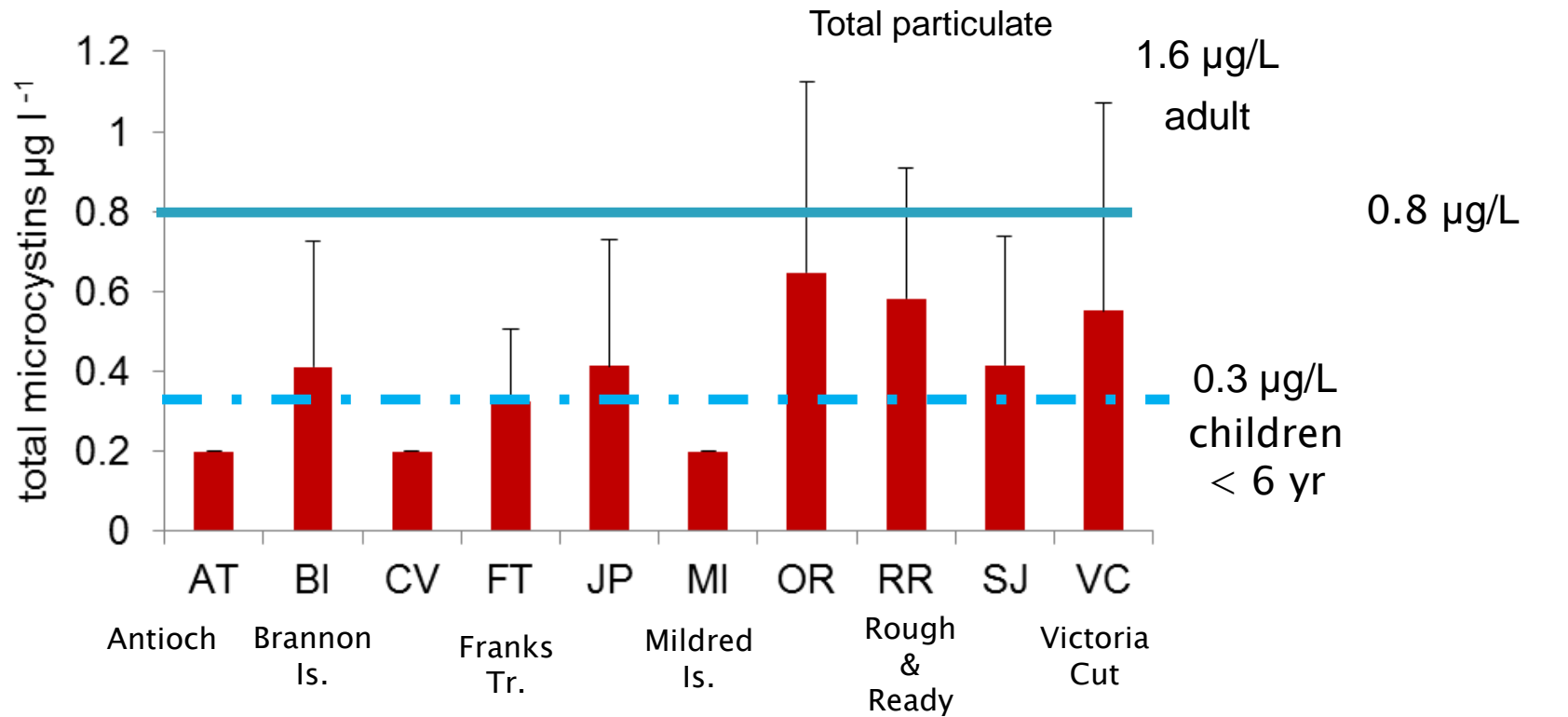
Integrated
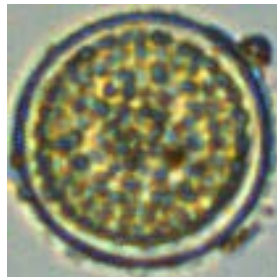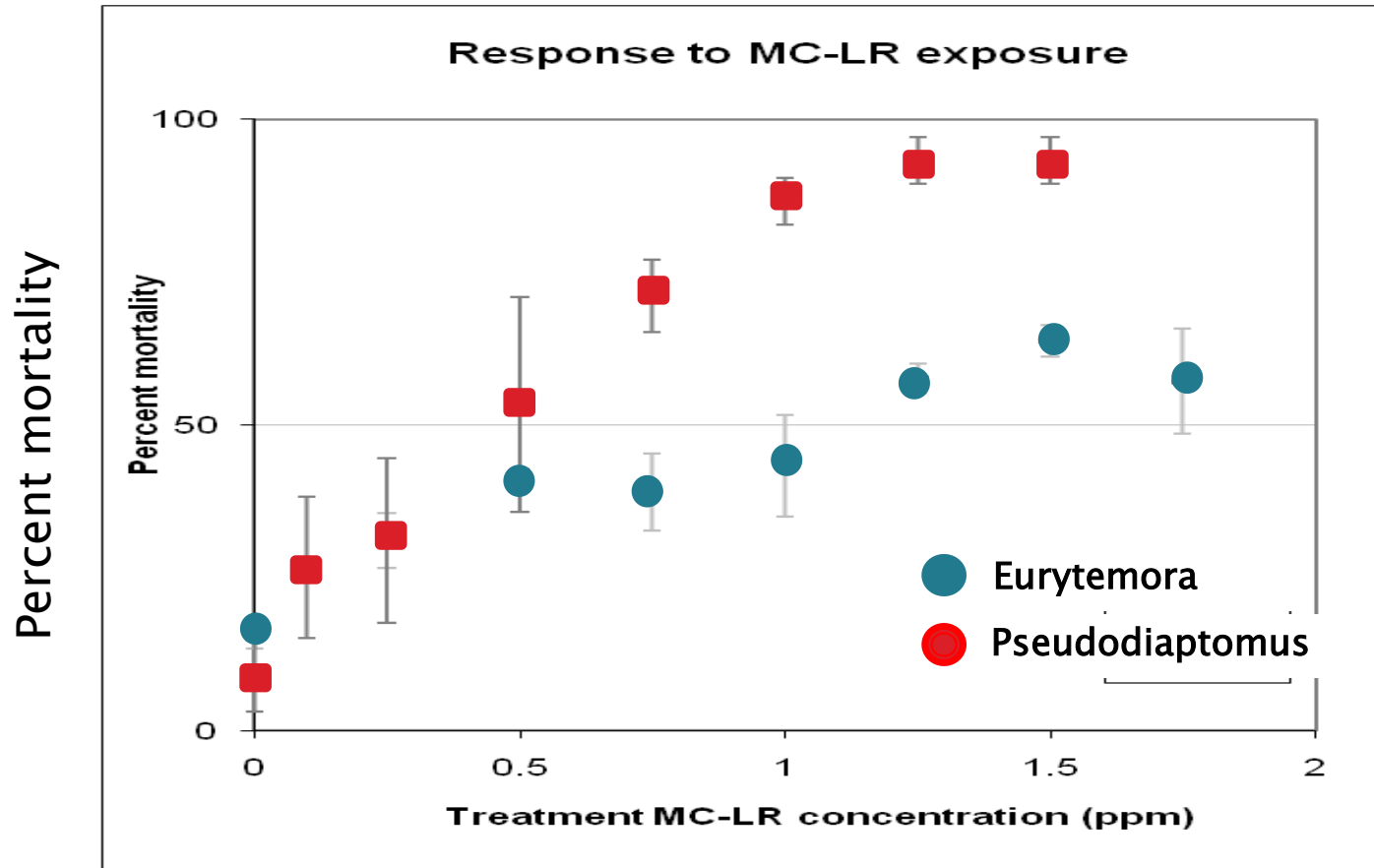surface sample

