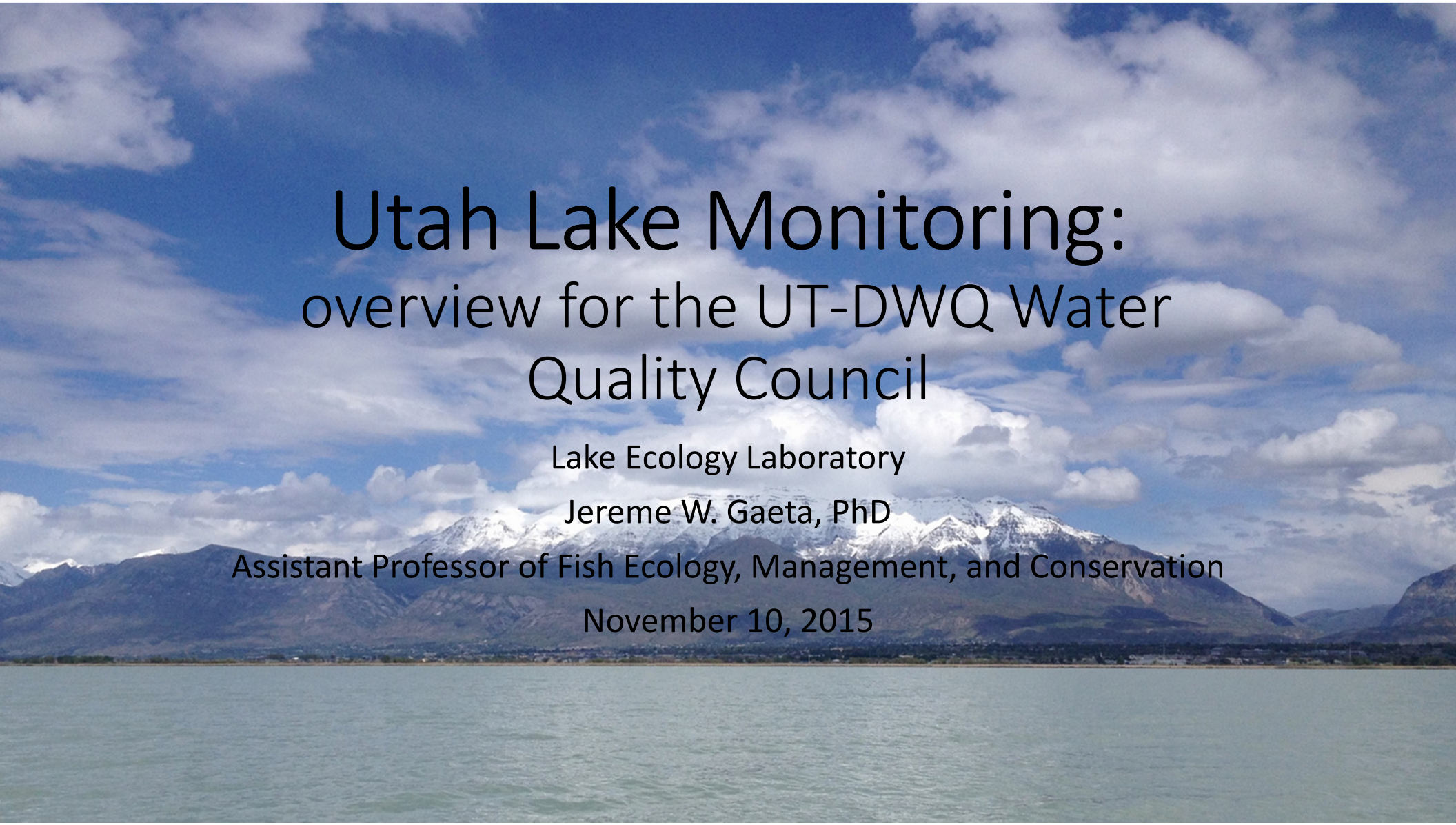


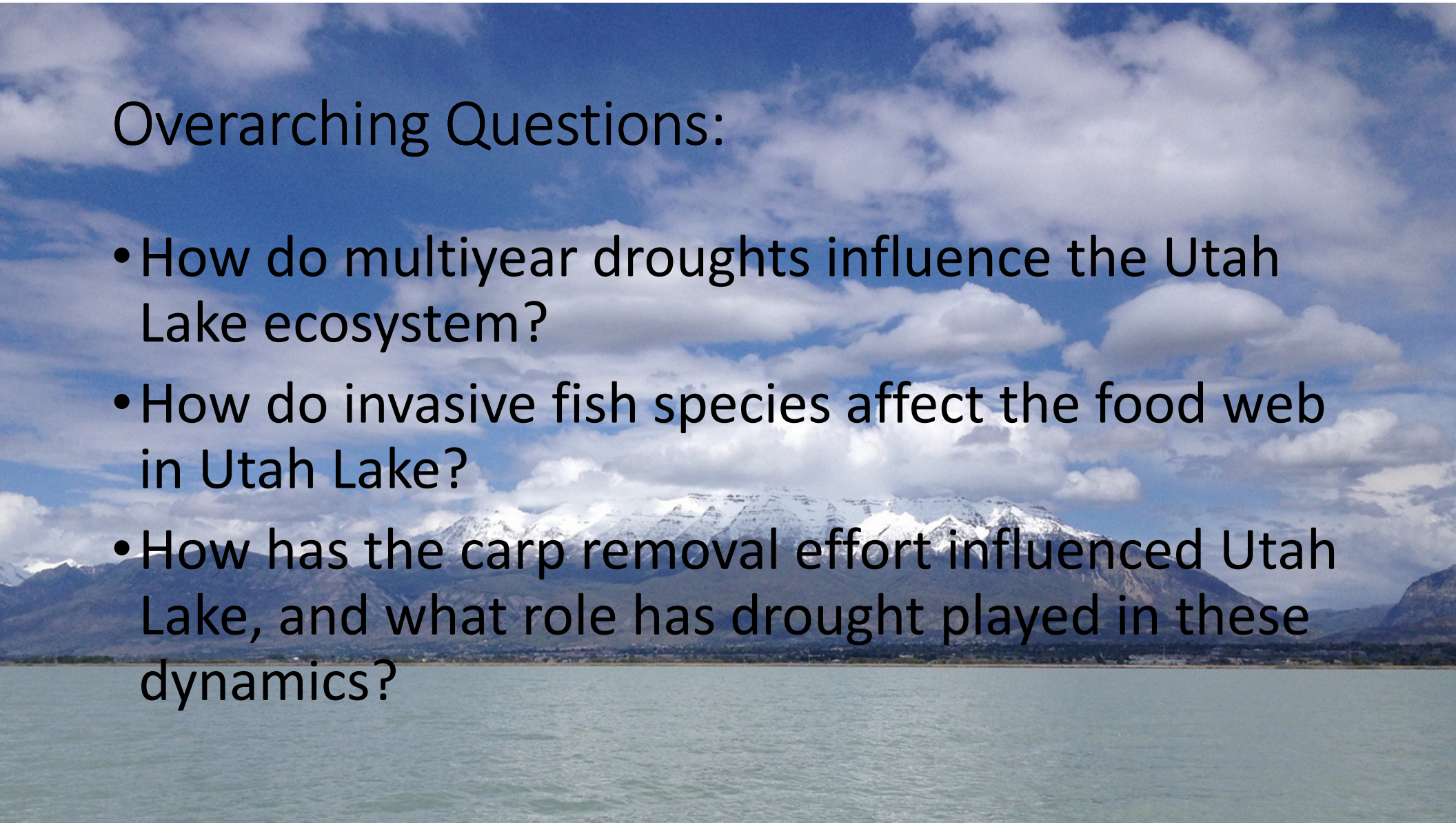
Utah Lake Monitoring:
overview for the UT-DWQ Water Quality Council

Lake Ecology Laboratory

Jereme W. Gaeta, PhD

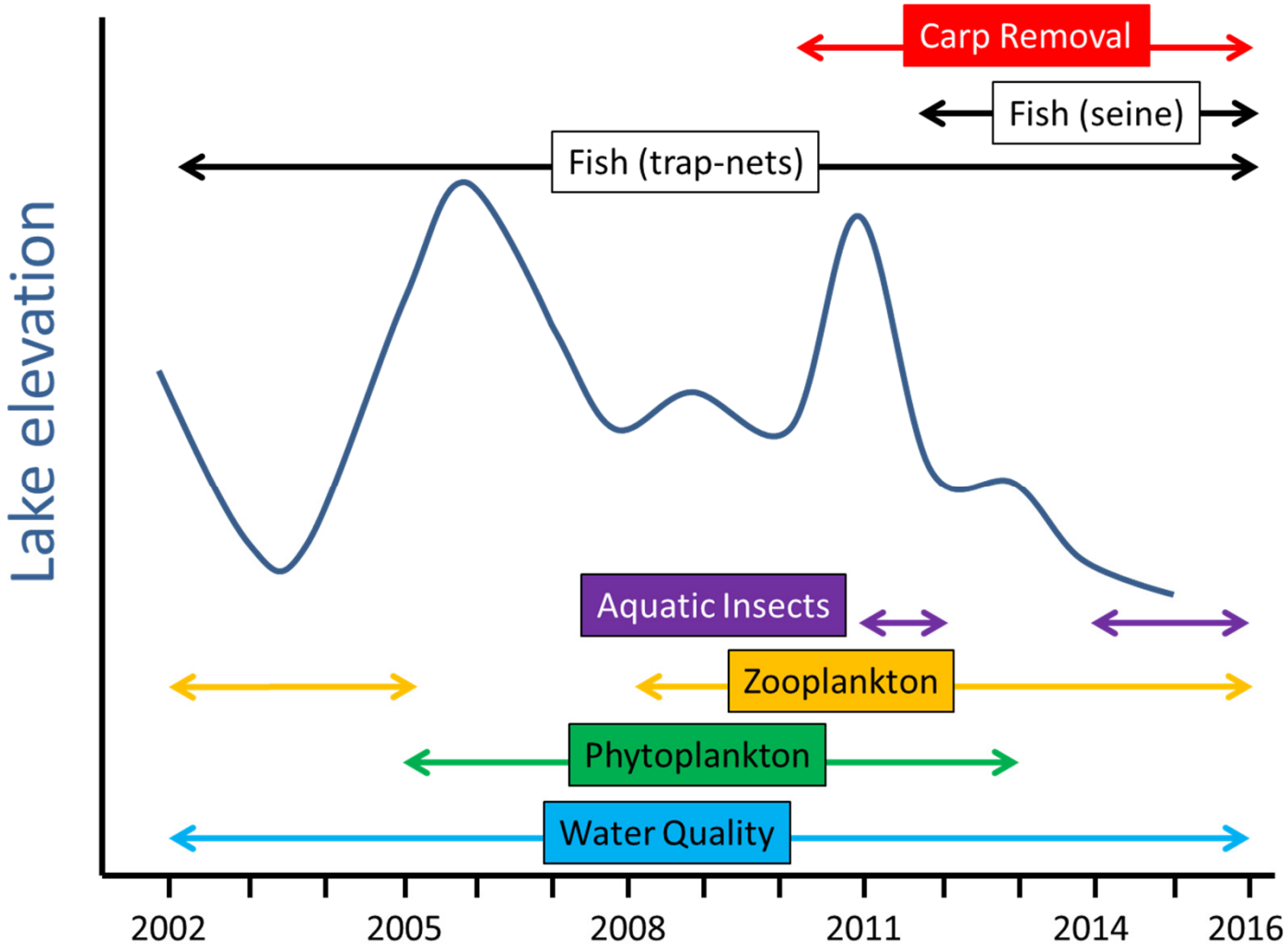
Assistant Professor of Fish Ecology, Management, and Conservation

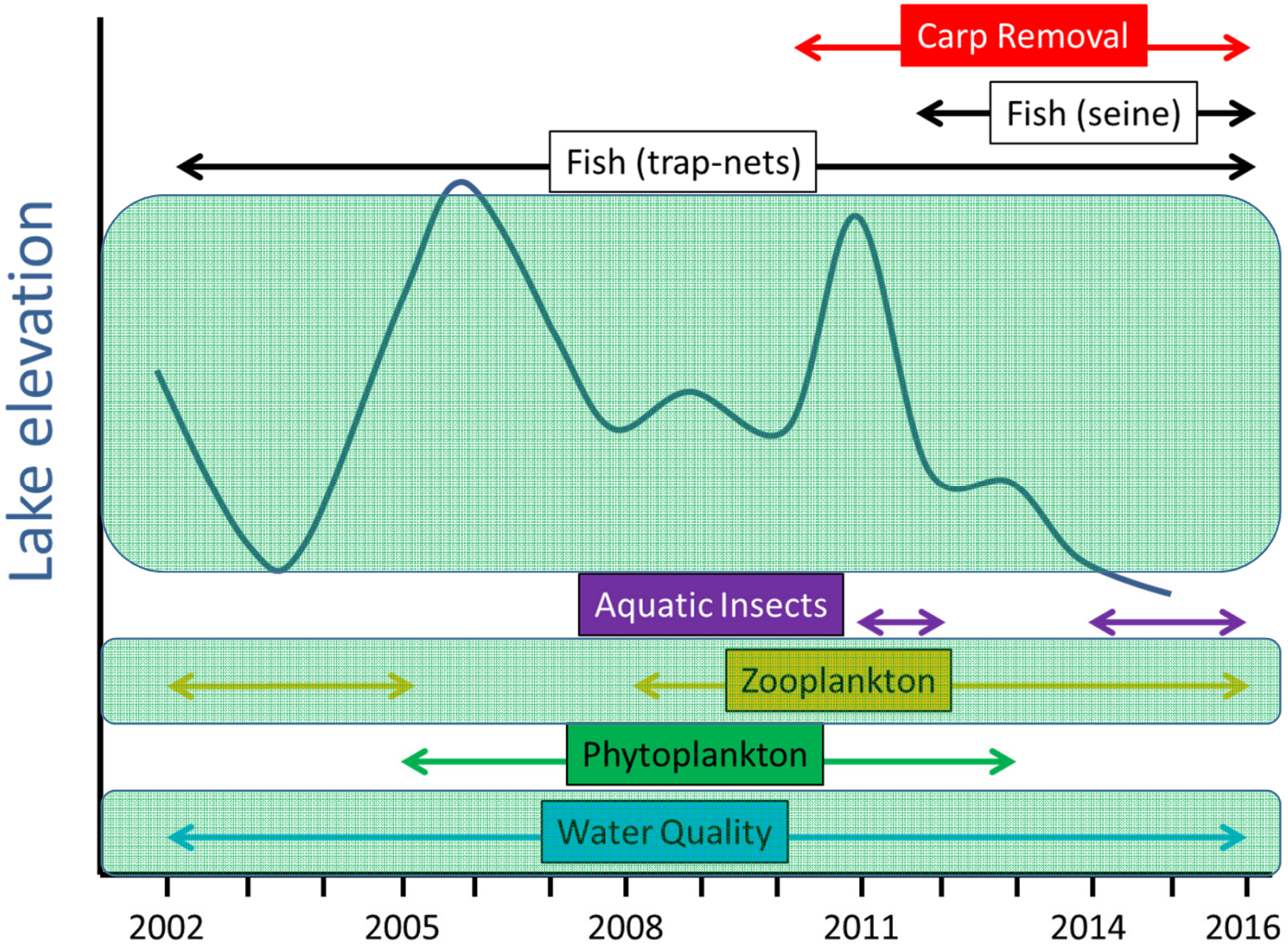
November 10, 2015

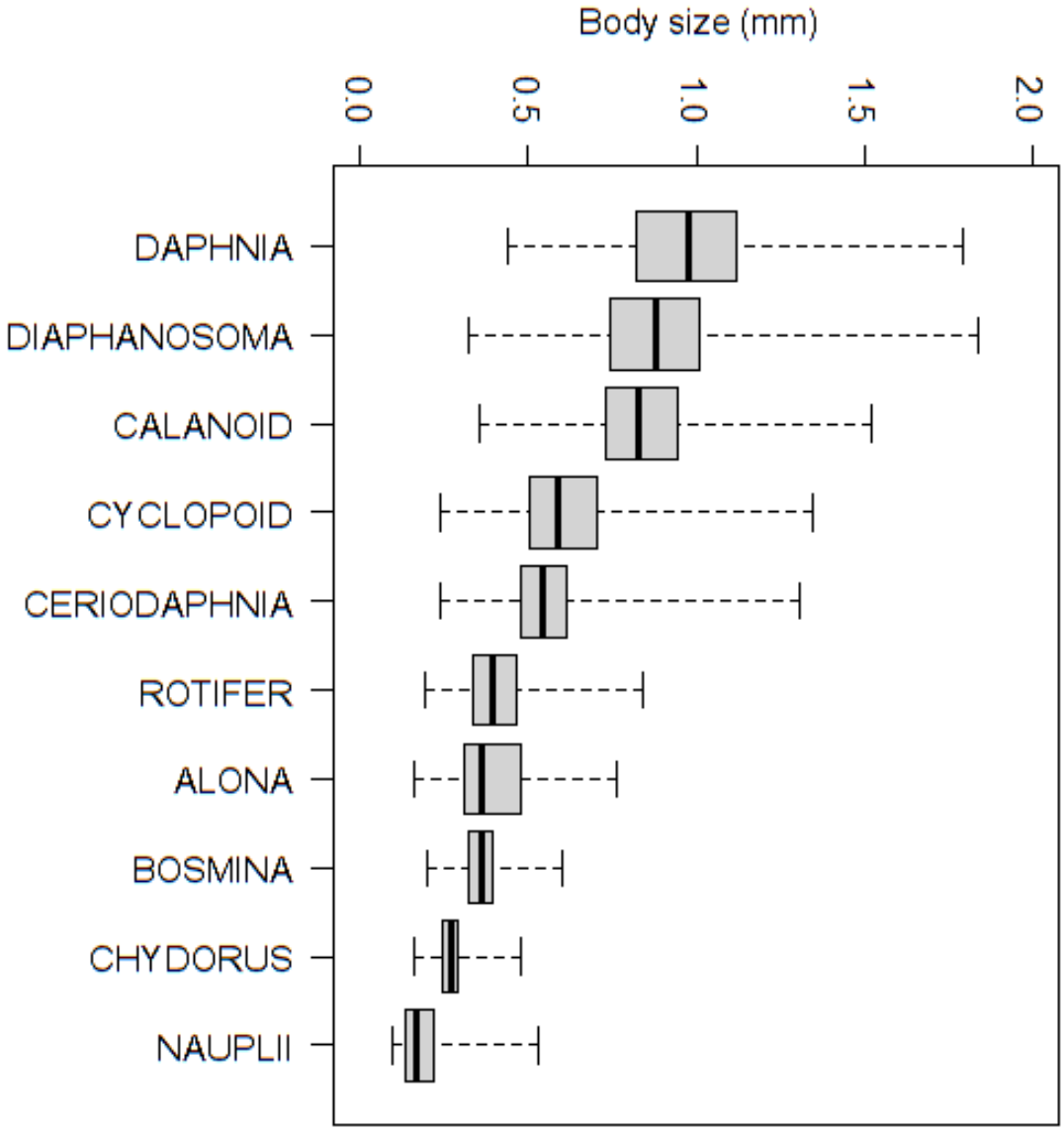


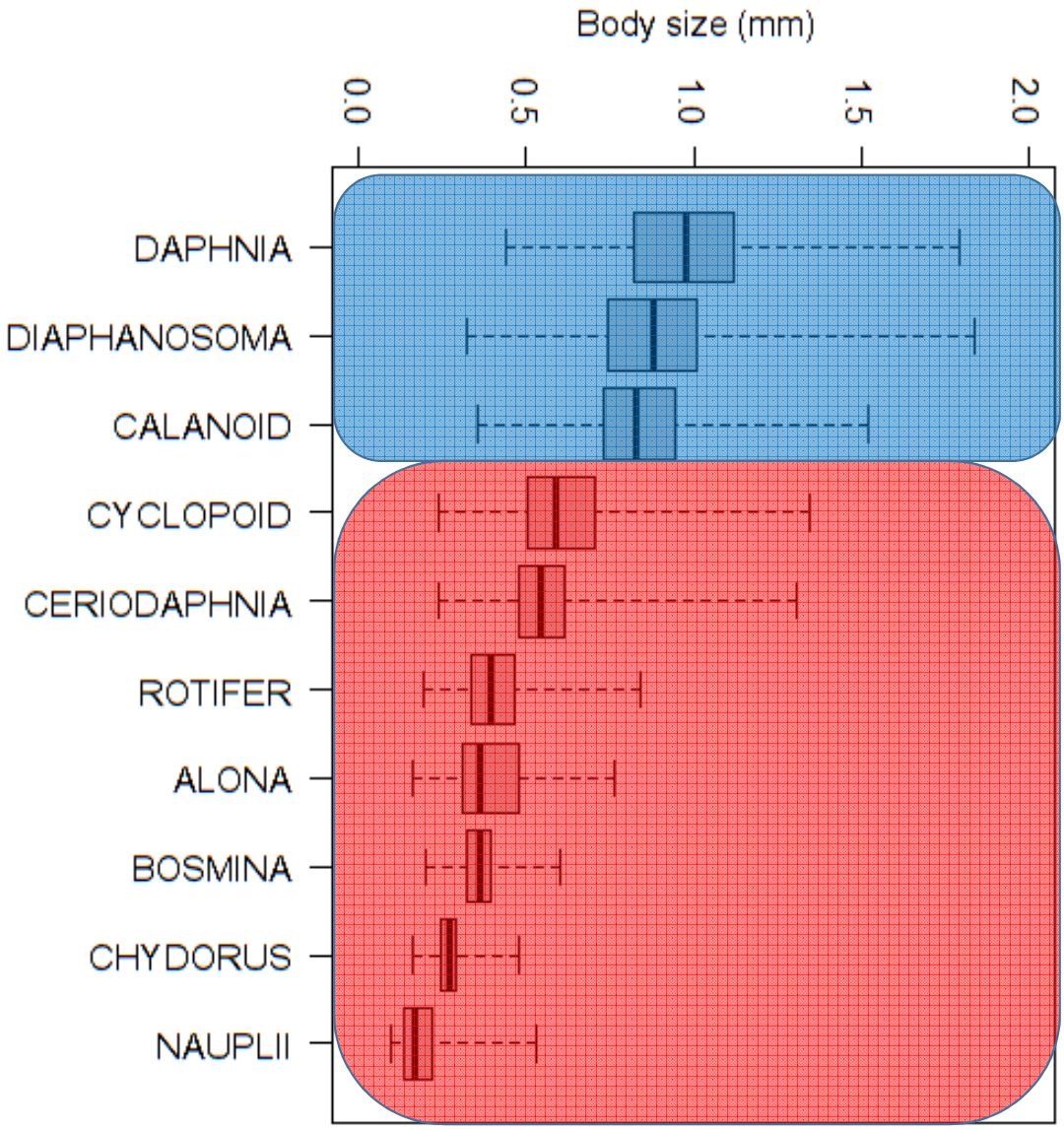
Overarching Questions:

- How do multiyear droughts influence the Utah Lake ecosystem?
- How do invasive fish species affect the food web in Utah Lake?
- How has the carp removal effort influenced Utah Lake, and what role has drought played in these dynamics?