Biological Impacts
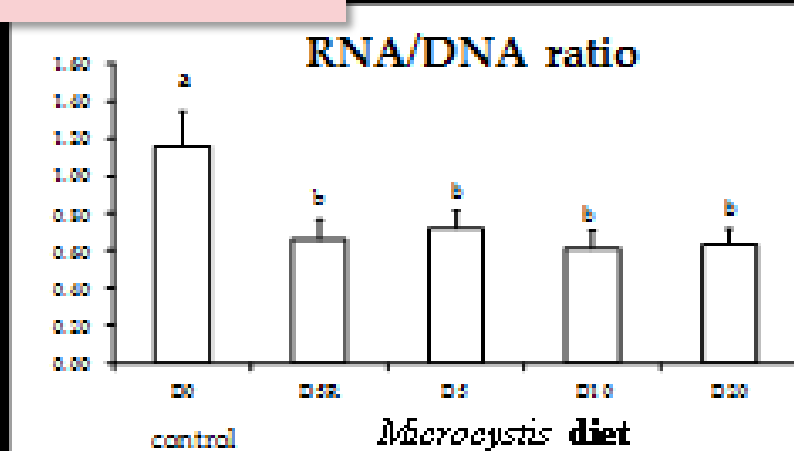
- Phytoplankton community composition

- Zooplankton composition and survival
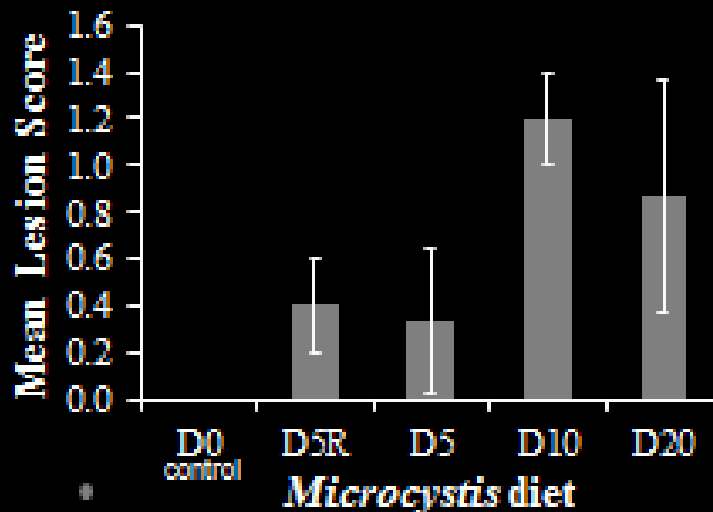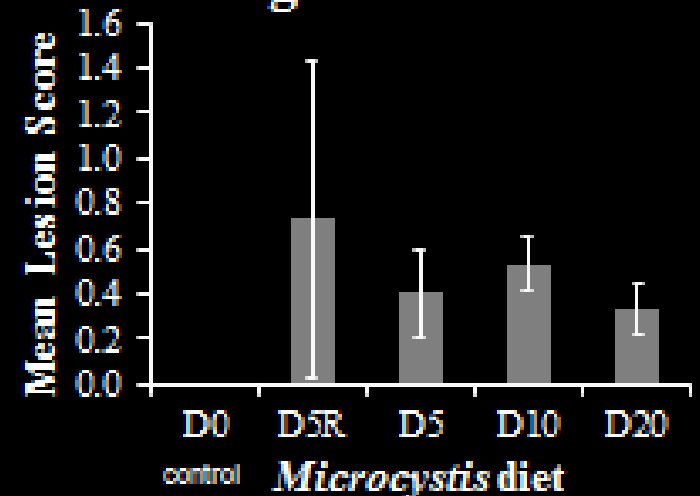
- Fish health and survival
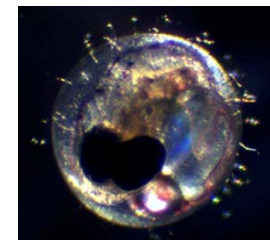
Lehman et al. 2010; Ger et al. 2009; Acuna et al. 2012; Kurobe et al. in prep