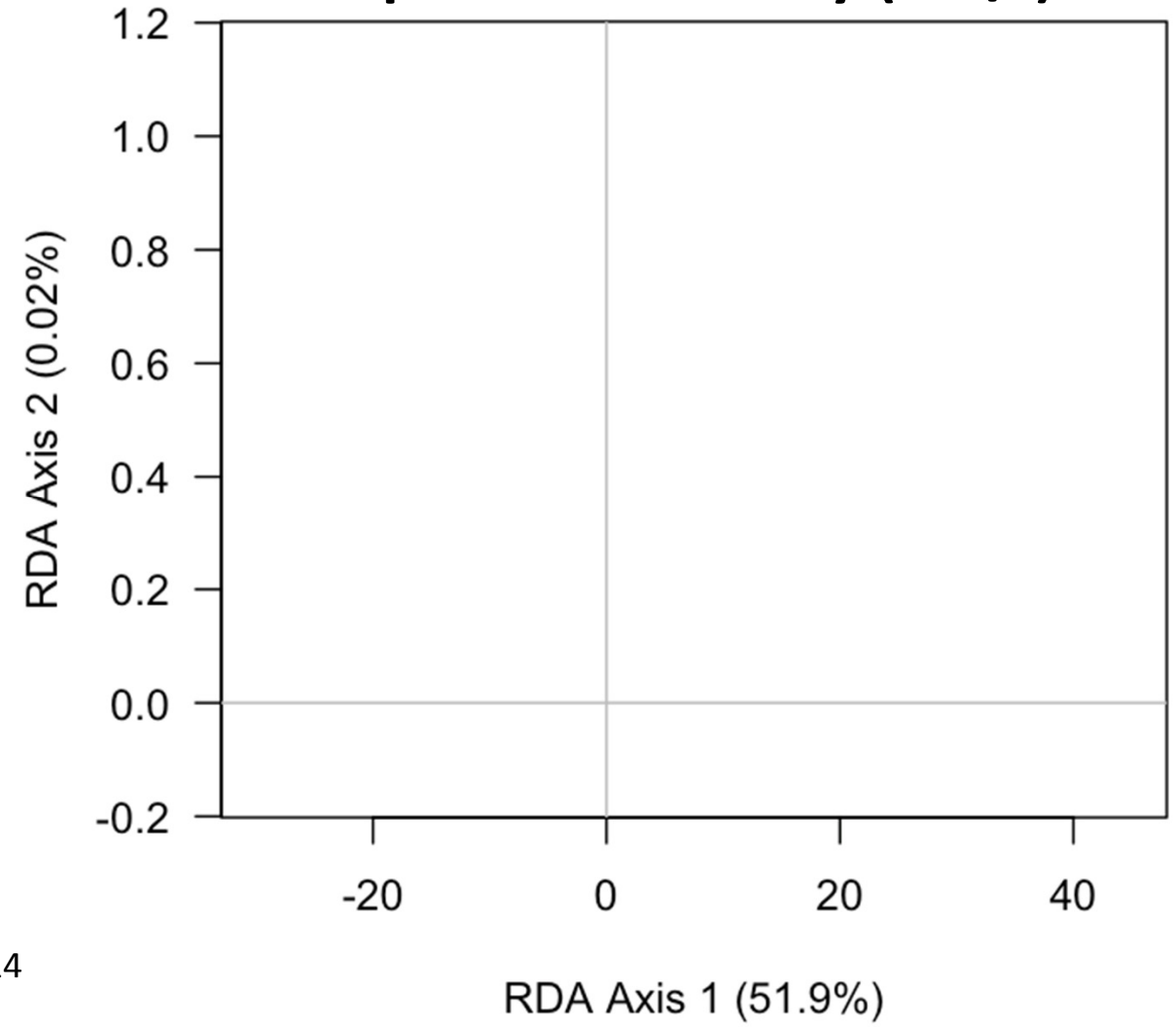

Carp Removal
Fish (seine)
Fish (trap-nets)
Lake elevation
Aquatic Insects
Zooplankton
Phytoplankton
Water Quality
2002
2005
2008
2011
2014
2016


Carp Removal
Fish (seine)
Fish (trap-nets)
Lake elevation
Aquatic Insects
Zooplankton
Phytoplankton
Water Quality
2002
2005
2008
2011
2014
2016


Body size (mm)
0.0
0.5
1.0
1.5
2.0
DAPHNIA
DIAPHANOSOMA
CALANOID
CYCLOPOID
CERIODAPHNIA
ROTIFER
ALONA
BOSMINA
CHYDORUS
NAUPLII

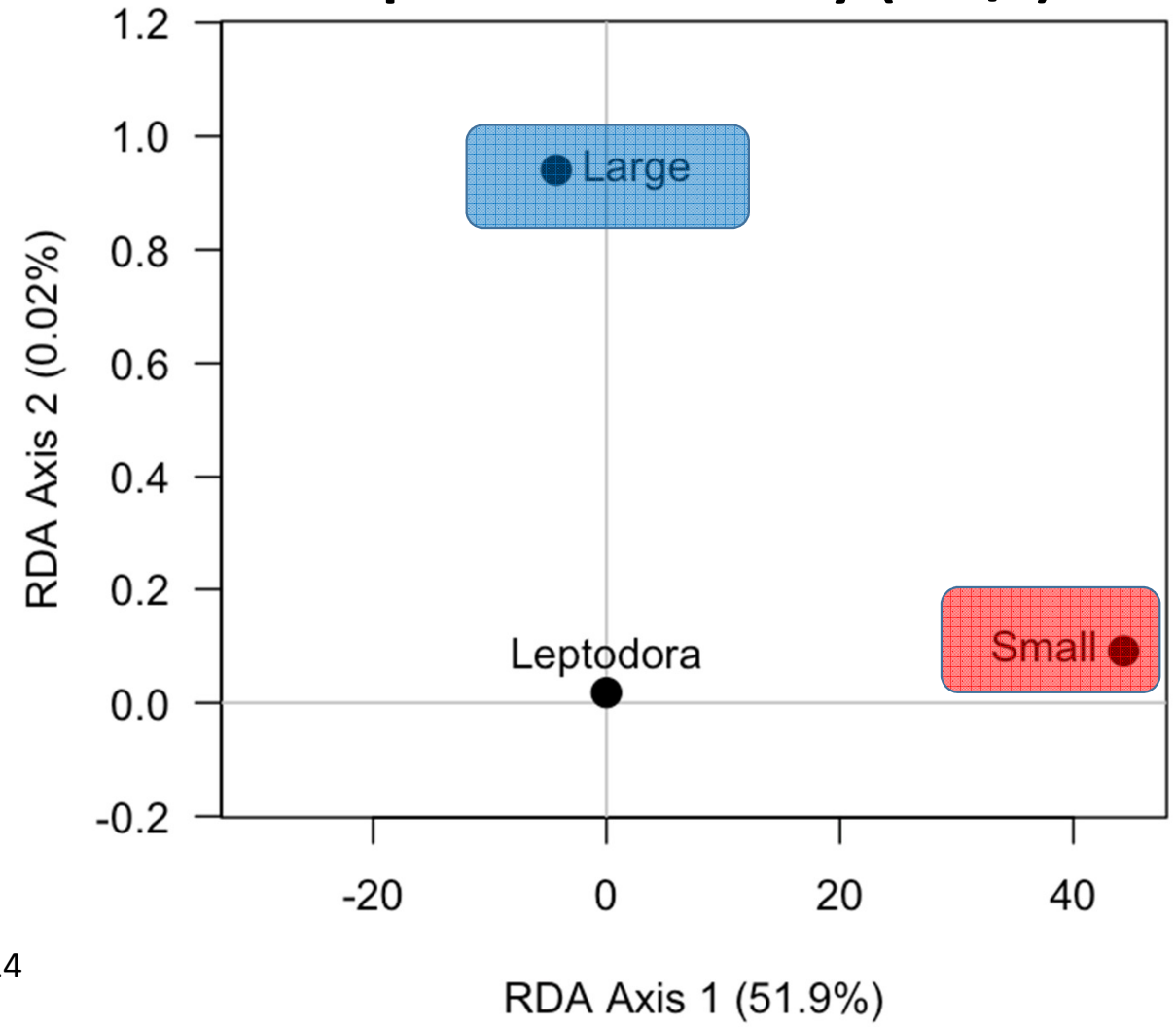

Body size (mm)
0.0
0.5
1.0
1.5
2.0
DAPHNIA
DIAPHANOSOMA
CALANOID
CYCLOPOID
CERIODAPHNIA
ROTIFER
ALONA
BOSMINA
CHYDORUS
NAUPLII

Zooplankton density (no./l)

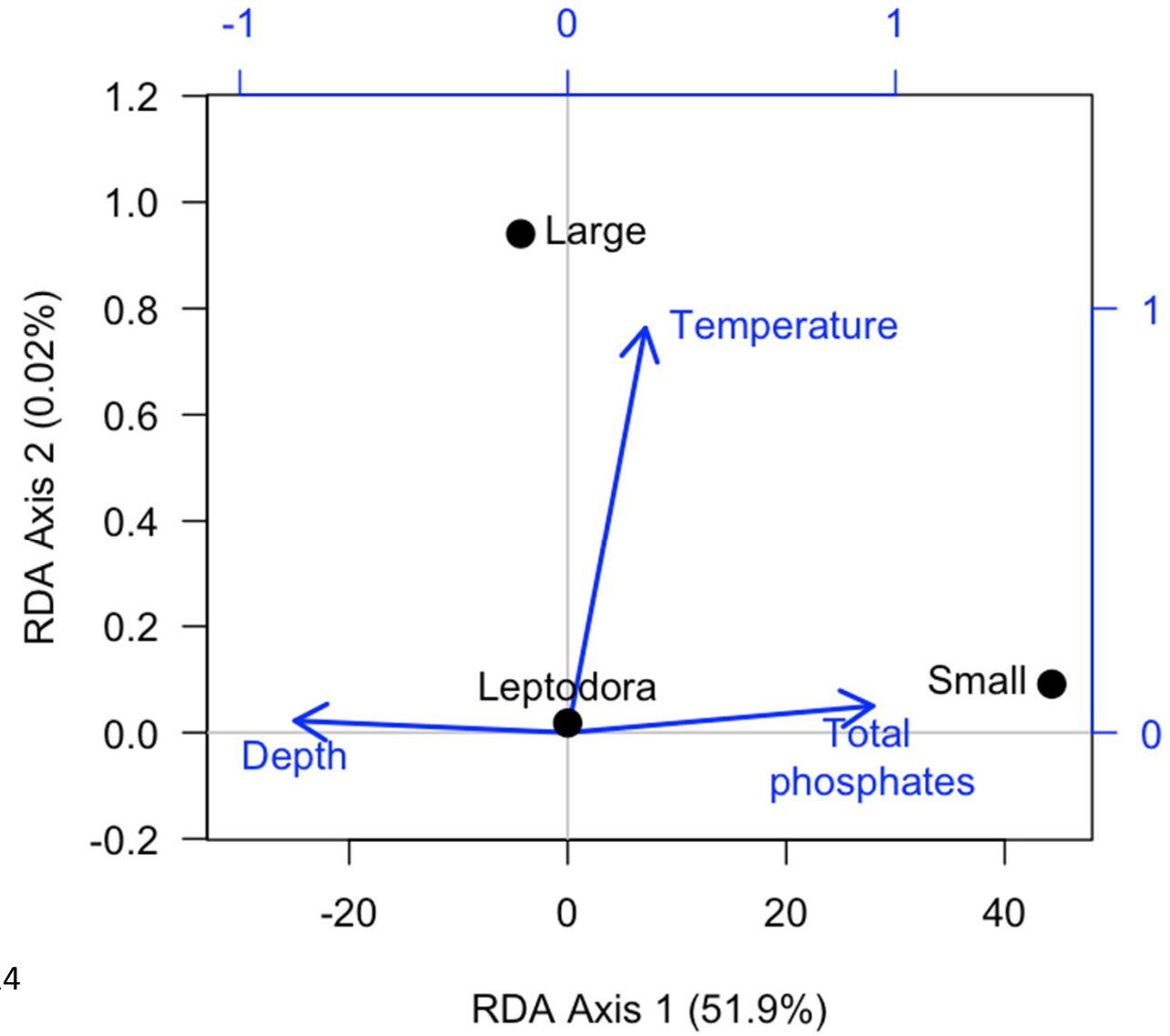


Sept 2011 – Sept 2014
N = 64 site/dates

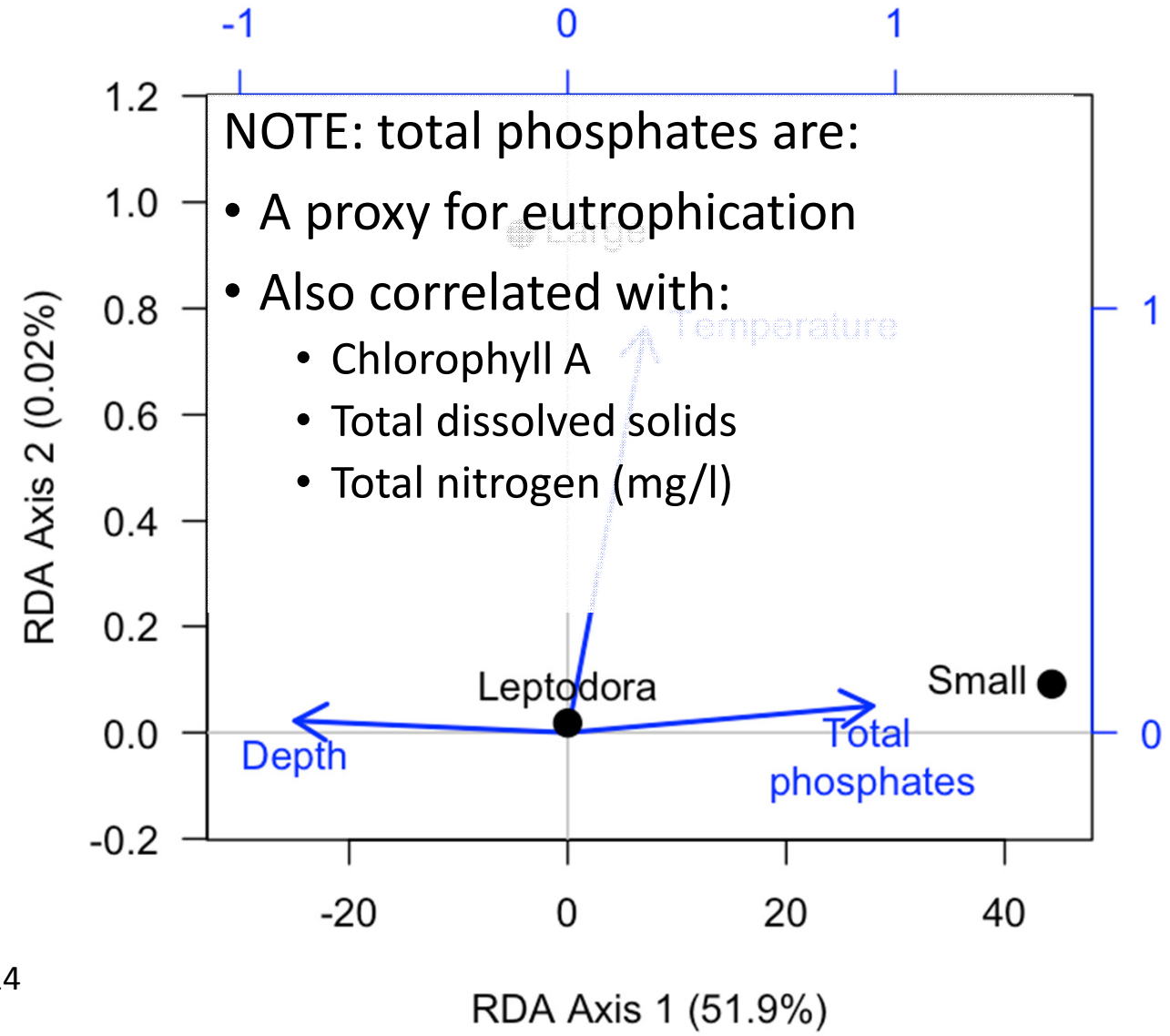
Zooplankton density (no./l)



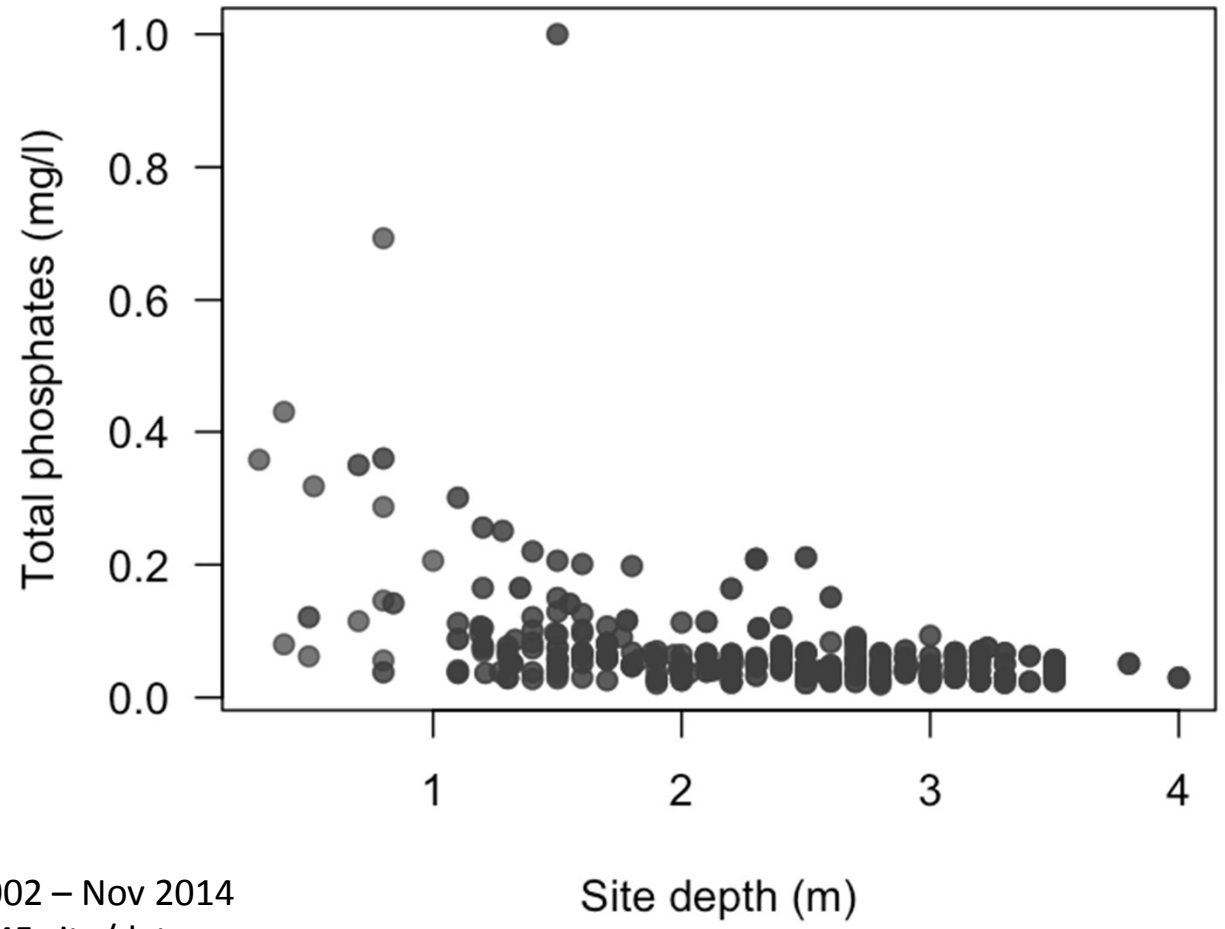
Sept 2011 – Sept 2014
N = 64 site/dates



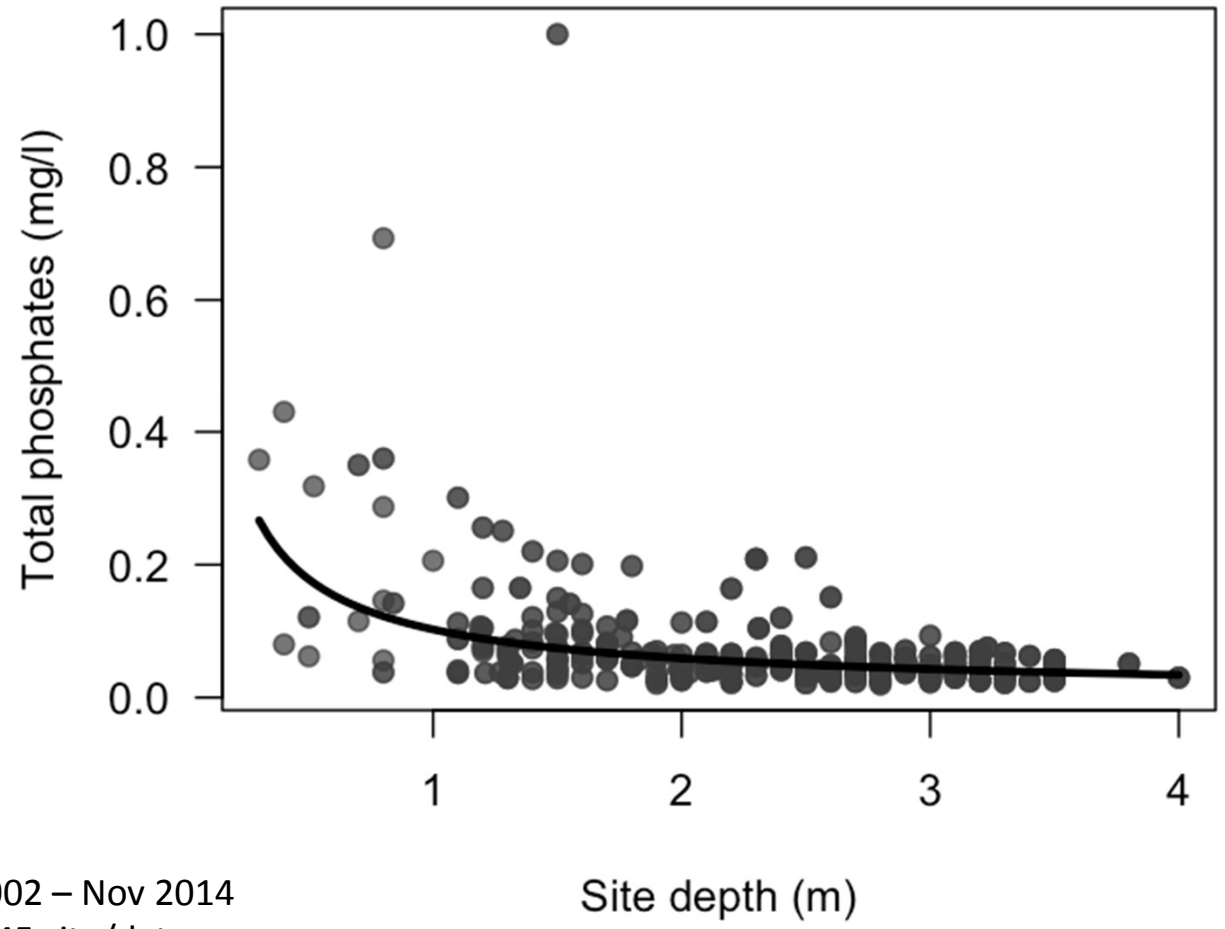
Sept 2011 – Sept 2014
N = 64 site/dates



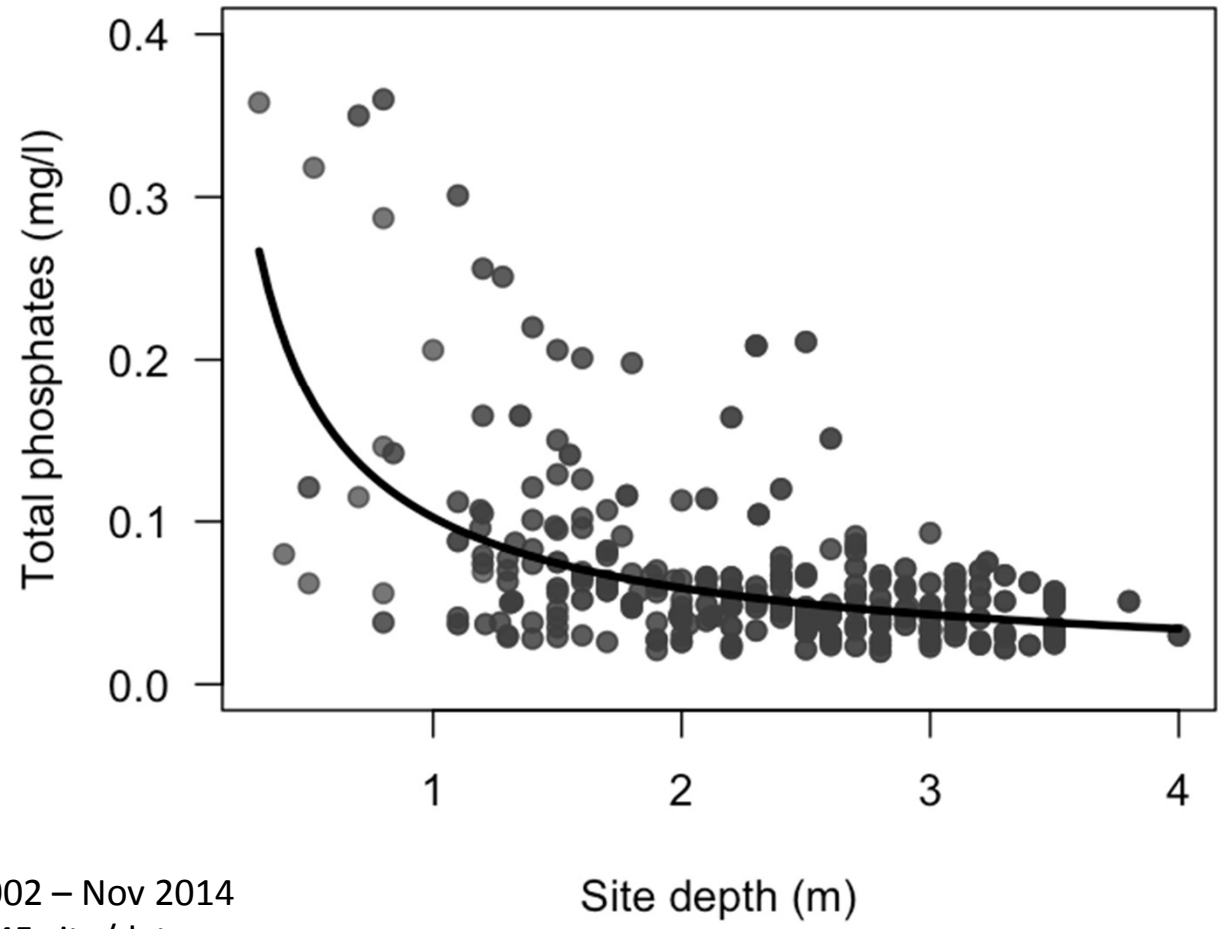
Sept 2011 – Sept 2014
N = 64 site/dates



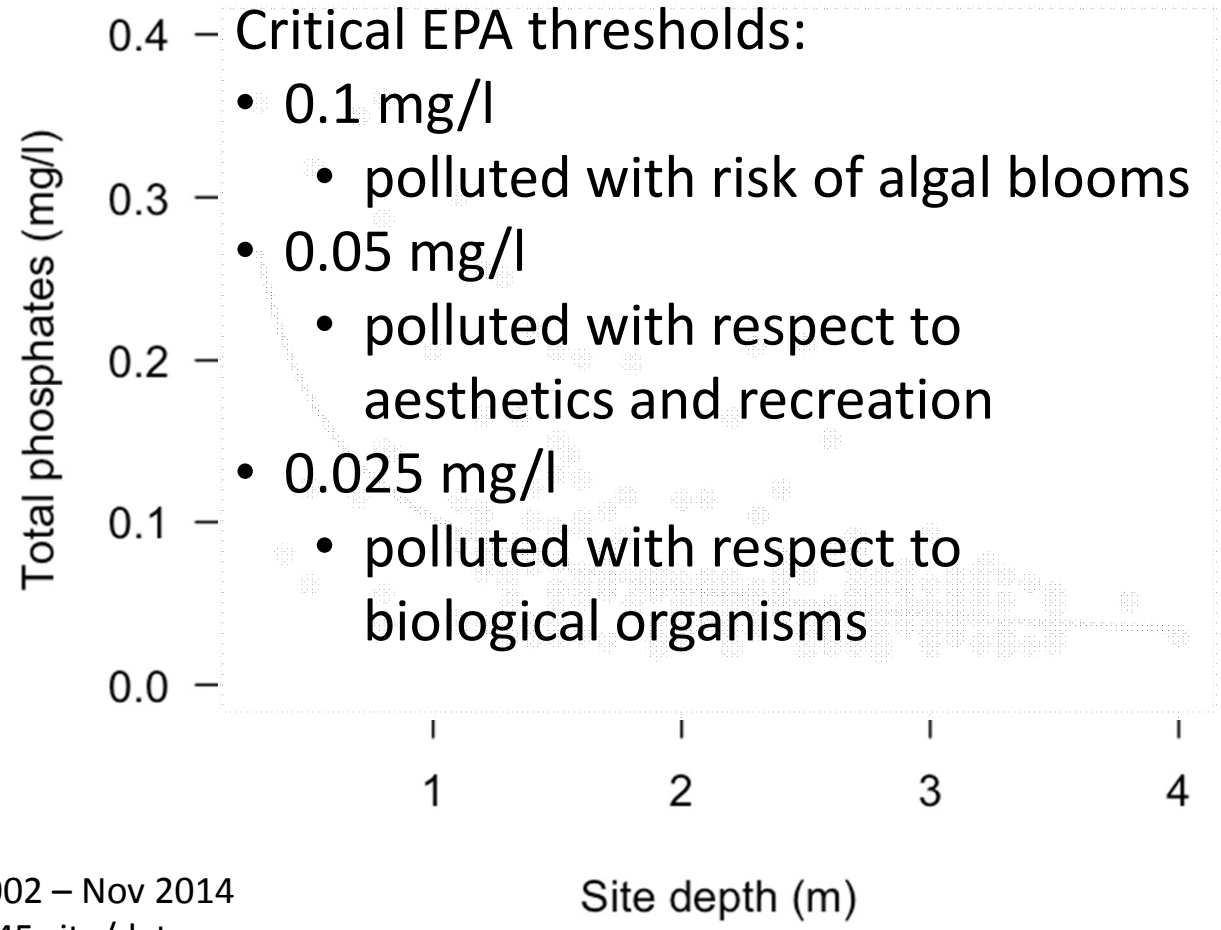
June 2002 – Nov 2014
N = 245 site/dates



June 2002 – Nov 2014
N = 245 site/dates

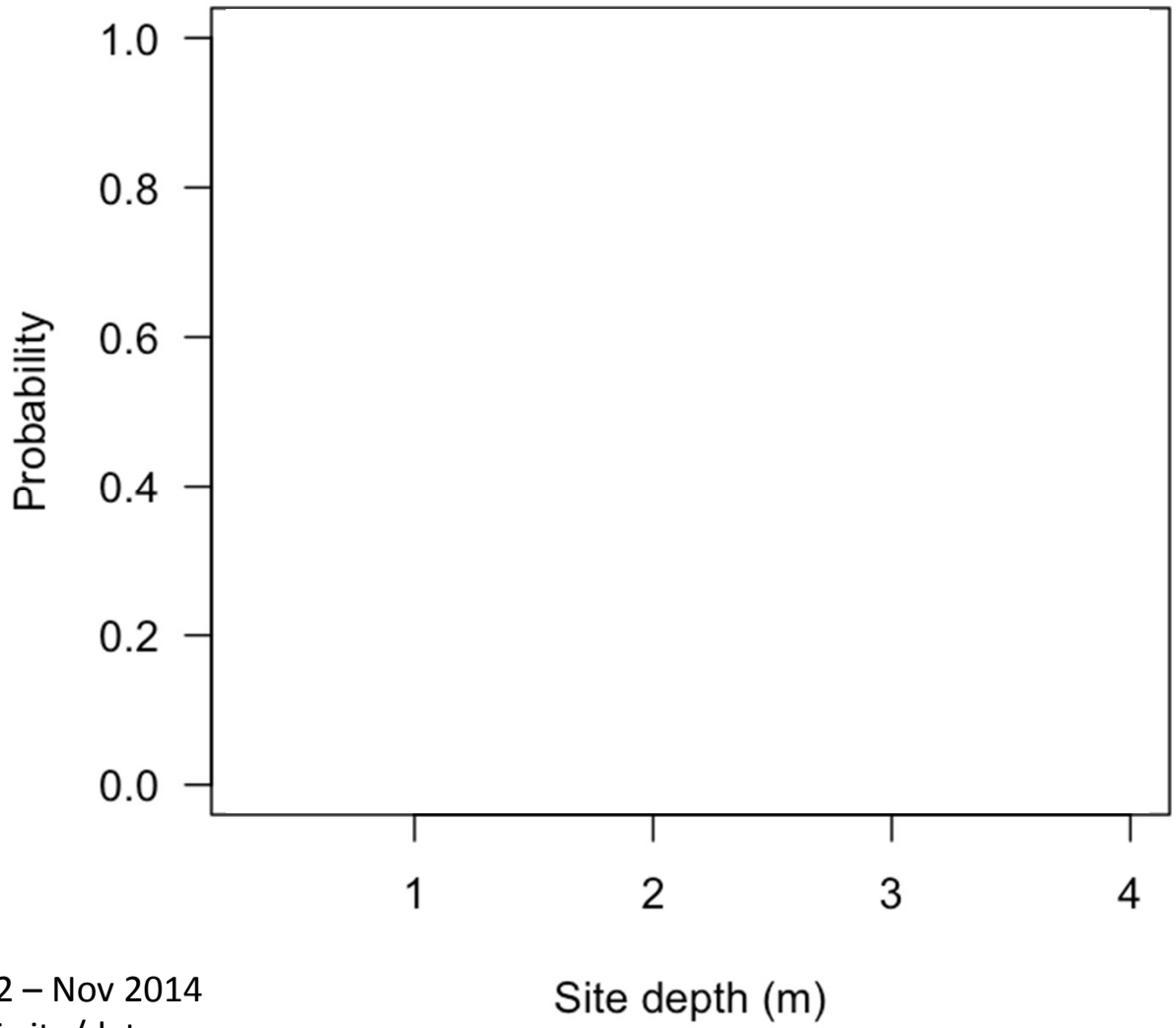


June 2002 – Nov 2014
N = 245 site/dates



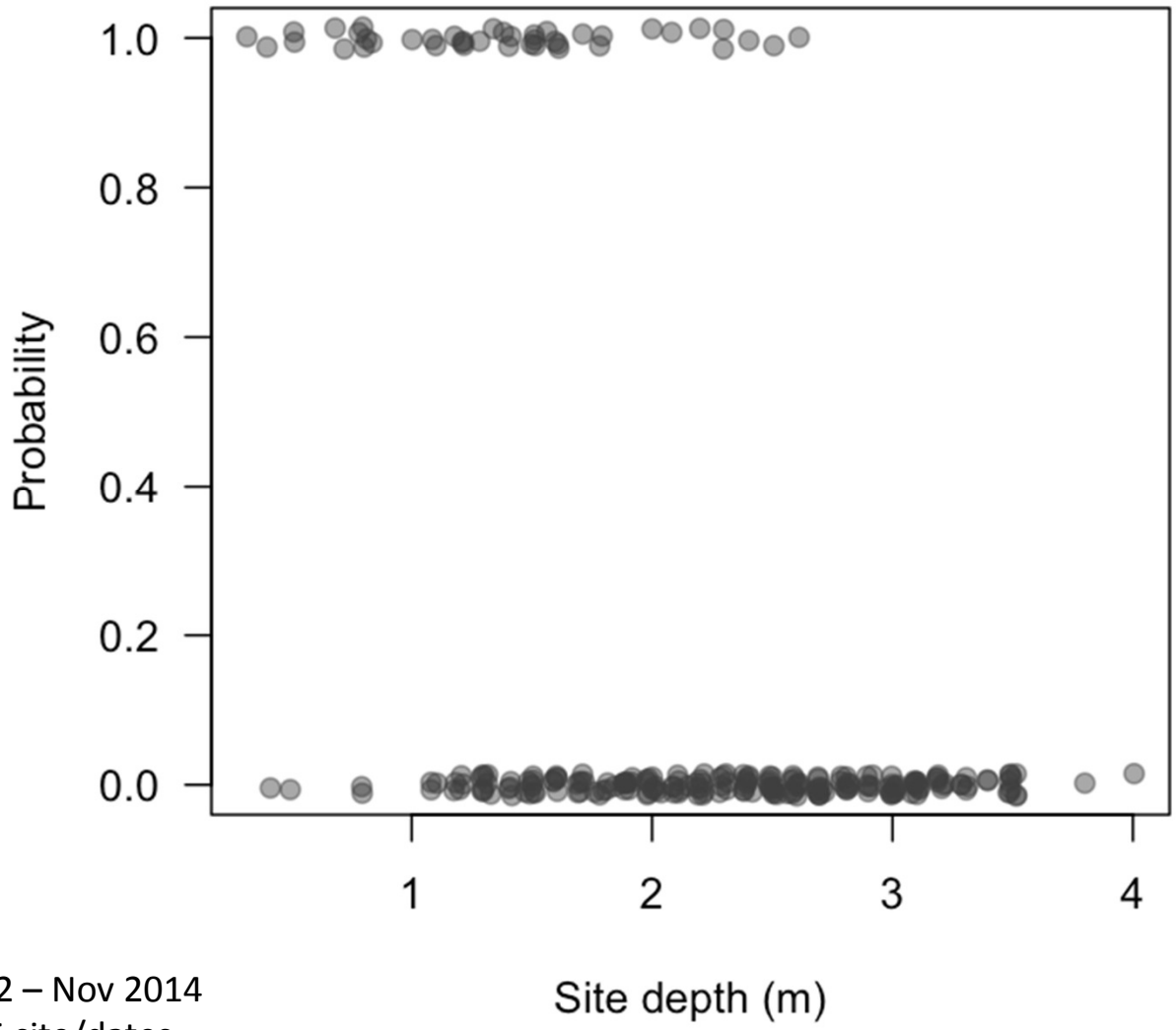
June 2002 – Nov 2014
N = 245 site/dates

Total Phosphates > 0.1 mg/l