zooplankton survival

Ger et al. 2010

Fish health
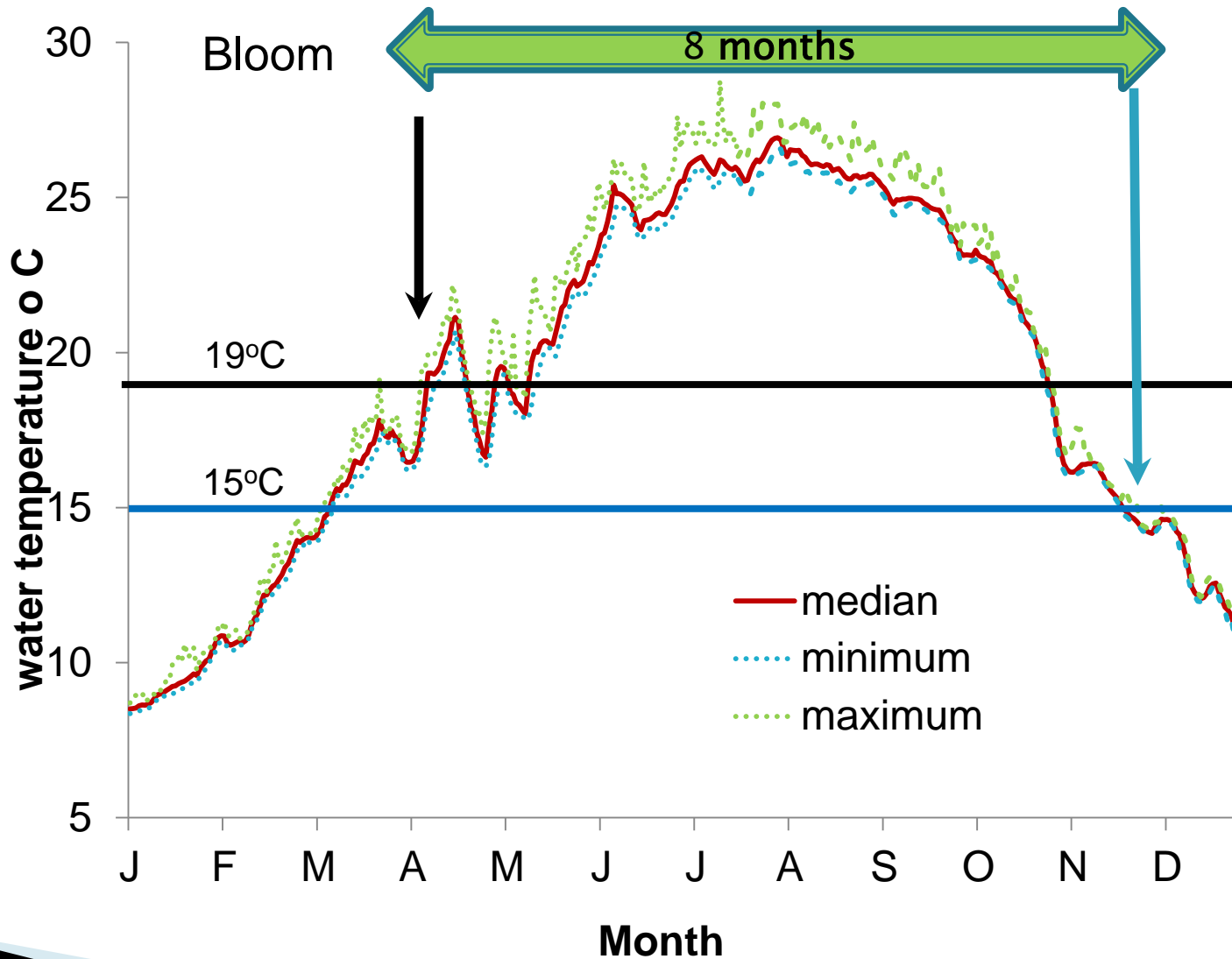

Acuna et al. 2012

toxic bluegreen algae

Lehman et al. in review