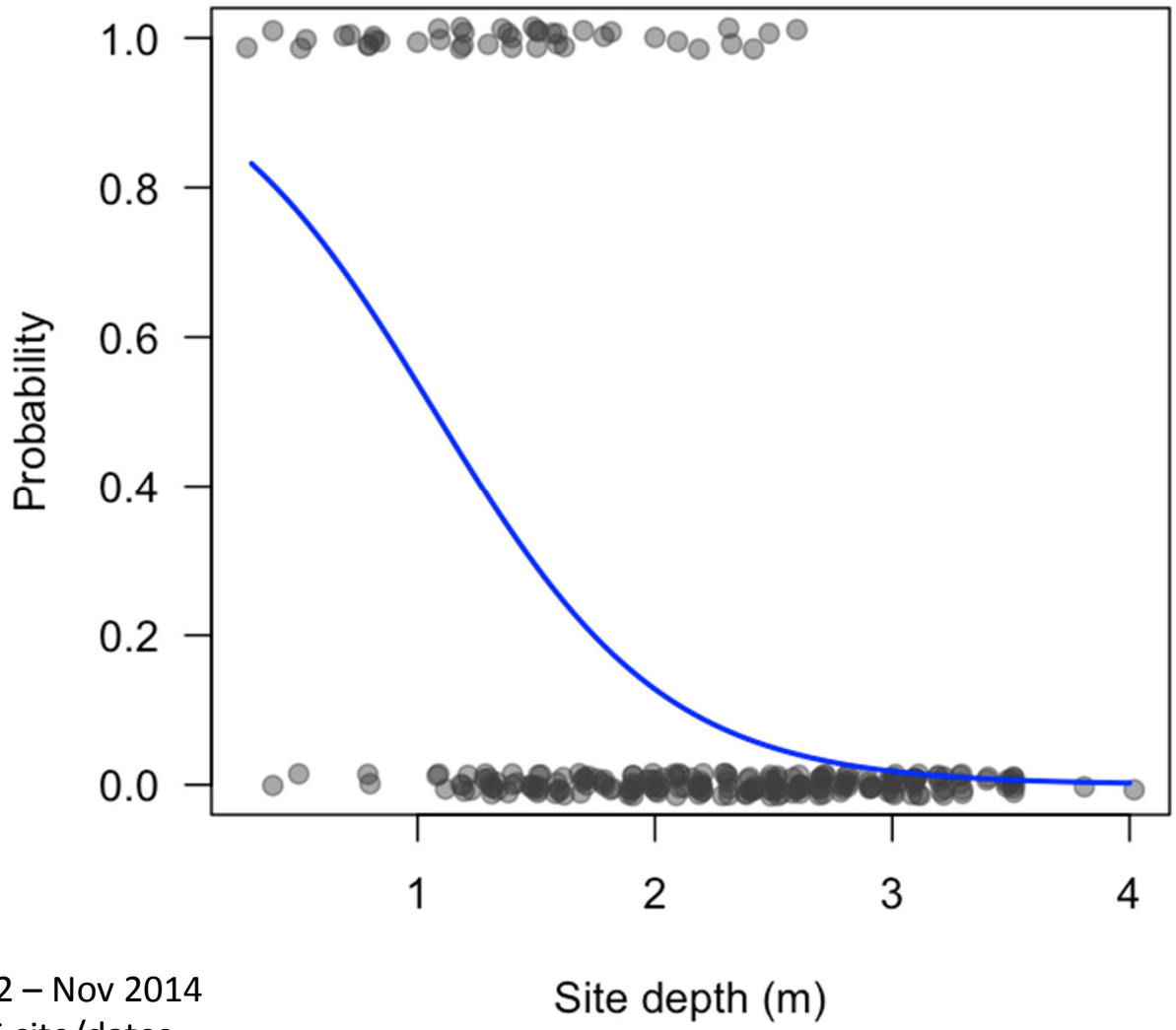
June 2002 – Nov 2014
N = 245 site/dates

Total Phosphates > 0.1 mg/l



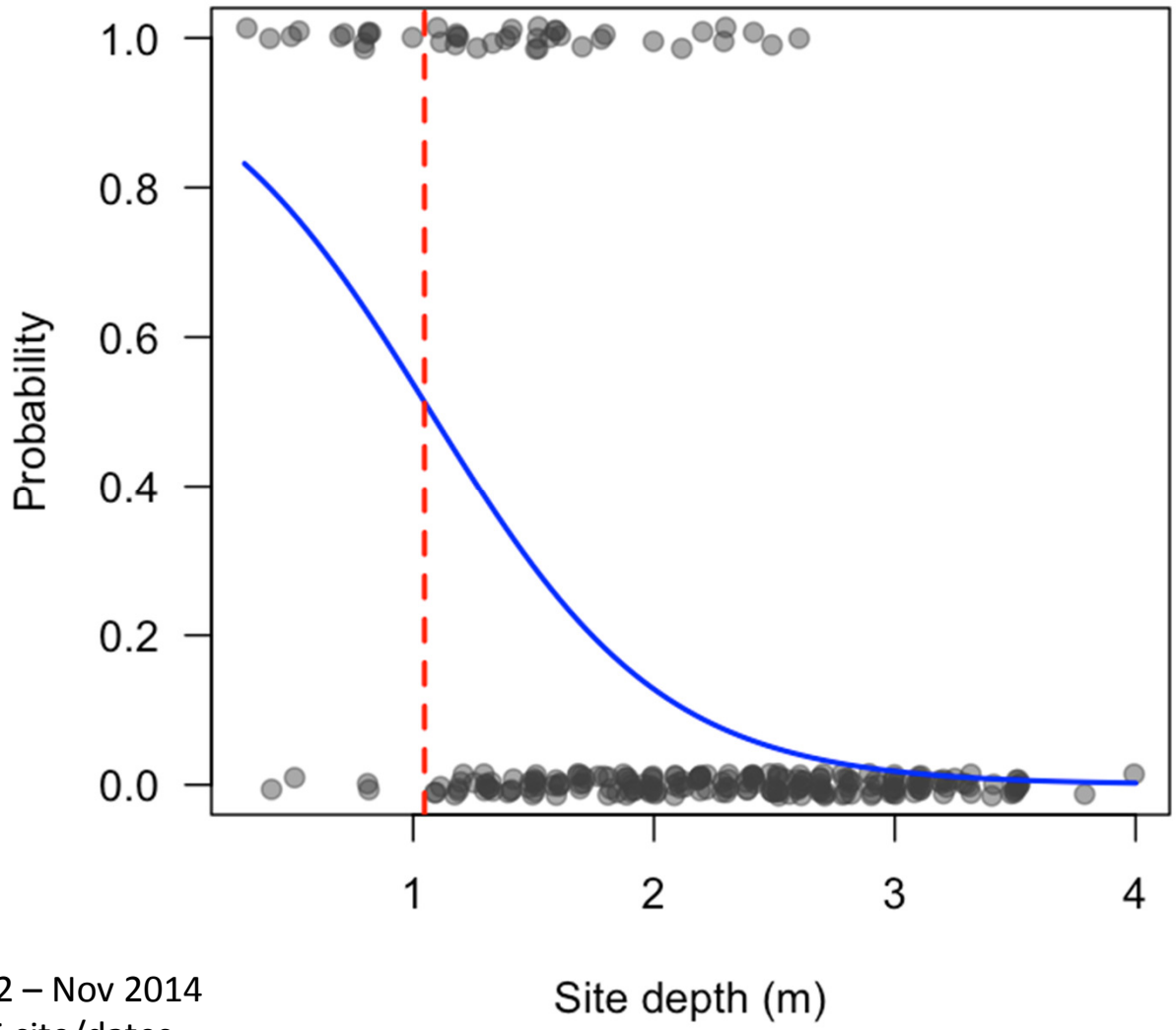
June 2002 – Nov 2014
N = 245 site/dates

Total Phosphates > 0.1 mg/l



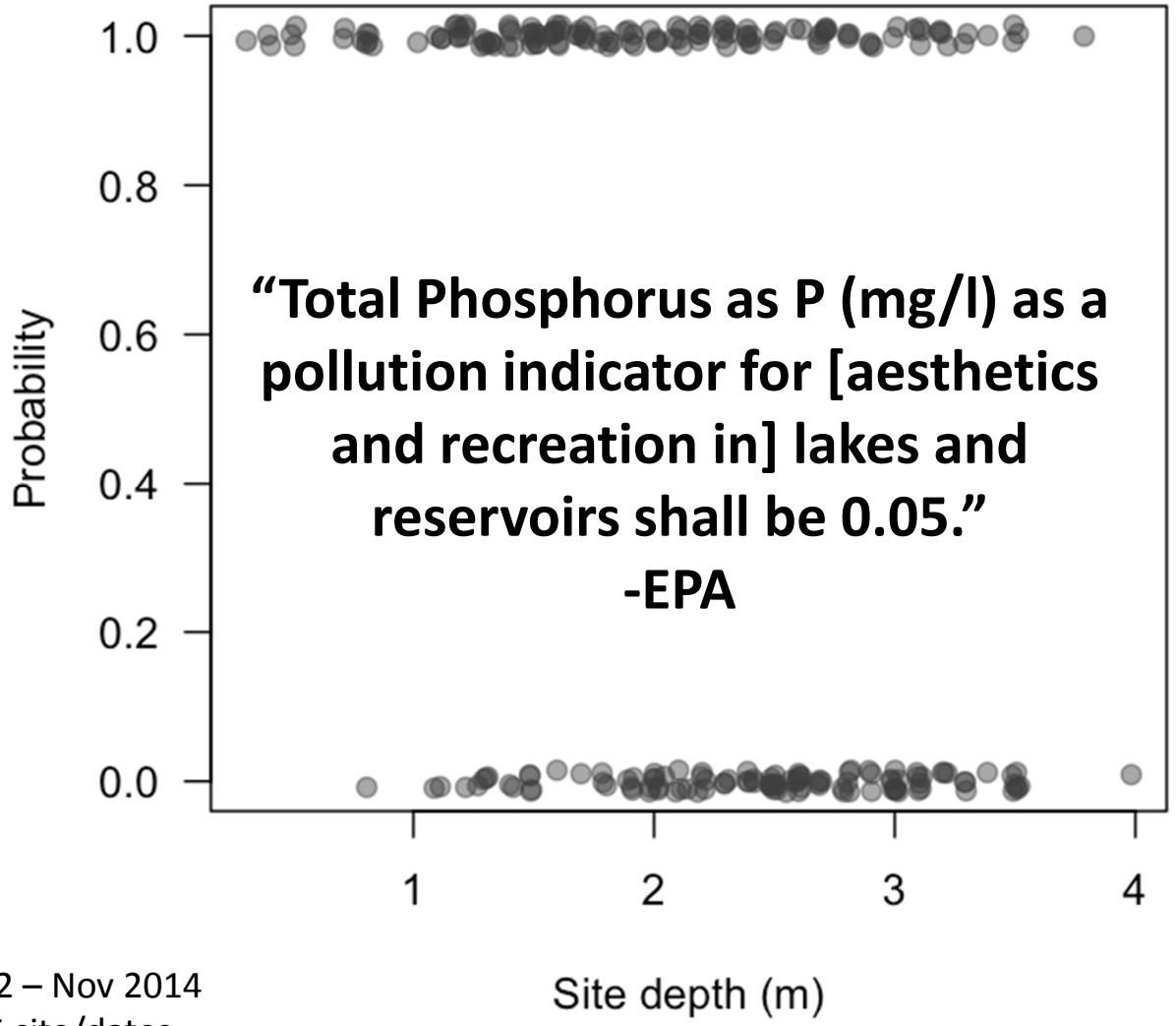
June 2002 – Nov 2014
N = 245 site/dates

Total Phosphates > 0.1 mg/l



June 2002 – Nov 2014
N = 245 site/dates

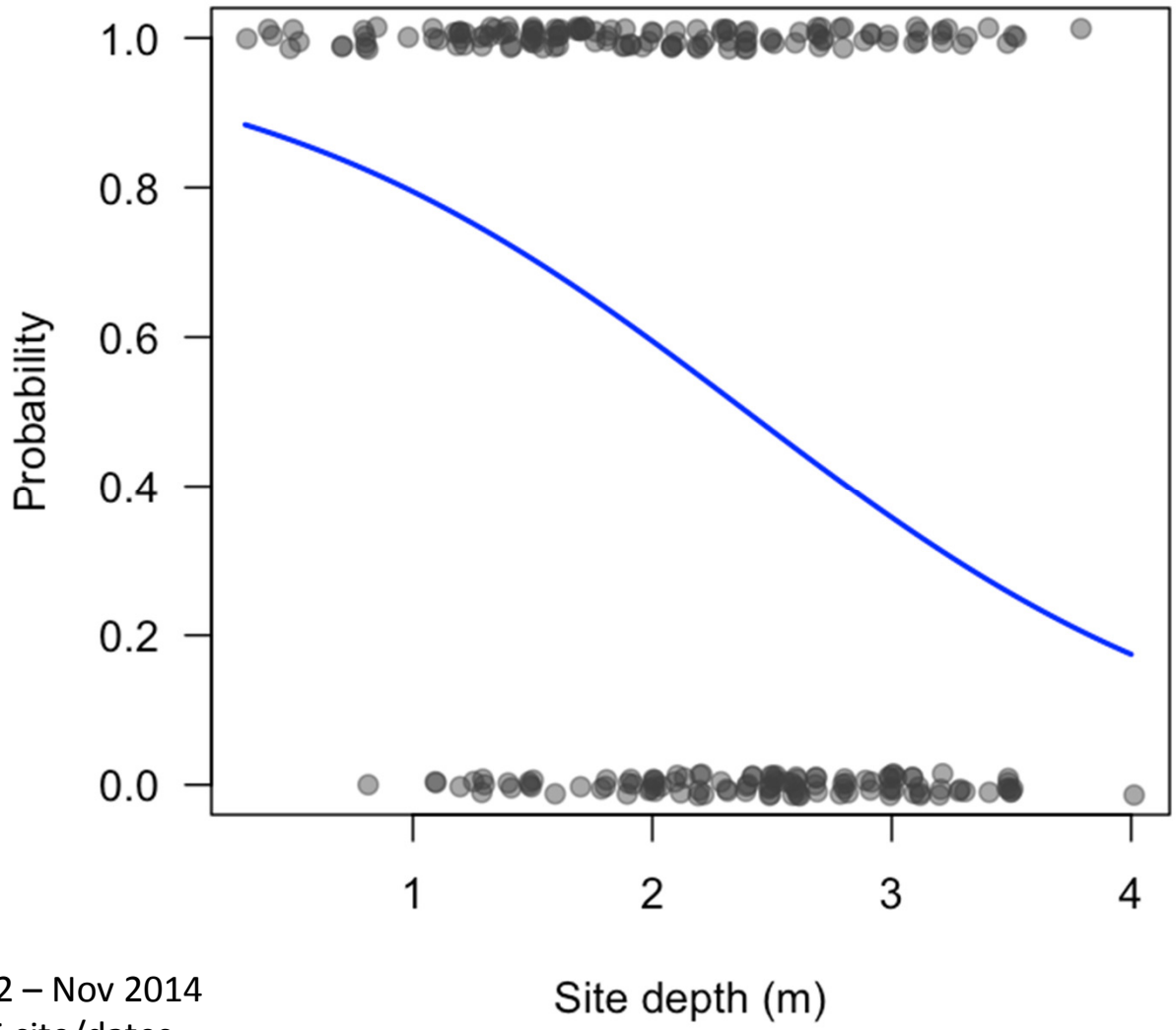
Total Phosphates > 0.05 mg/l



“Total Phosphorus as P (mg/l) as a pollution indicator for [aesthetics and recreation in] lakes and reservoirs shall be 0.05.”
-EPA

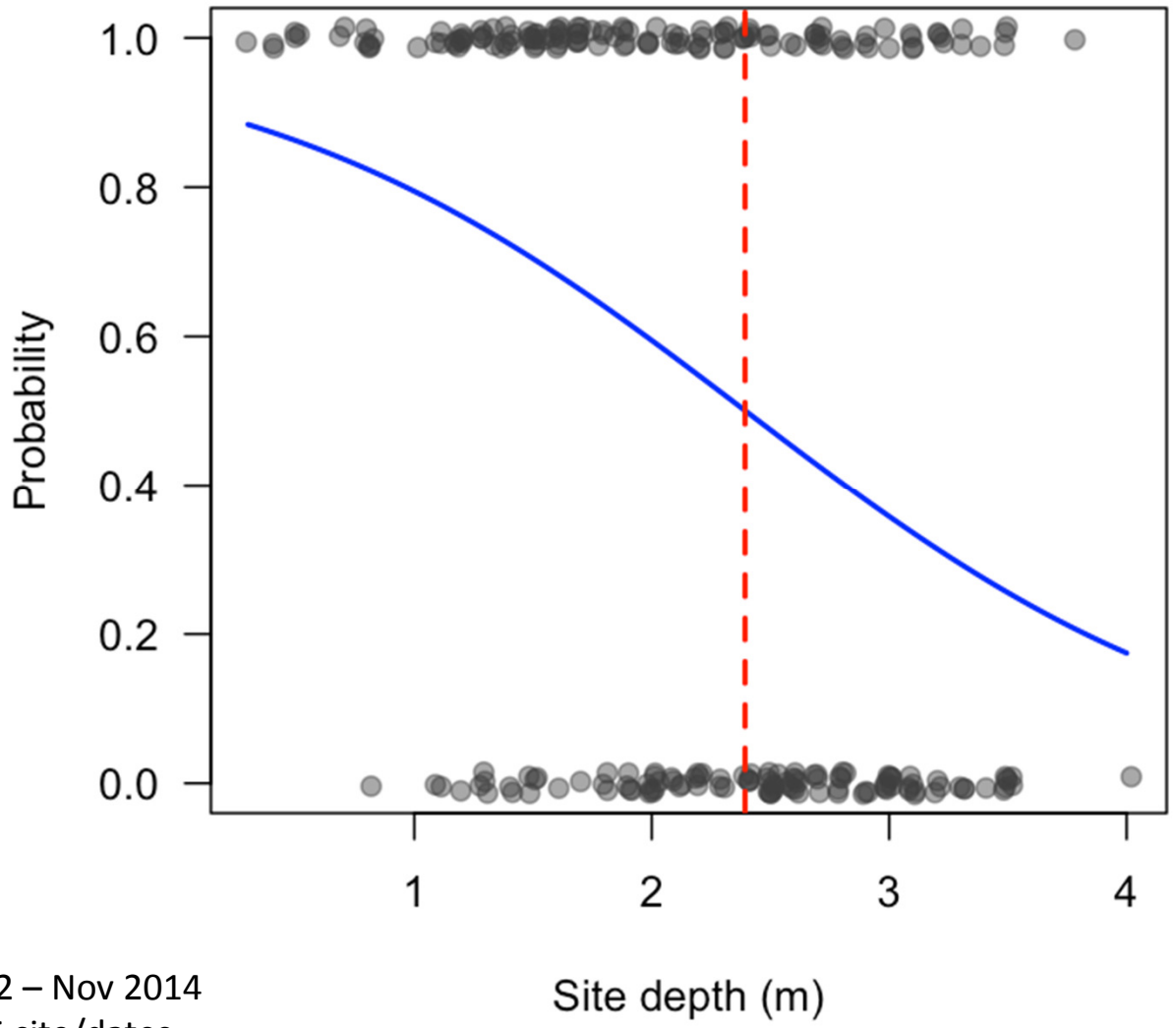
June 2002 – Nov 2014
N = 245 site/dates

Total Phosphates > 0.05 mg/l

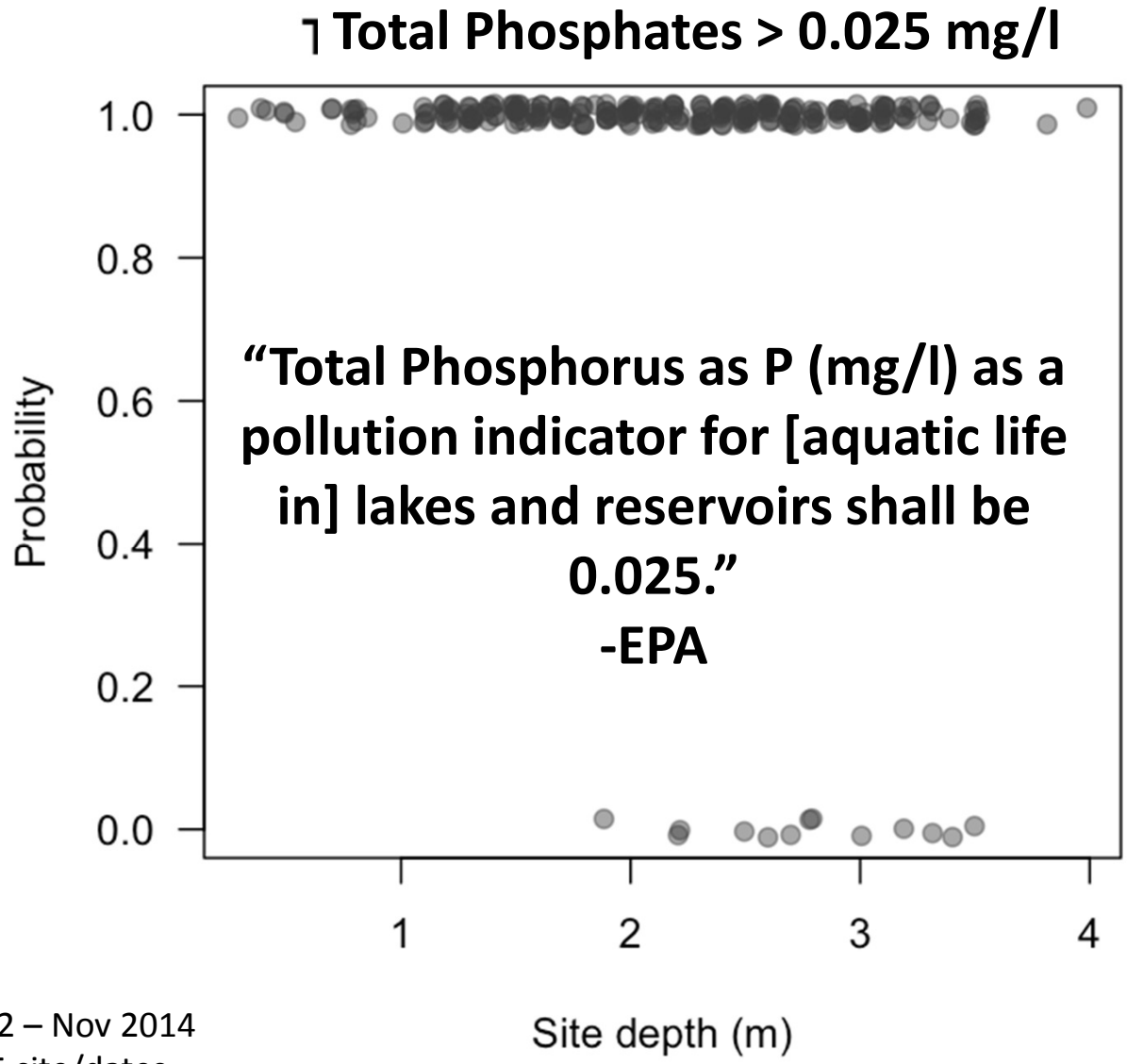


June 2002 – Nov 2014
N = 245 site/dates

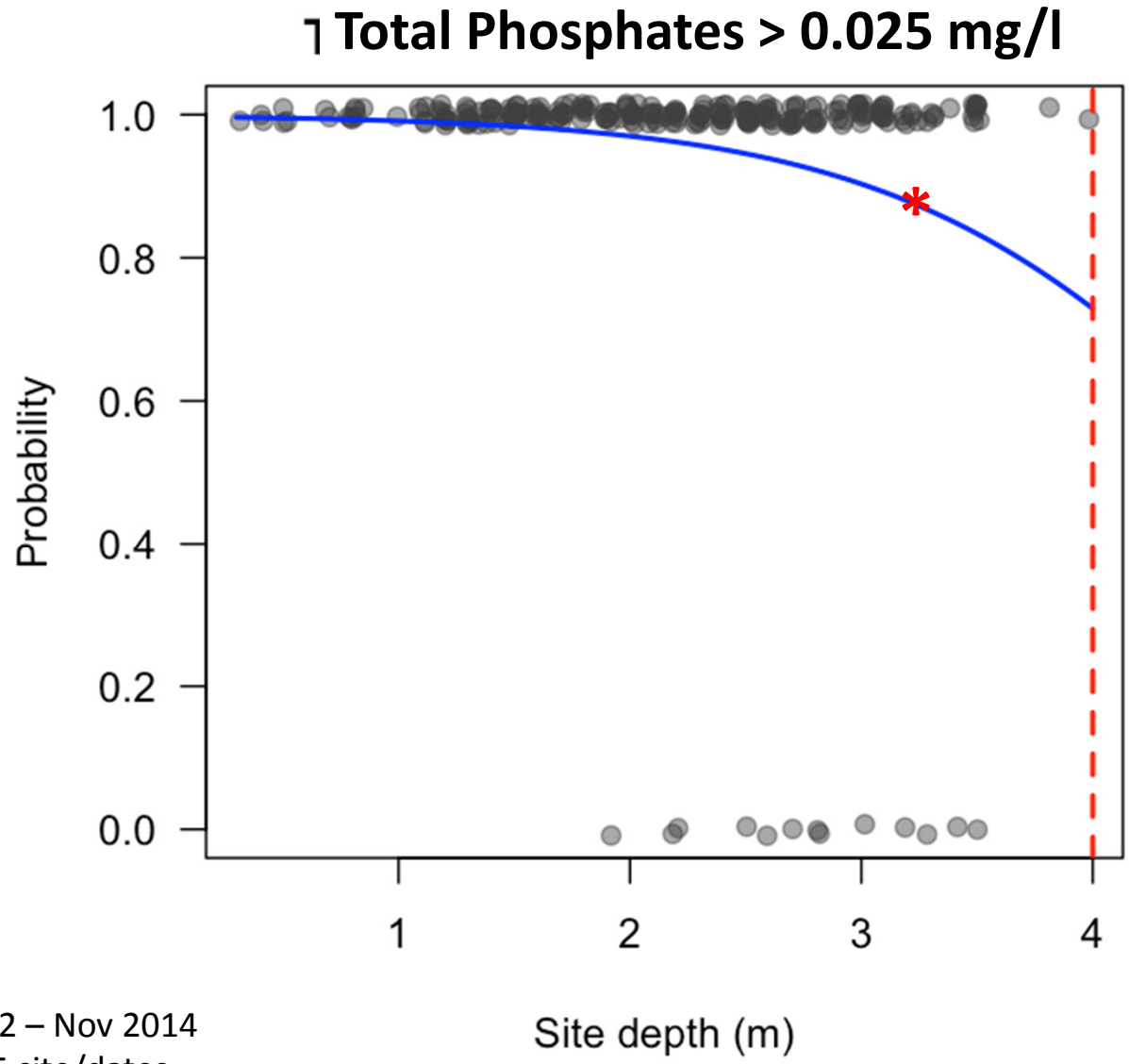
Total Phosphates > 0.05 mg/l



June 2002 – Nov 2014
N = 245 site/dates

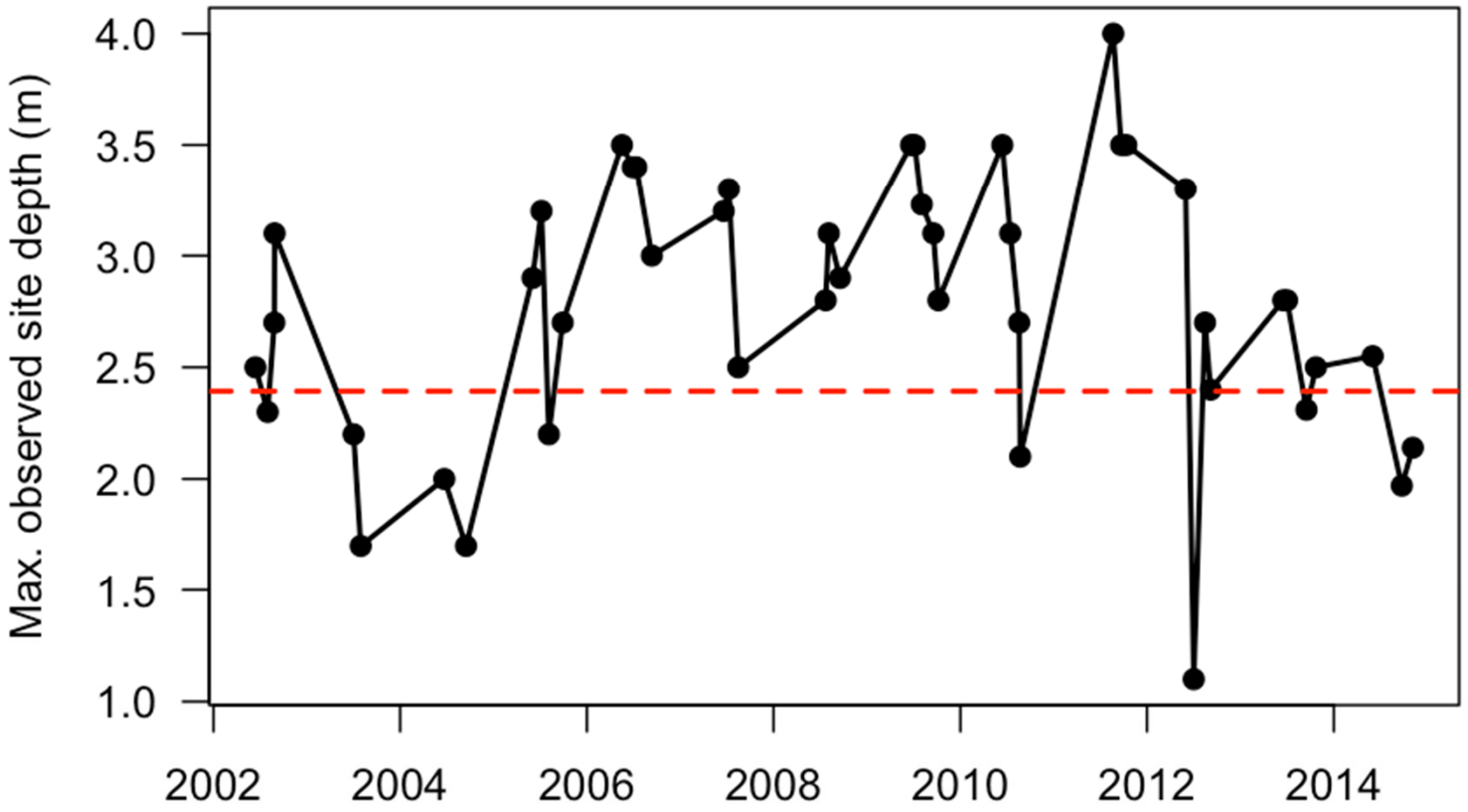


June 2002 – Nov 2014
N = 245 site/dates

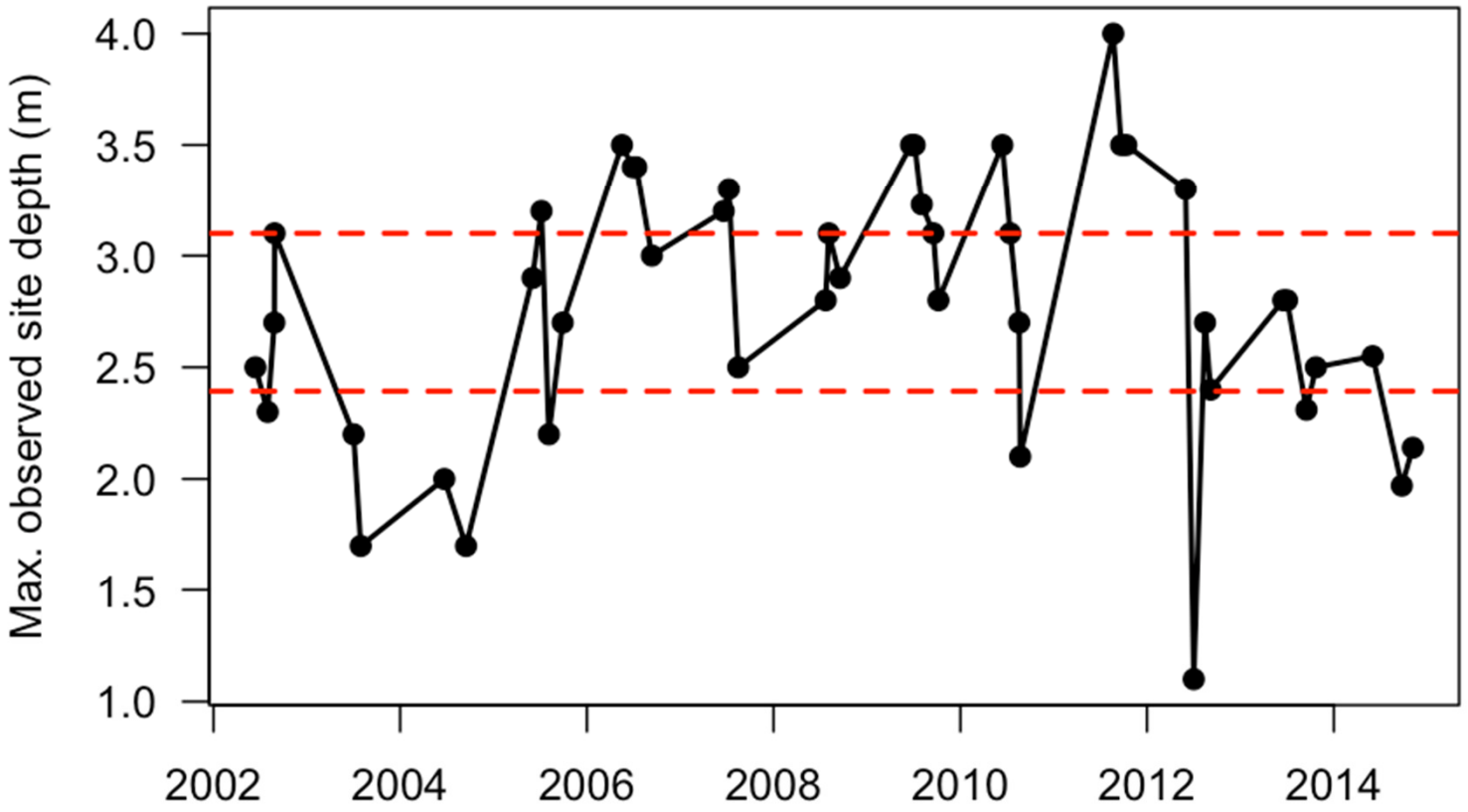


*0.9 at 3.1 m
0.73 minimum

June 2002 – Nov 2014
N = 245 site/dates



50% chance being polluted for aesthetics and recreation (0.05 mg/l)



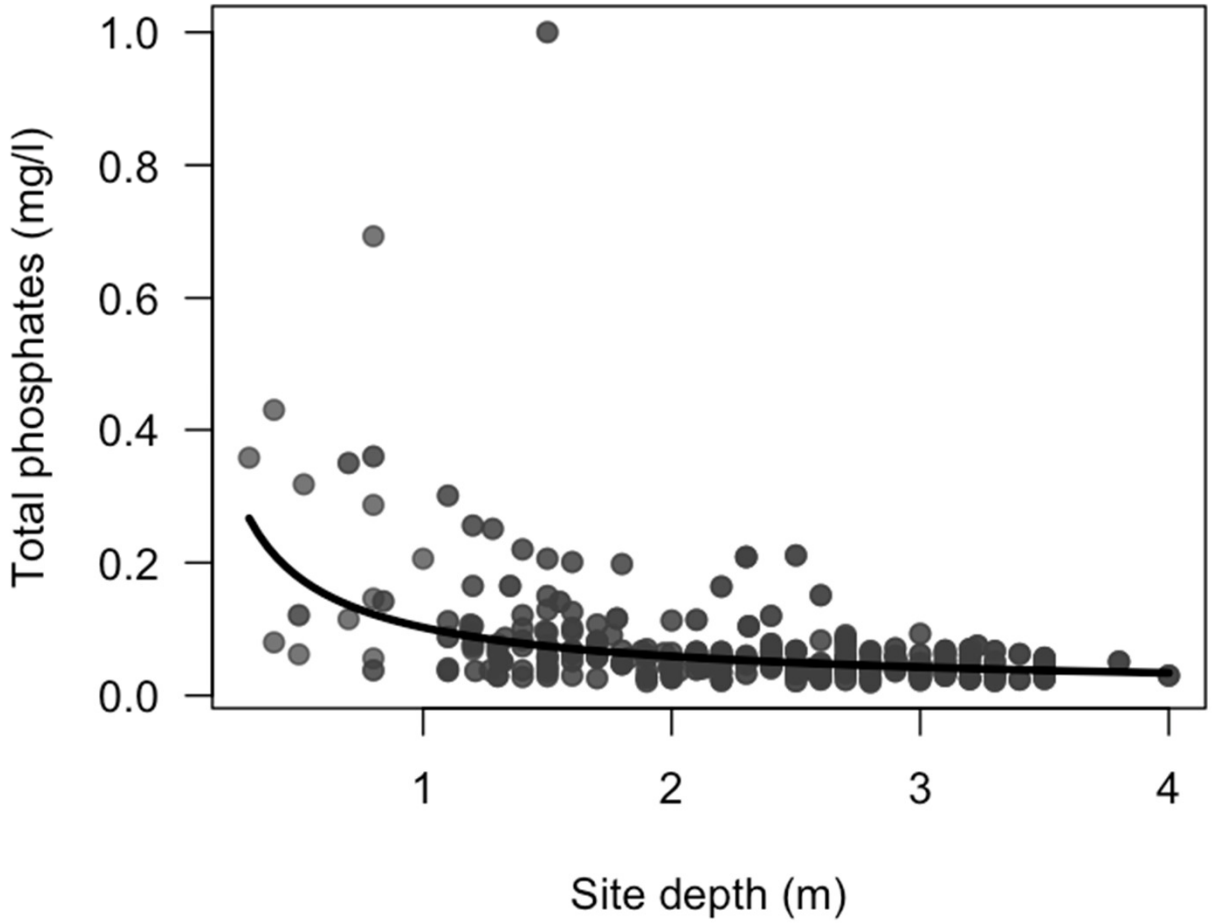
90% chance being polluted for aquatic life (0.025 mg/l)

50% chance being polluted for aesthetics and recreation (0.05 mg/l)

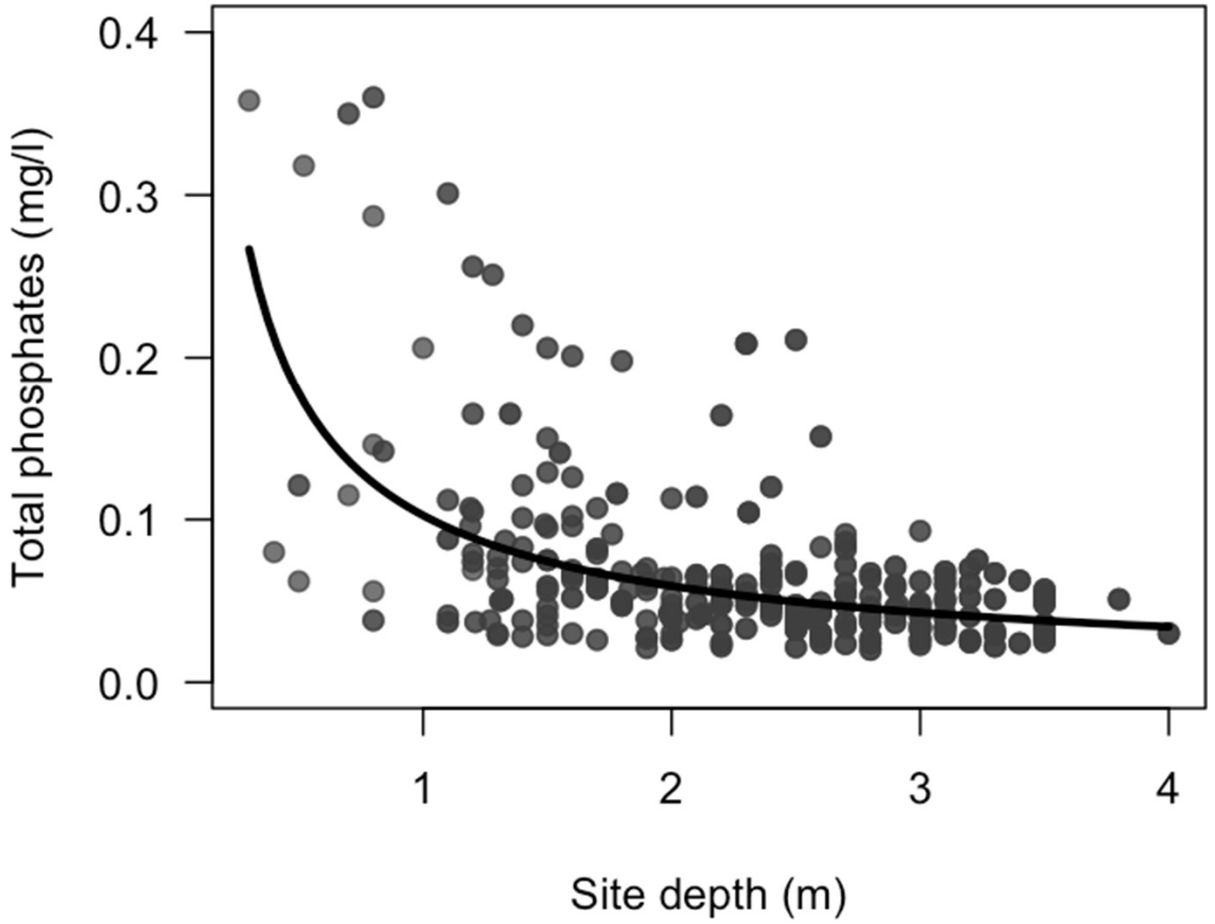
Do changes in total phosphate and depth influence zooplankton, specifically, *Daphnia* body size?