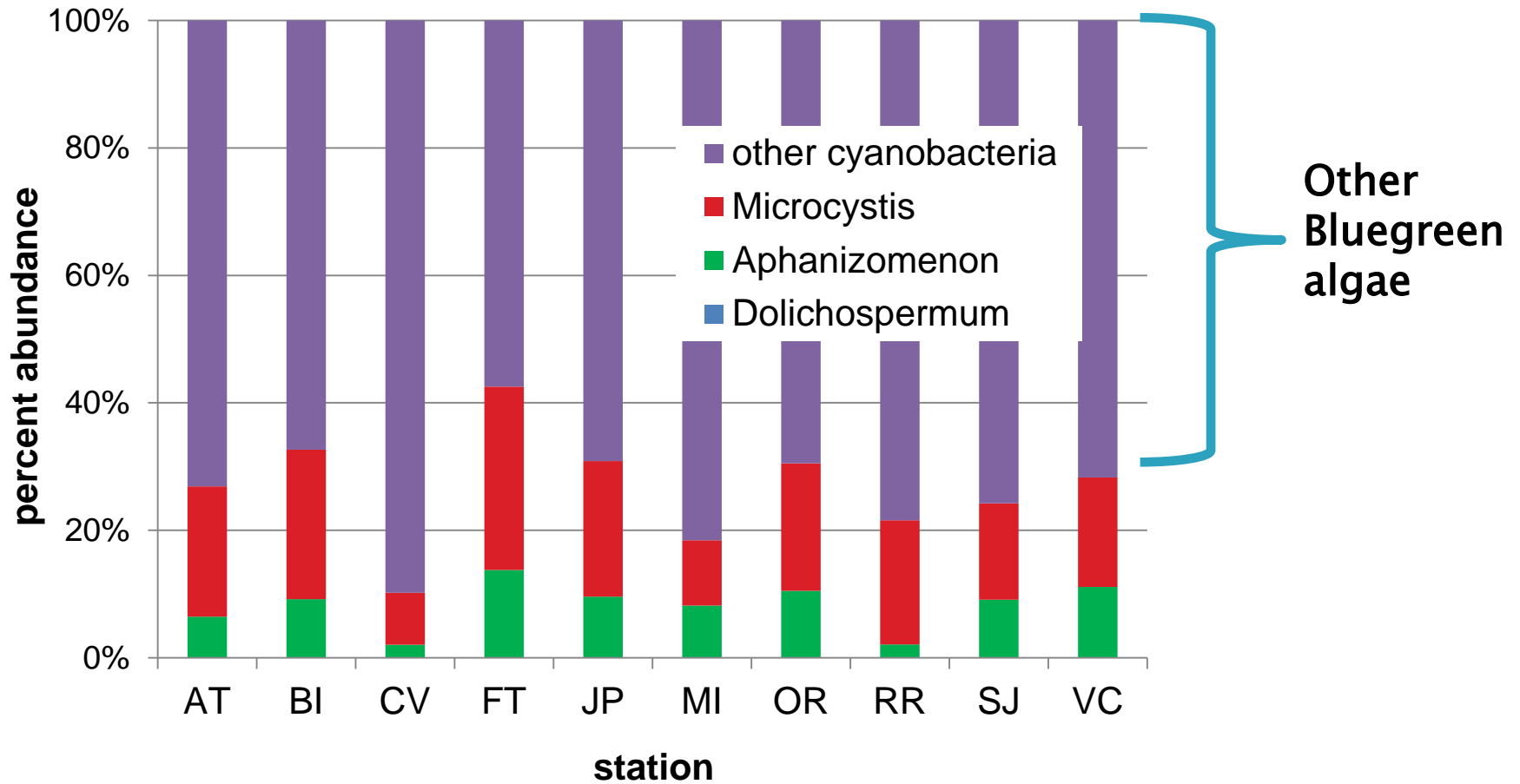
Environmental factors
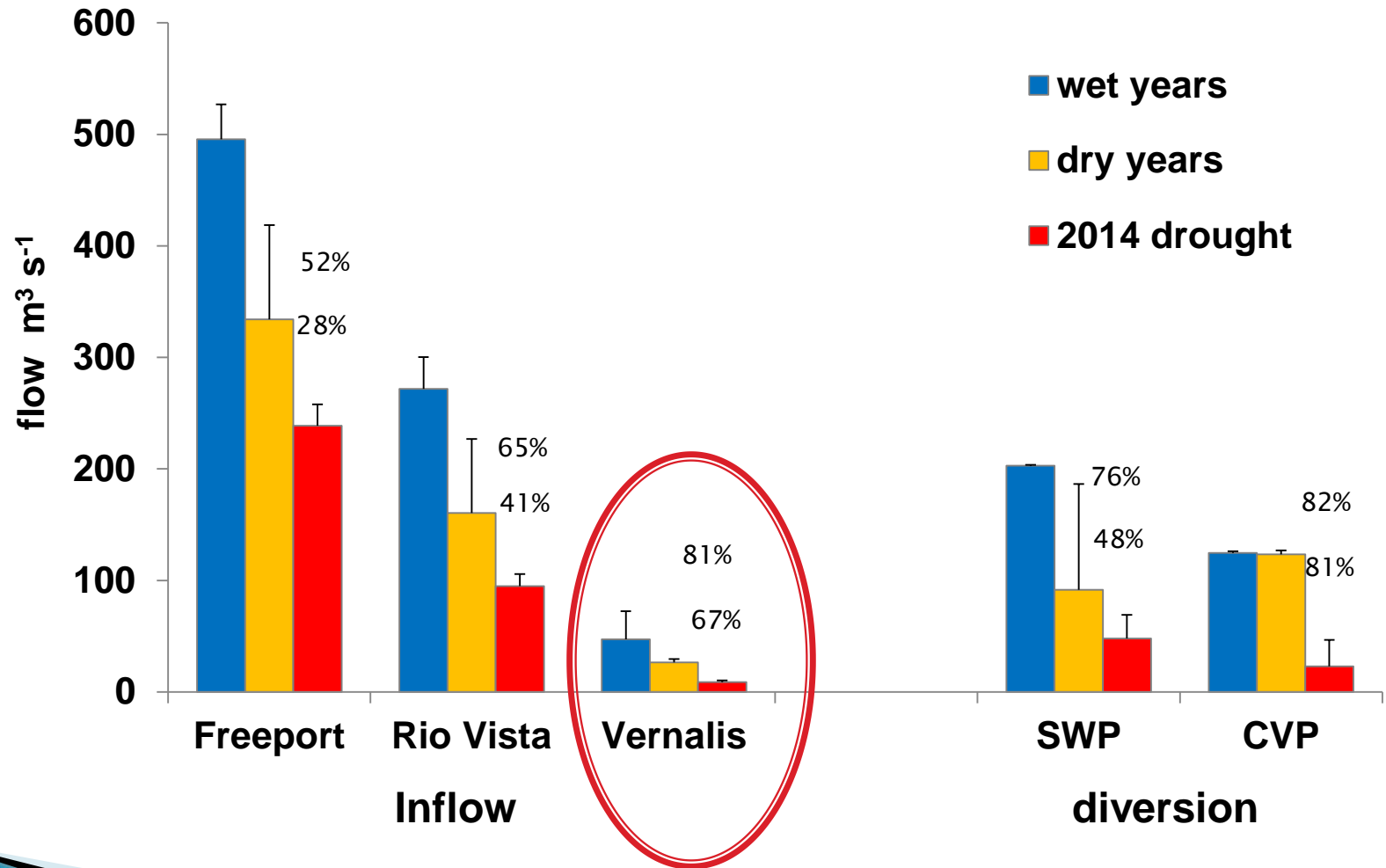
- ✓ Warm water temperature >18ºC