"If herbivorous zooplankton are in competition for limiting resources, then falling TP levels should favour larger herbivores (Gliwicz 1990), given their greater starvation resistance. Consistent with this hypothesis, TP is negatively correlated with mean cladoceran body size." Yan et al. (2008)

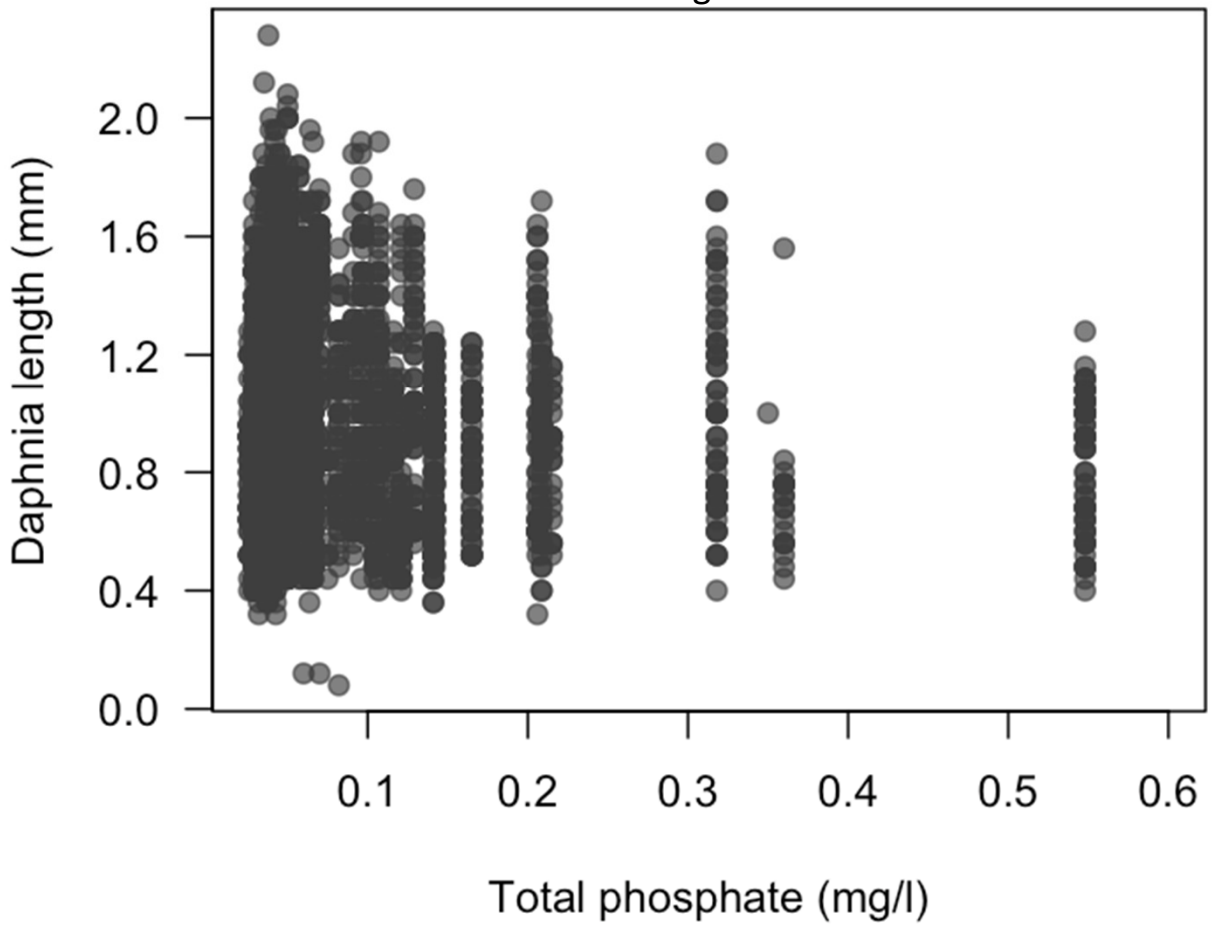
June 2002 – Nov 2014
N = 245 site/dates



June 2002 – Nov 2014
N = 245 site/dates

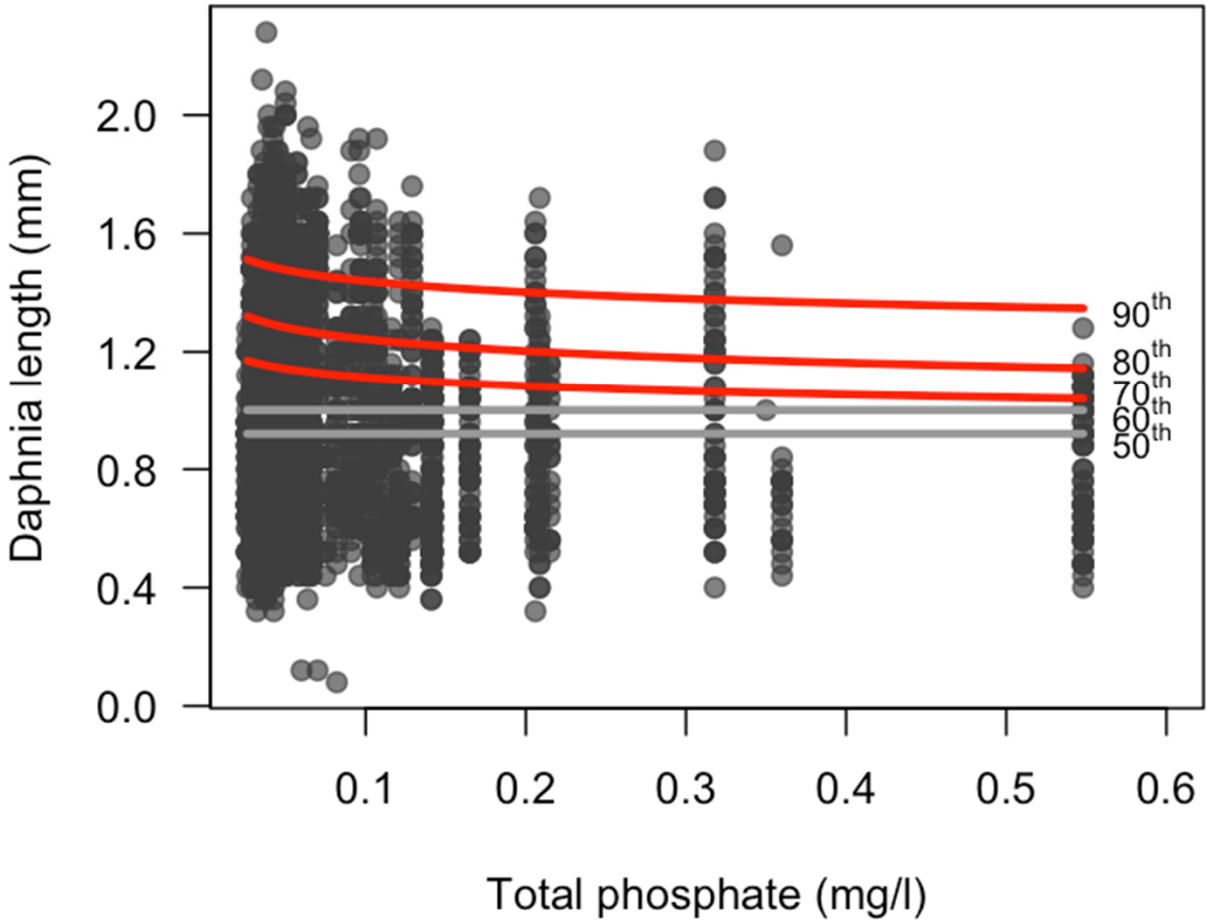


Sept 2011 – Sept 2014
66 site/dates
3711 lengths

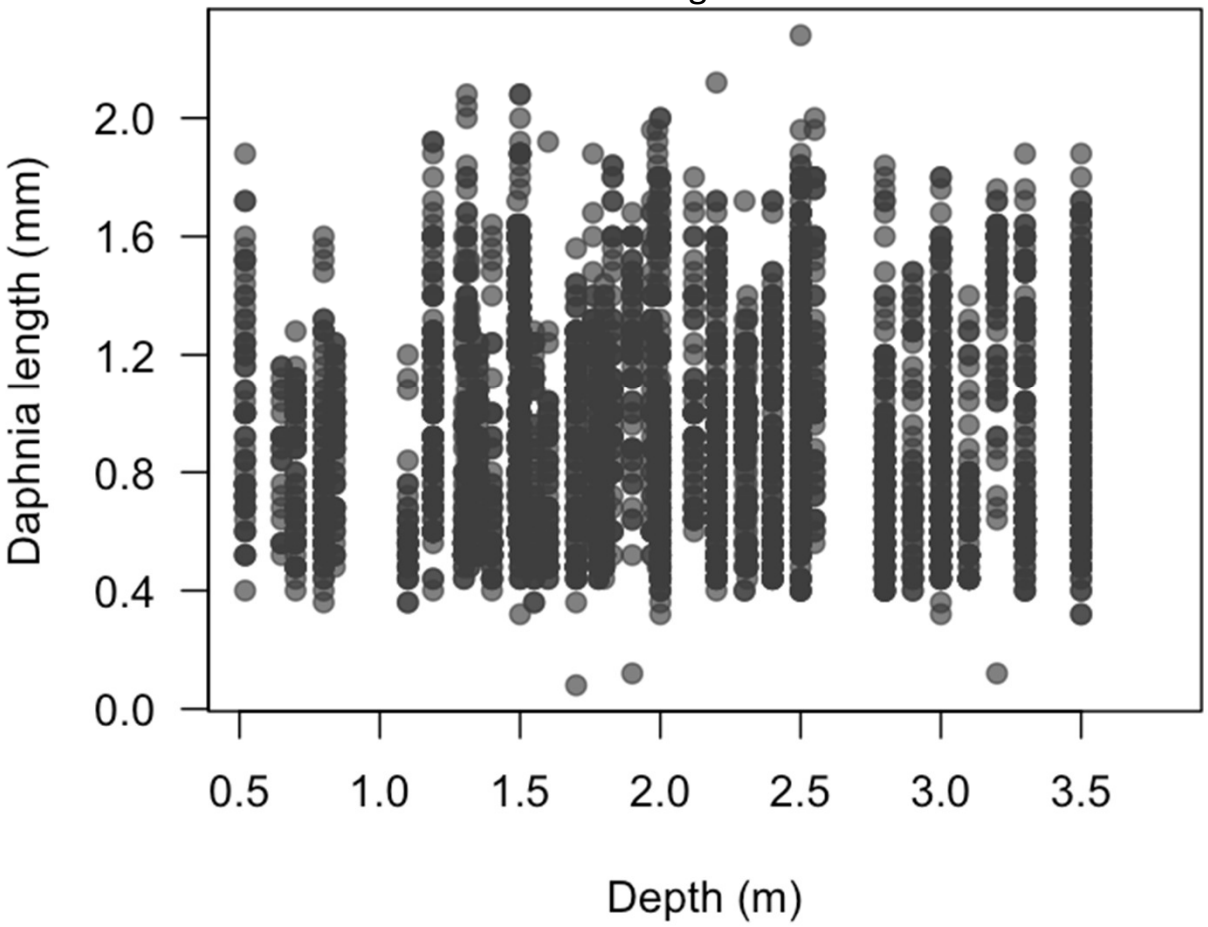


90th percentile = 12% decrease

Sept 2011 – Sept 2014

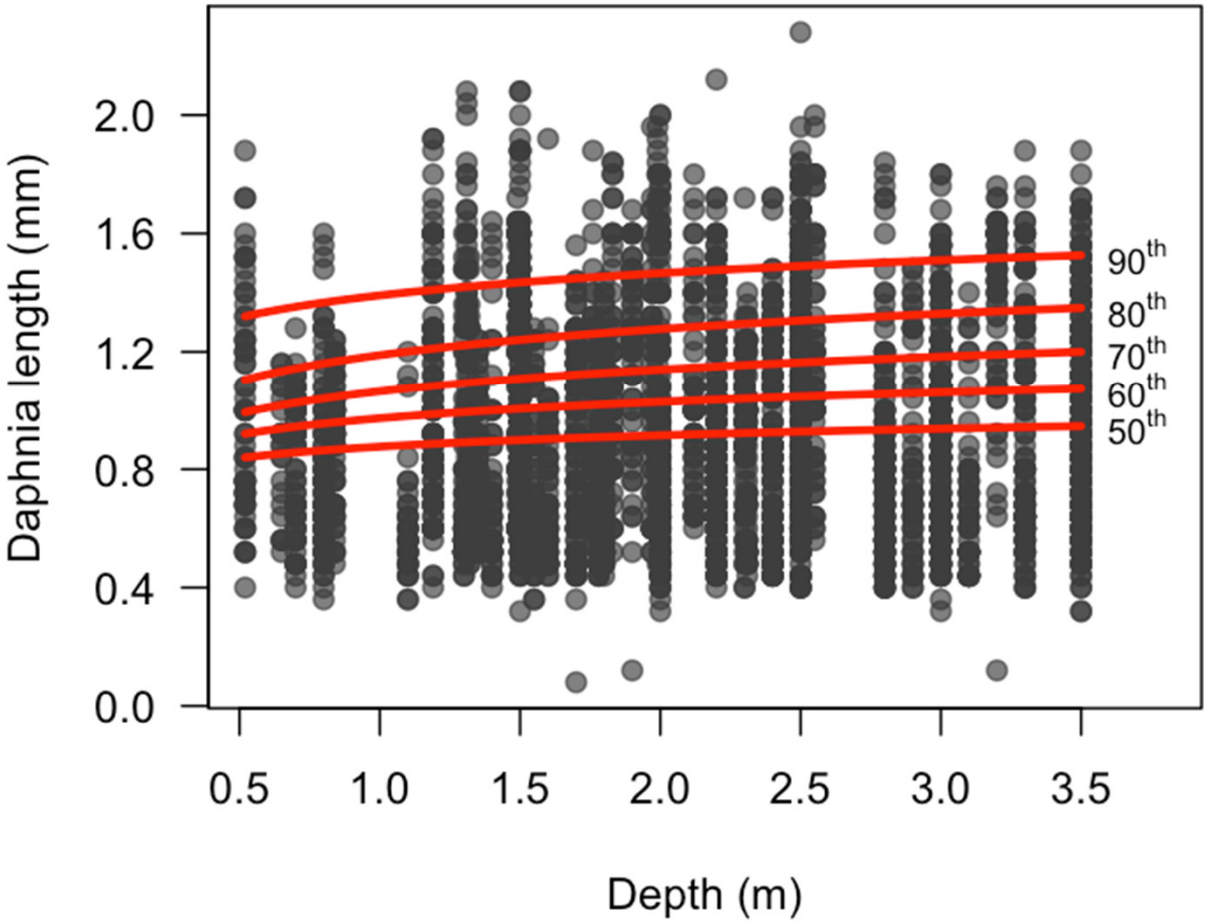


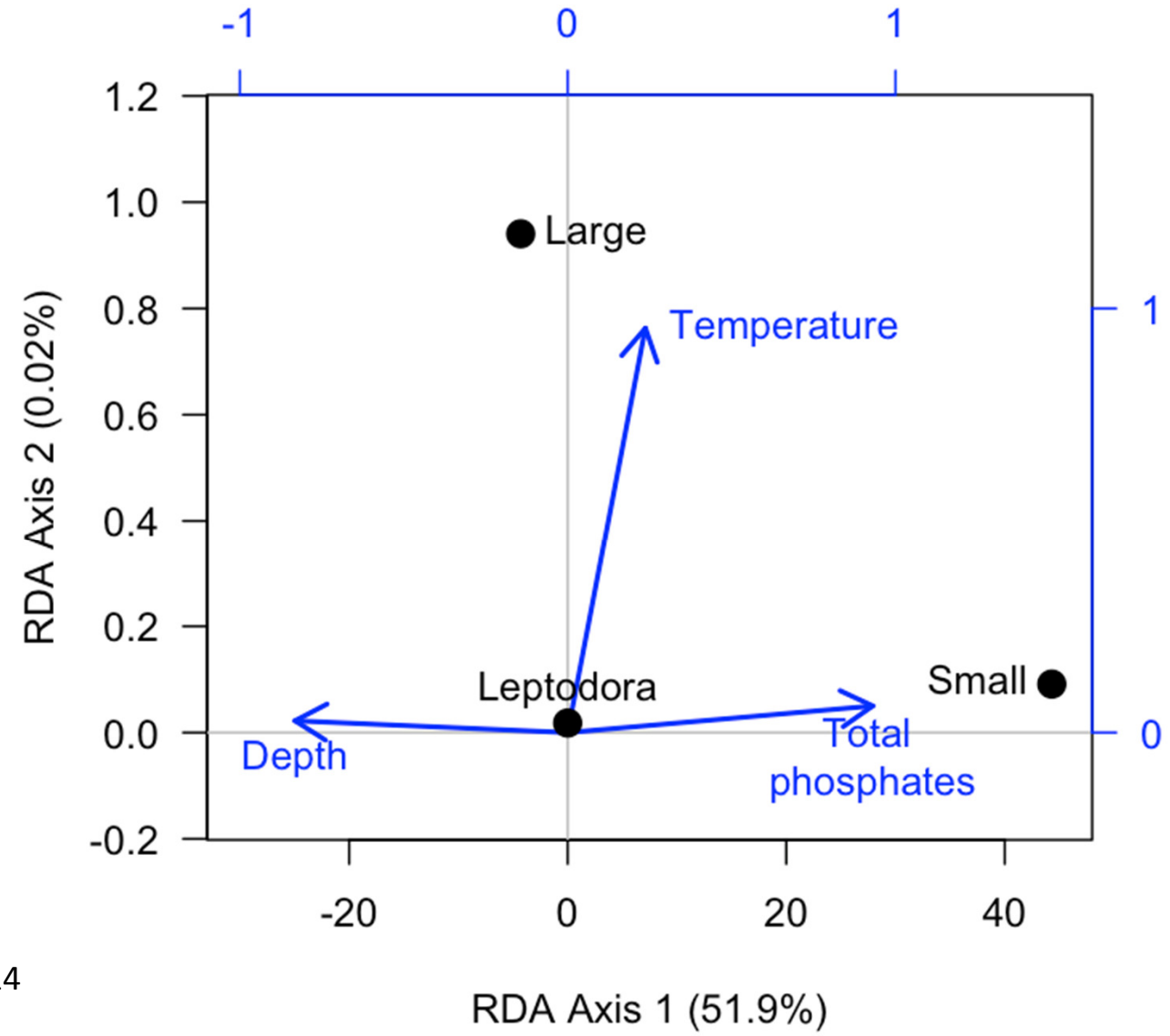
Sept 2011 – Sept 2014
66 site/dates
3711 lengths



90th percentile = 16% increase

Sept 2011 – Sept 2014

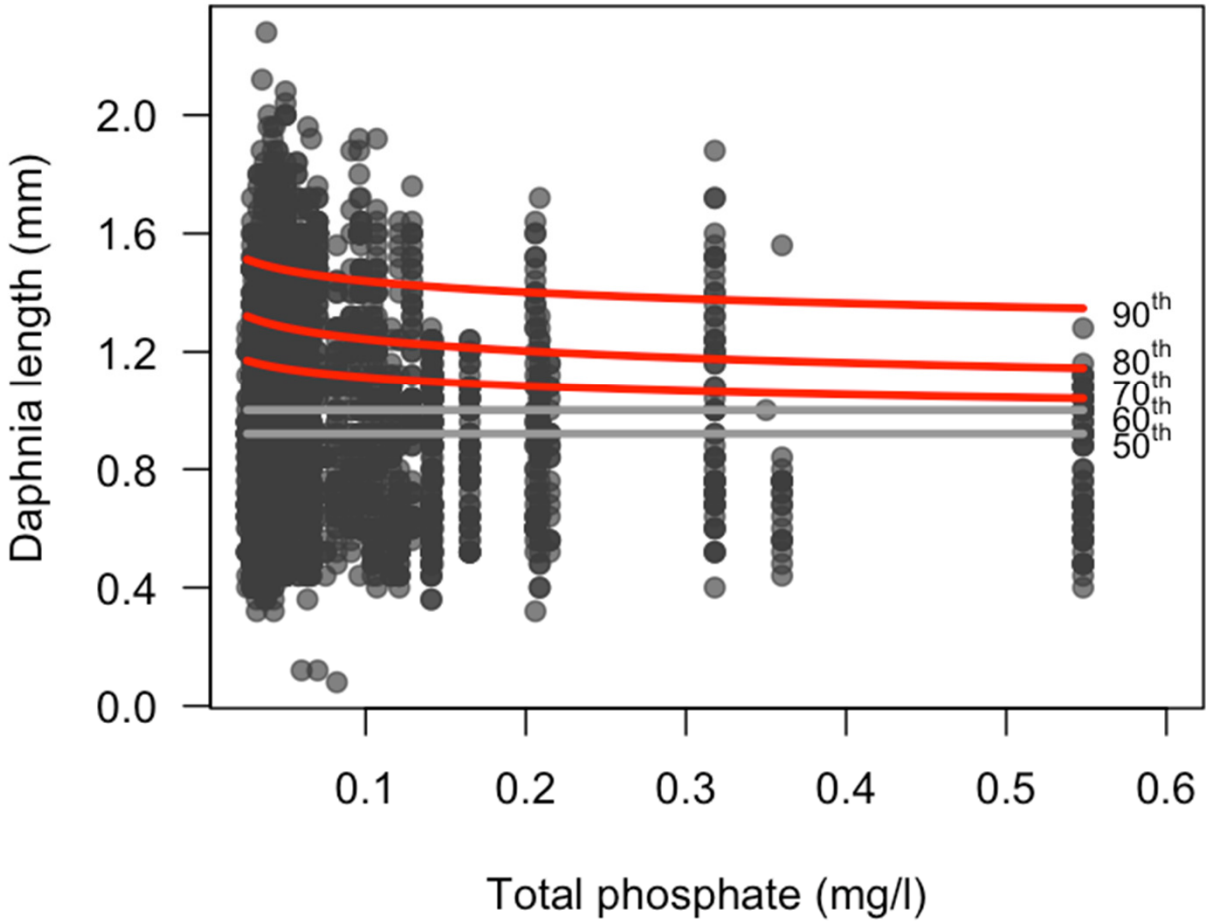


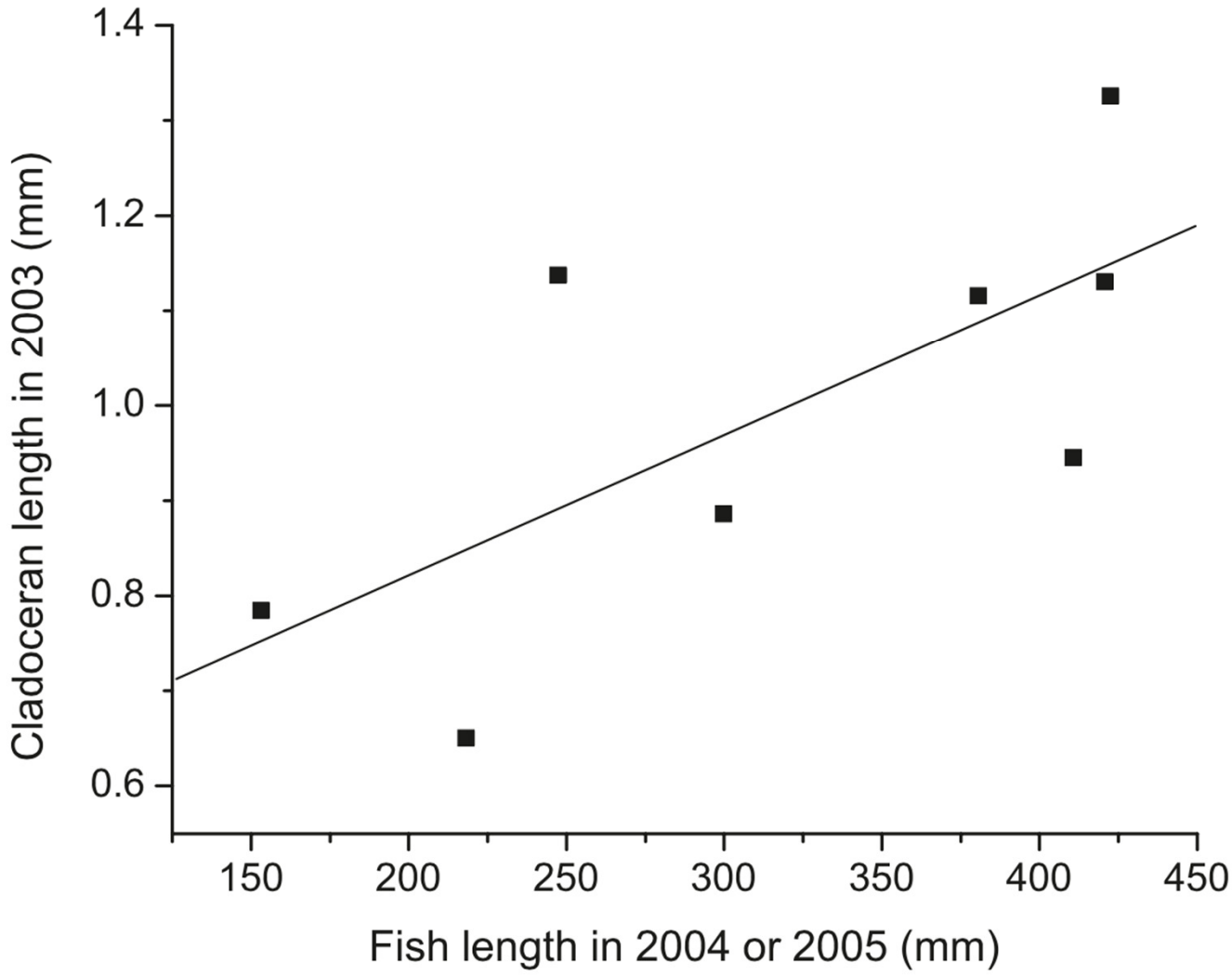


Sept 2011 – Sept 2014
N = 64 site/dates

90th percentile = 12% decrease

Sept 2011 – Sept 2014





Yan et al. 2008 CJFAS: Zooplankton in Canadian Shield Lakes

Summary:

- The zooplankton community shifts toward smaller taxa as total phosphates increase and as depths decrease
- Maximum *Daphnia* (optimal fish food) body size decreases as total phosphates increase and as depths decrease
- Suggesting that fish food decreases in abundance and quality as total phosphates increase and as depths decrease

Next steps:

- Investigate phytoplankton dynamics with an emphasis on cyanobacteria
- Test whether (and if so, how) carp removal may influence water quality, phytoplankton, and zooplankton dynamics

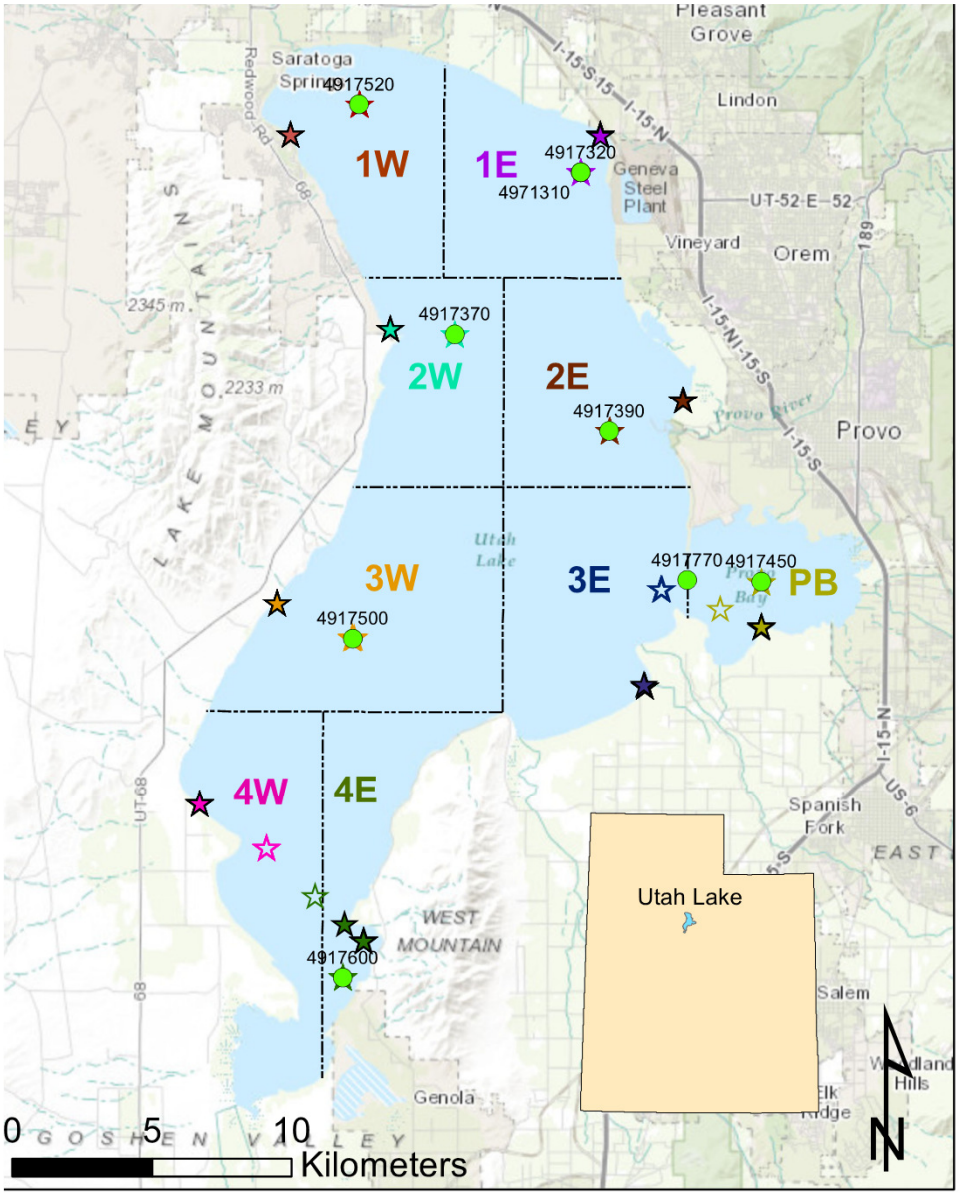
Questions / comments?

Jereme Gaeta
Jereme.Gaeta@usu.edu
435-797-2498

Kevin Landom
KevinLandom@gmail.com

Photo credit: Jamie Reynolds

Zooplankton Sampling Locations



Legend

- UDWQ Sampling Sites

USU Limnology Sampling sites

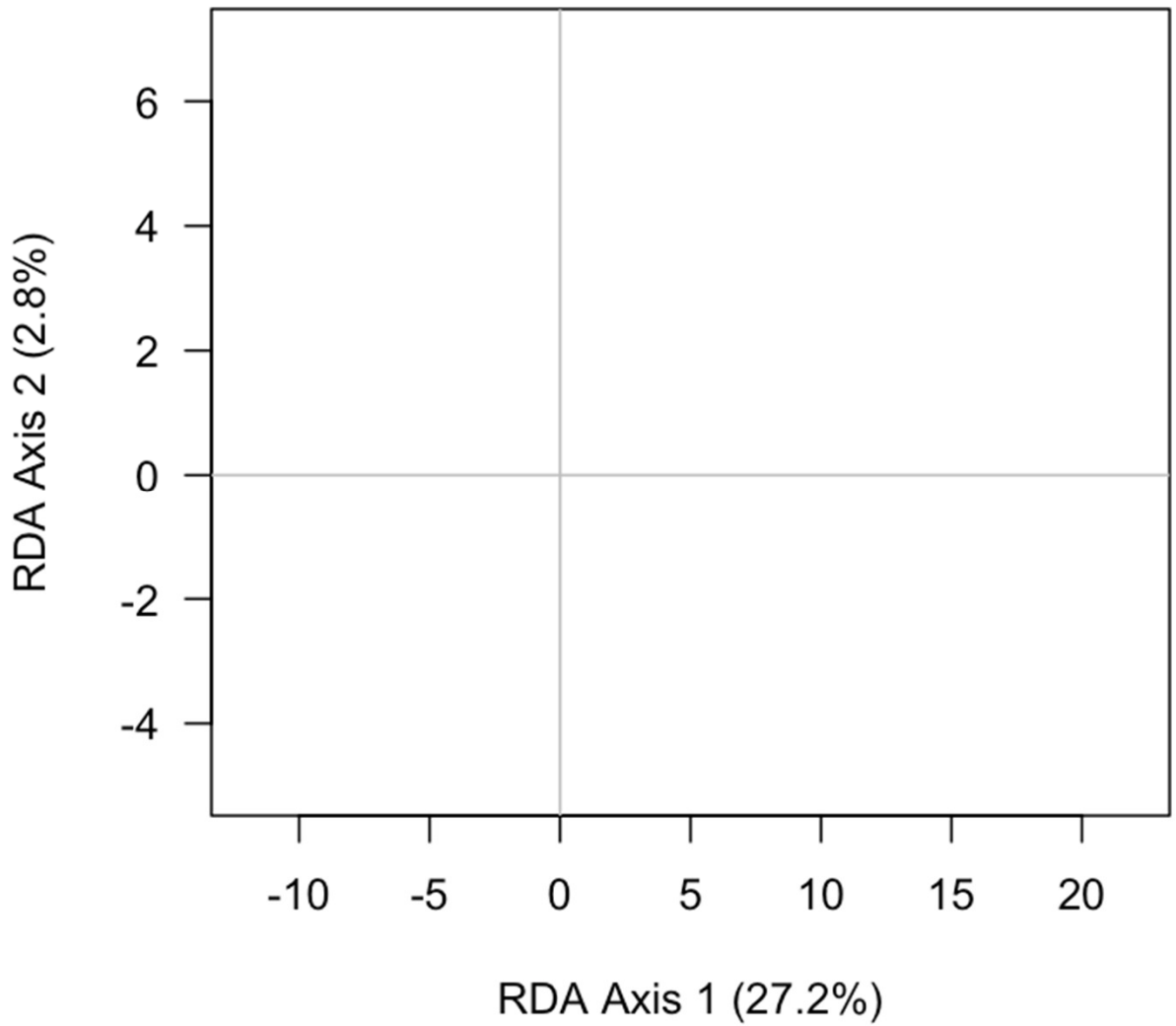
SITE, HABITAT

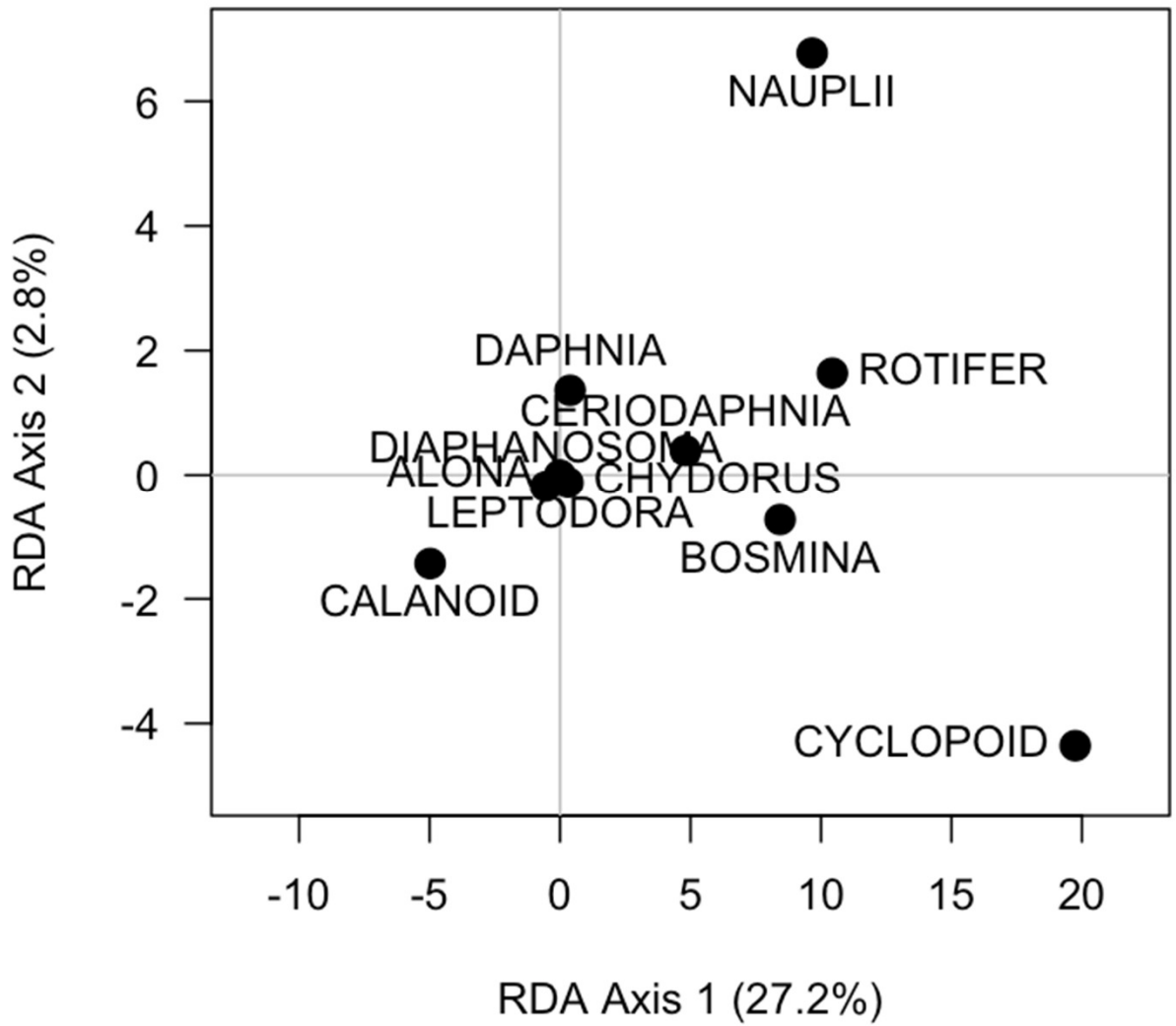
- 1E, Littoral
- 1E, Pelagic
- 1W, Littoral
- 1W, Pelagic
- 2E, Littoral
- 2E, Pelagic
- 2W, Littoral
- 2W, Pelagic
- 3E, Littoral
- 3E, Pelagic
- 3W, Littoral
- 3W, Pelagic
- 4E, Littoral
- 4E, Pelagic
- 4W, Littoral
- 4W, Pelagic
- PB, Littoral
- PB, Pelagic
- Stratum

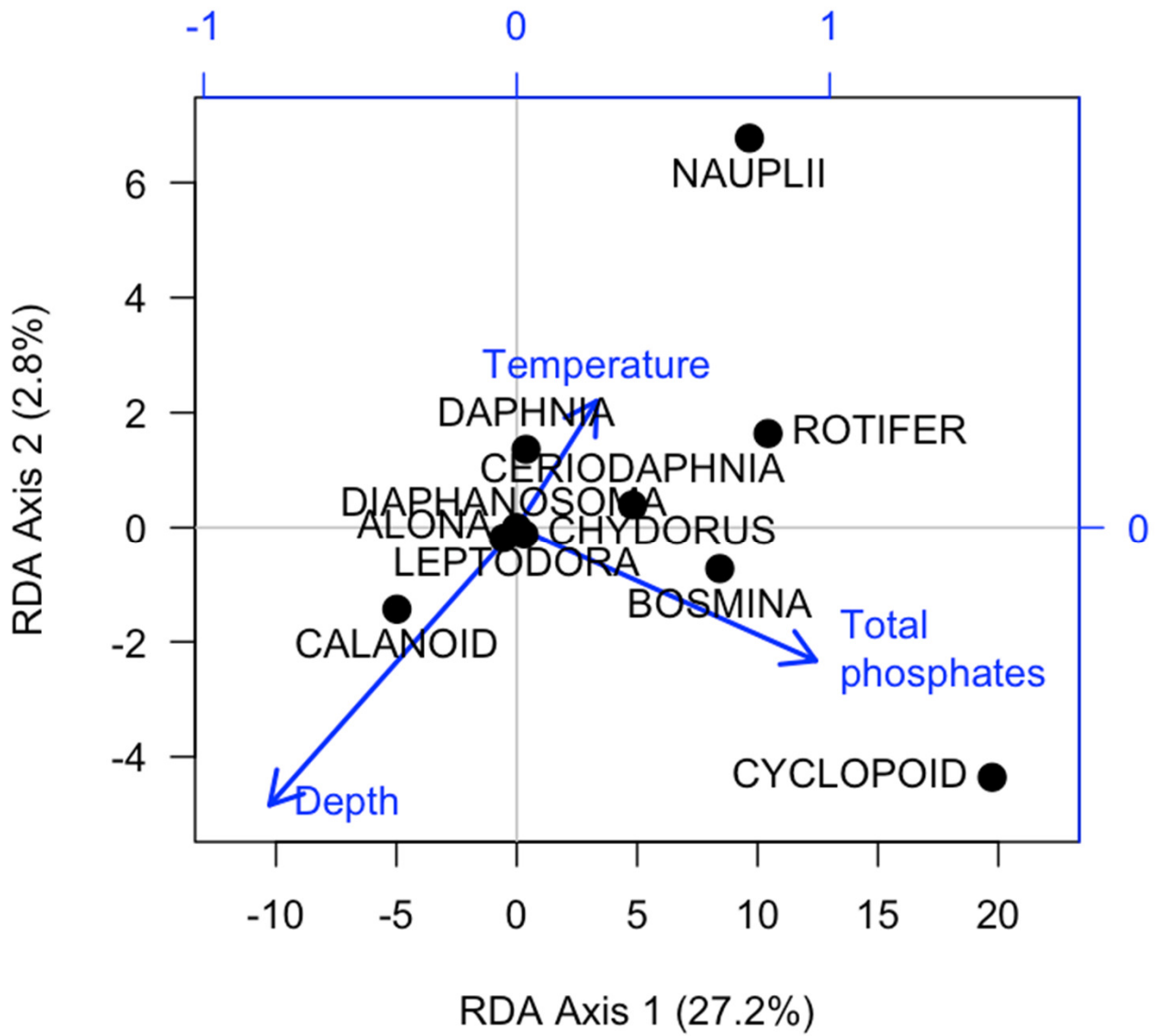
The purpose of this map is to illustrate the variation of the zooplankton sampling sites, of the efforts made by Utah State University (USU) and the Utah Division of Water Quality (UDWQ), at Utah Lake in Utah.

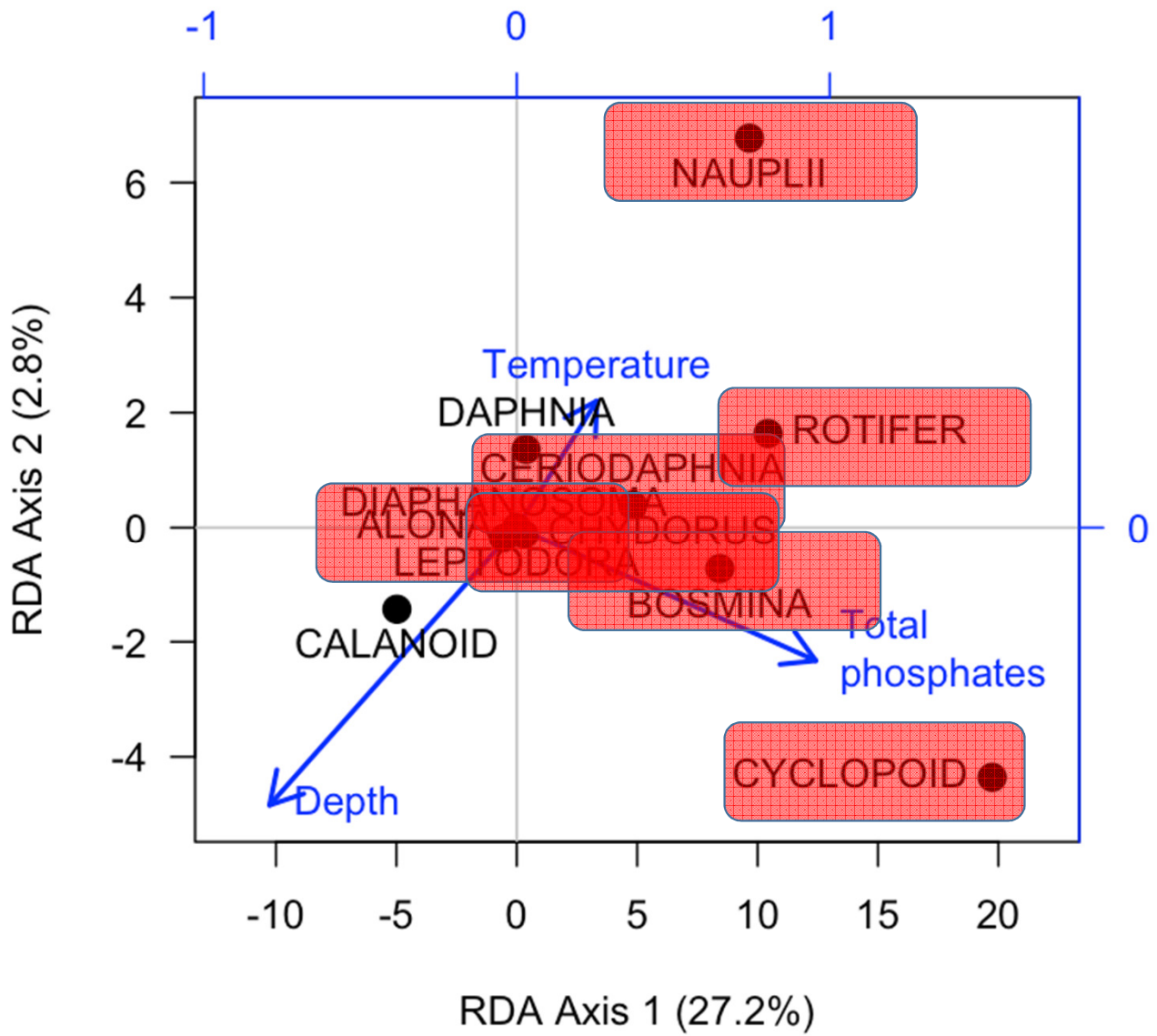
All of the sampling sites that the UDWQ has executed are included in the USU sampling sites, except for the sampling site located in between the 3E and PB stratums (UDWQ site #4917770).