- ✓ High residence time

- ✓ High nutrient concentration, particularly ammonium

- ✓ High light intensity

- ✓ Low turbulence – stratification
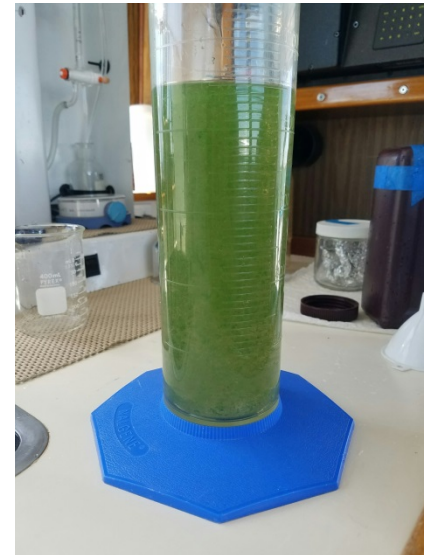
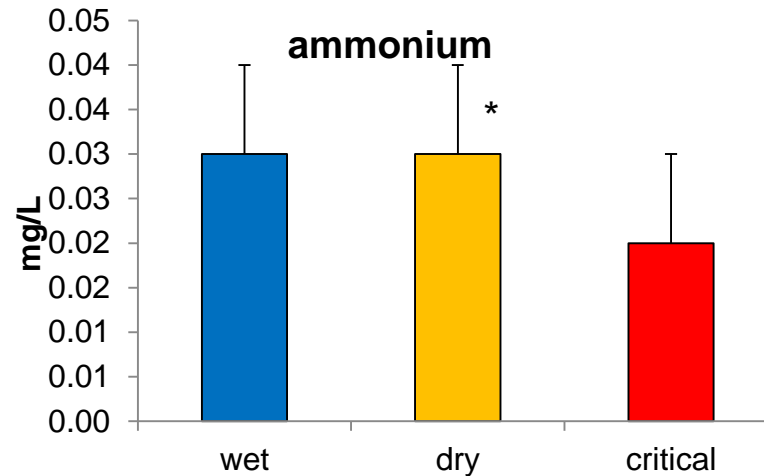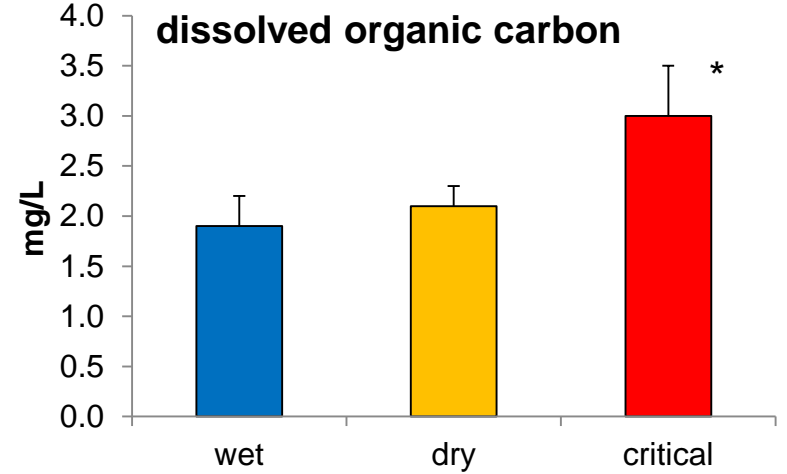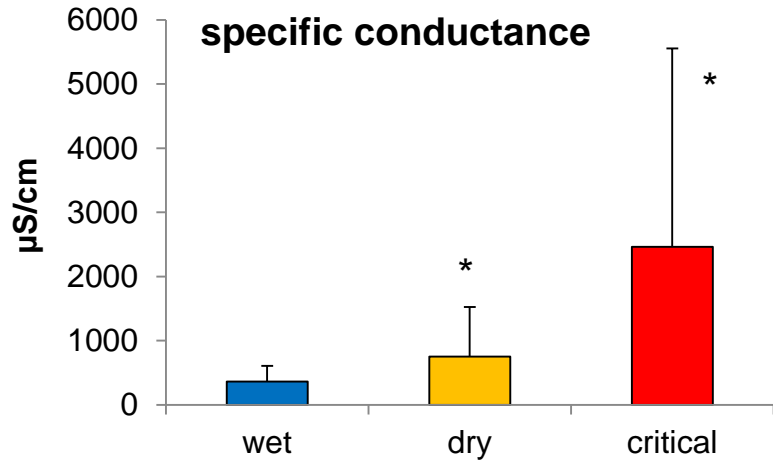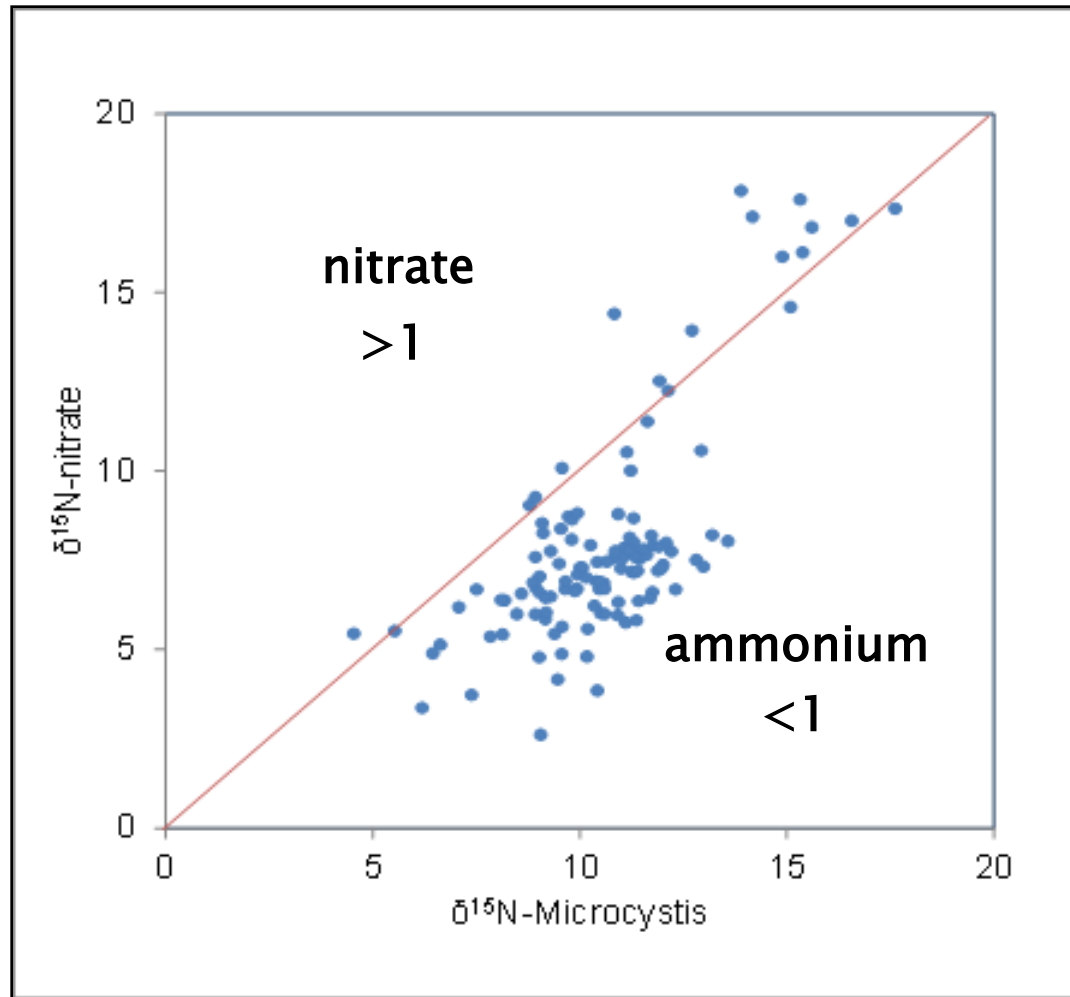# Water temperature

Residence time

Physical and chemical

ammonium

Lehman et al. 2015

Soluble reactive phosphorus
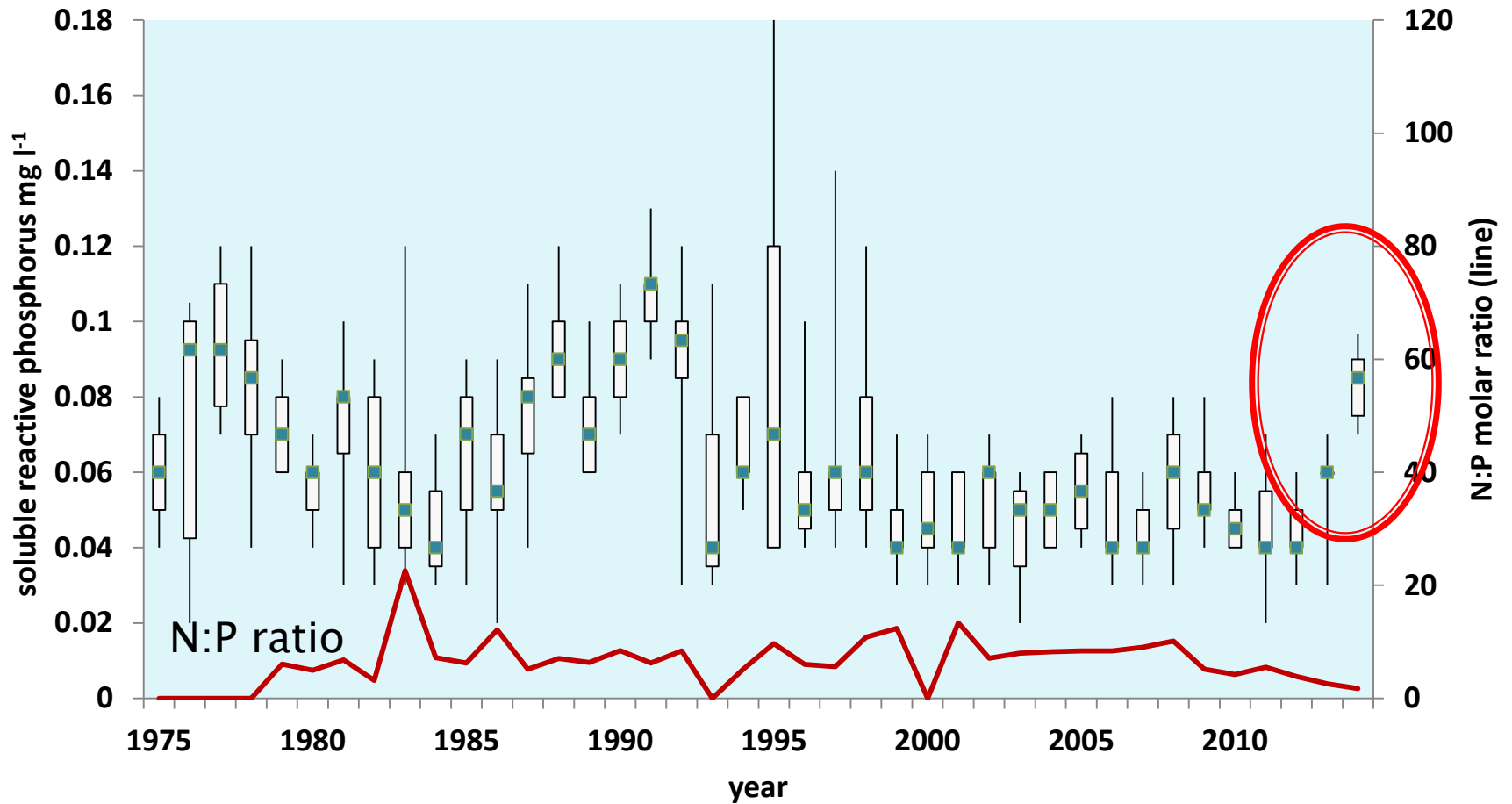
Old River

Drought

Water temperature	Salinity	Residence time	Nutrients	Mixing

Cyanobacteria blooms

Toxins

Biomass

Toxins

Foodweb

Humans
Drinking water
recreation
aesthetics

Wildlife
Health
growth & survival
species composition

Questions?