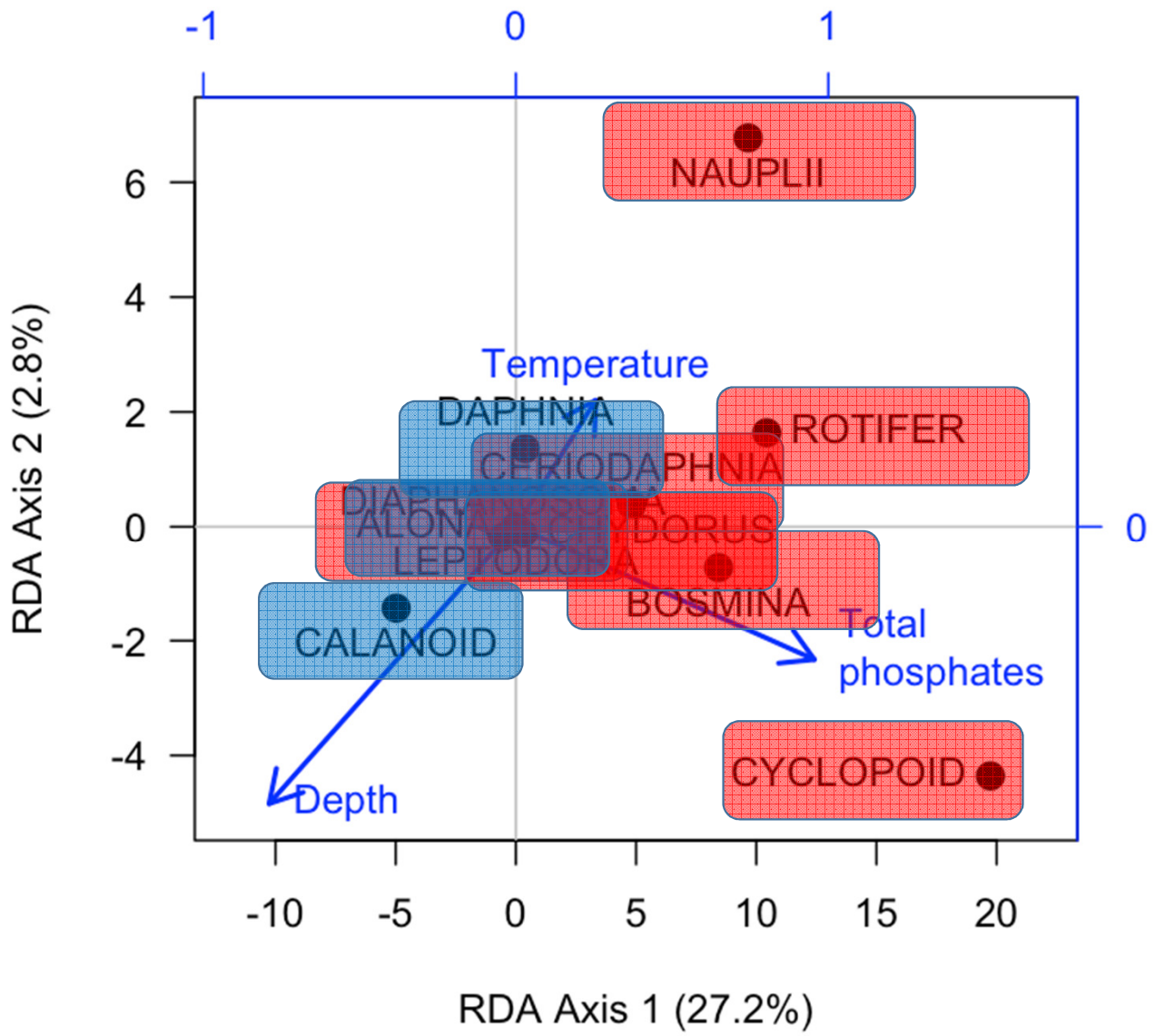
Data Credits
Technicians from working on Utah Lake during field seasons, Utah Division of Water Quality, and the Utah AGRC
Map Created by Matthew Meier
June 26, 2015


6
4
2
0
-2
-4
RDA Axis 2 (2.8%)
-10
-5
0
5
10
15
20
RDA Axis 1 (27.2%)

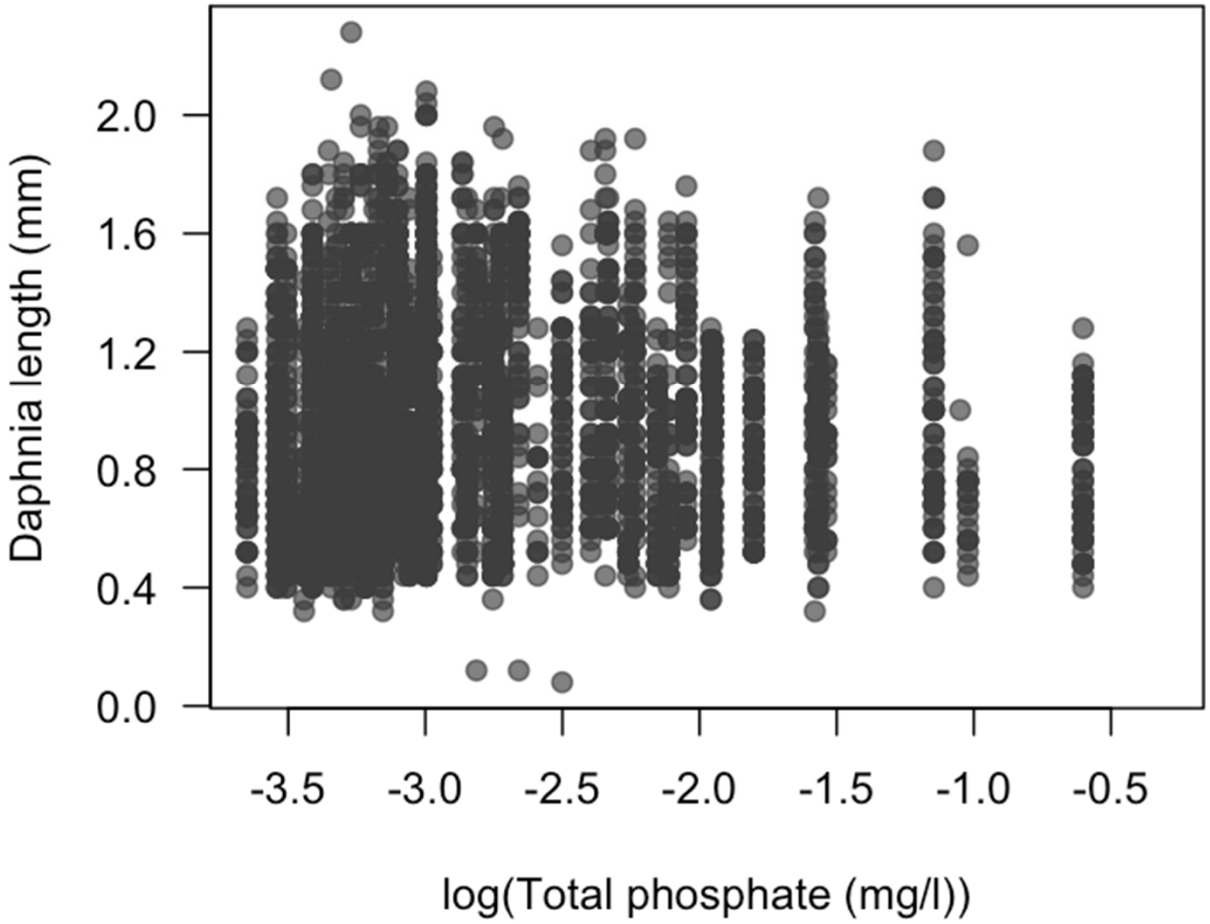

NAUPLII
DAPHNIA
ROTIFER
CERIODAPHNIA
DIAPHANOSOMA
ALONA
CHYDORUS
LEPTODORA
BOSMINA
CALANOID
CYCLOPOID
6
4
2
0
-2
-4
-10
-5
0
5
10
15
20
RDA Axis 2 (2.8%)
RDA Axis 1 (27.2%)


-1
0
1
NAUPLII
6
4
2
0
-2
-4
Temperature
DAPHNIA
ROTIFER
CERIODAPHNIA
DIAPHANOSOMA
ALONA
CHYDORUS
LEPTODORA
BOSMINA
CALANOID
Total
phosphates
CYCLOPOID
Depth
0
RDA Axis 2 (2.8%)
-10
-5
0
5
10
15
20
RDA Axis 1 (27.2%)

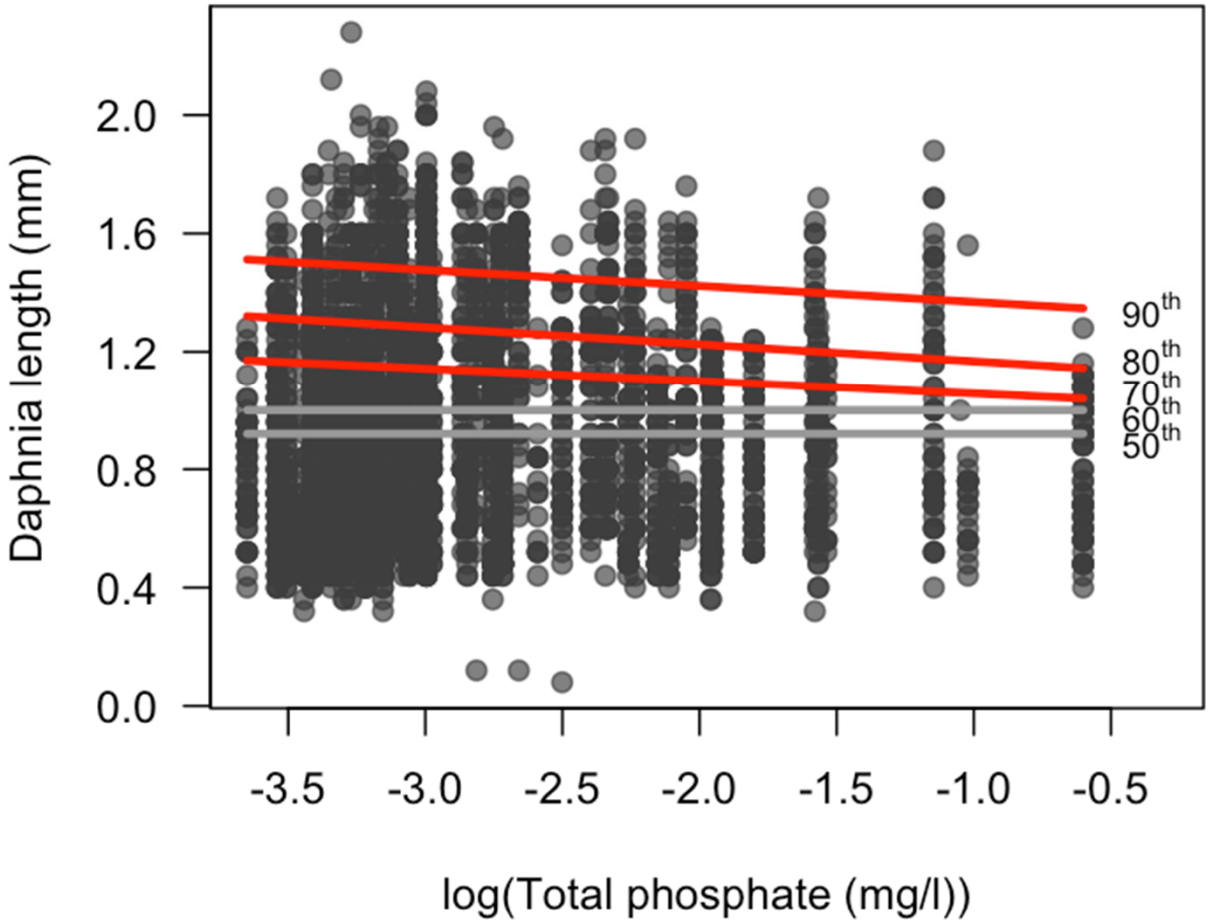

-1
0
1
NAUPLII
6
4
2
0
-2
-4
Temperature
DAPHNIA
ROTIFER
CERIODAPHNIA
DIAPHANOSOMA
ALONA
CHYDORUS
LEPTODORA
BOSMINA
CALANOID
Total
phosphates
CYCLOPOID
Depth
0
-10
-5
0
5
10
15
20
RDA Axis 2 (2.8%)
RDA Axis 1 (27.2%)

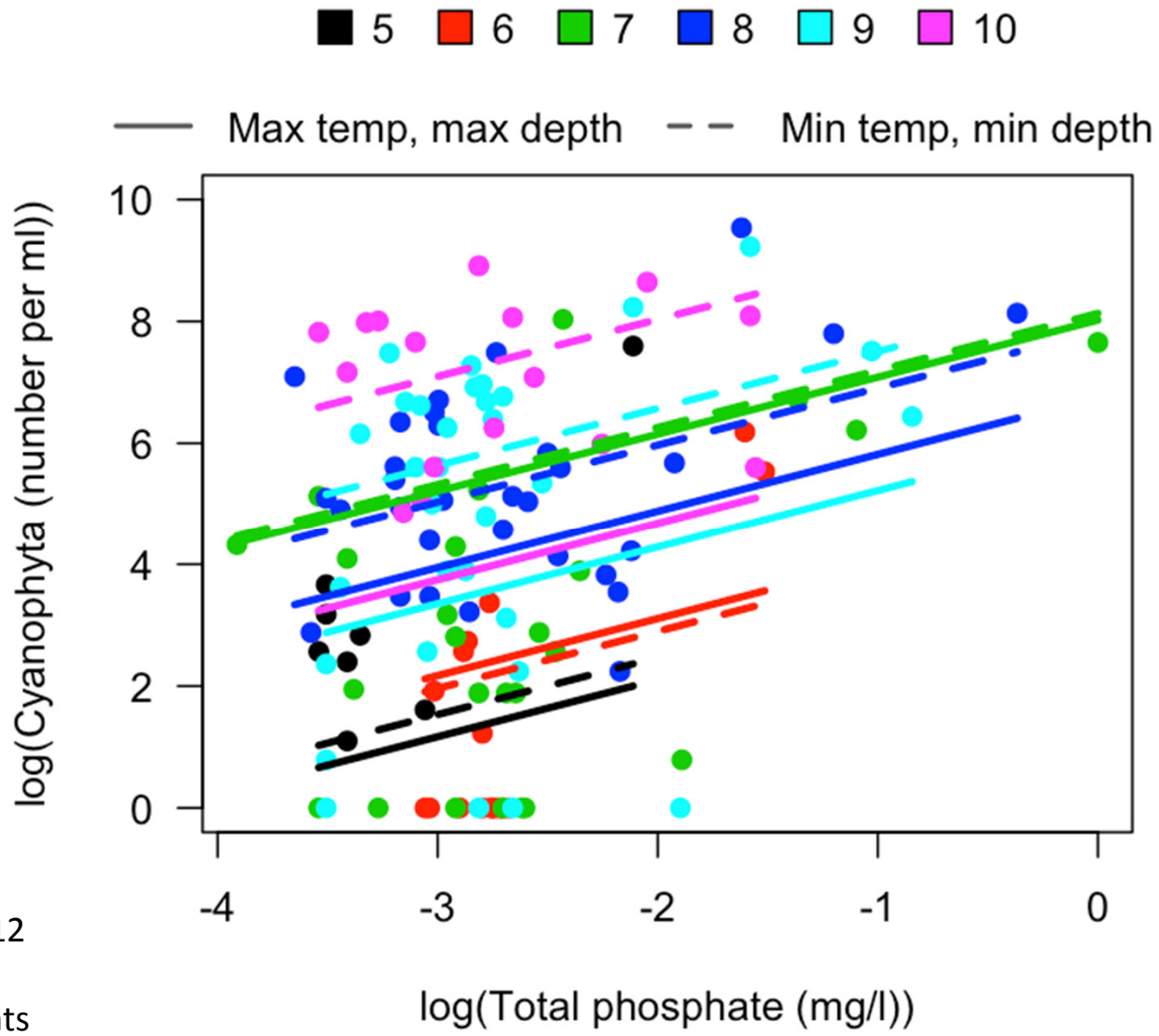

-1
0
1
NAUPLII
6
4
2
0
-2
-4
Temperature
DAPHNIA
CERIODAPHNIA
ROTIFER
BOSMINA
CALANOID
CYCLOPOID
Total
phosphates
Depth
0
-10
-5
0
5
10
15
20
RDA Axis 2 (2.8%)
RDA Axis 1 (27.2%)

Sept 2011 – Sept 2014

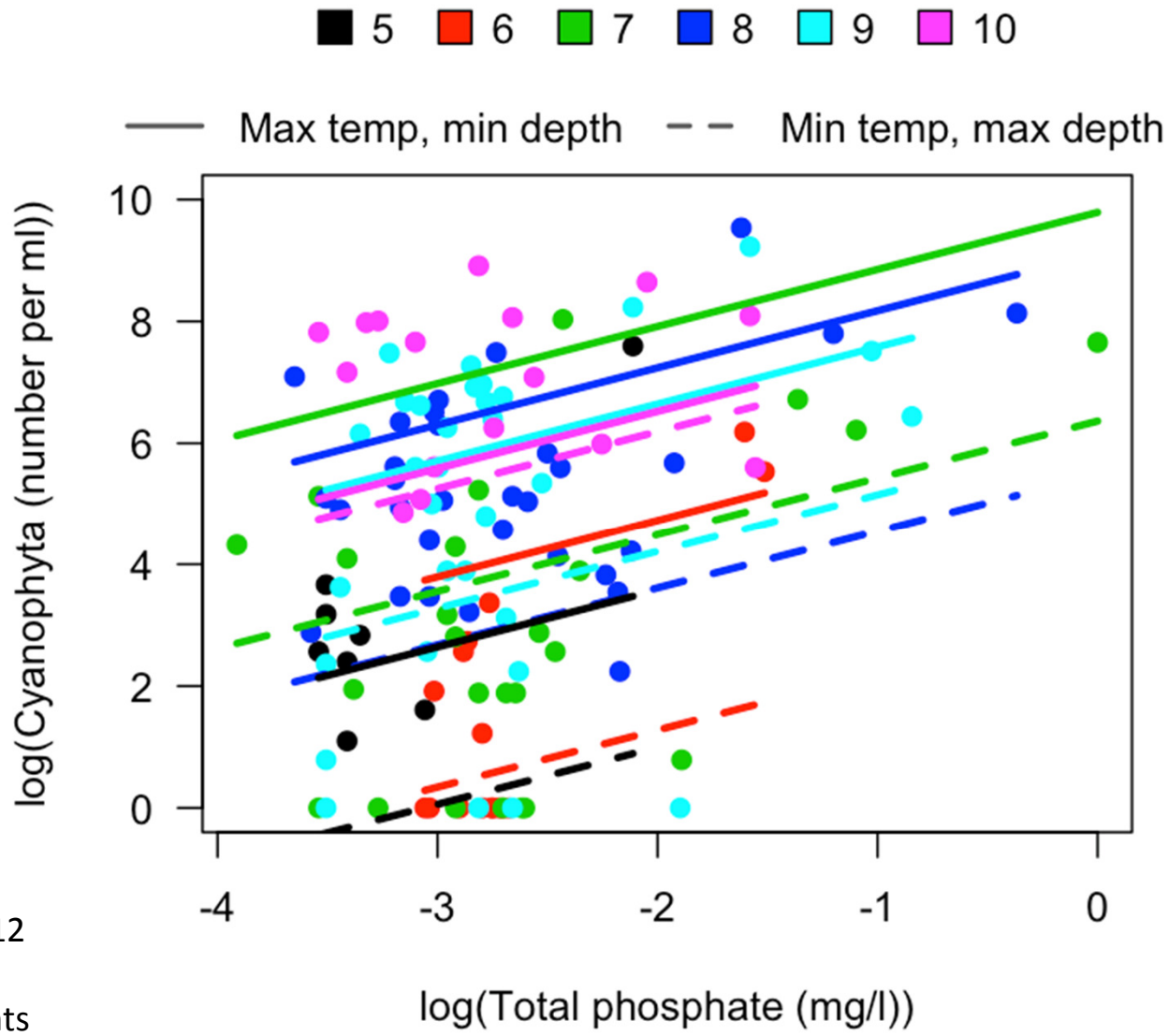


Sept 2011 – Sept 2014

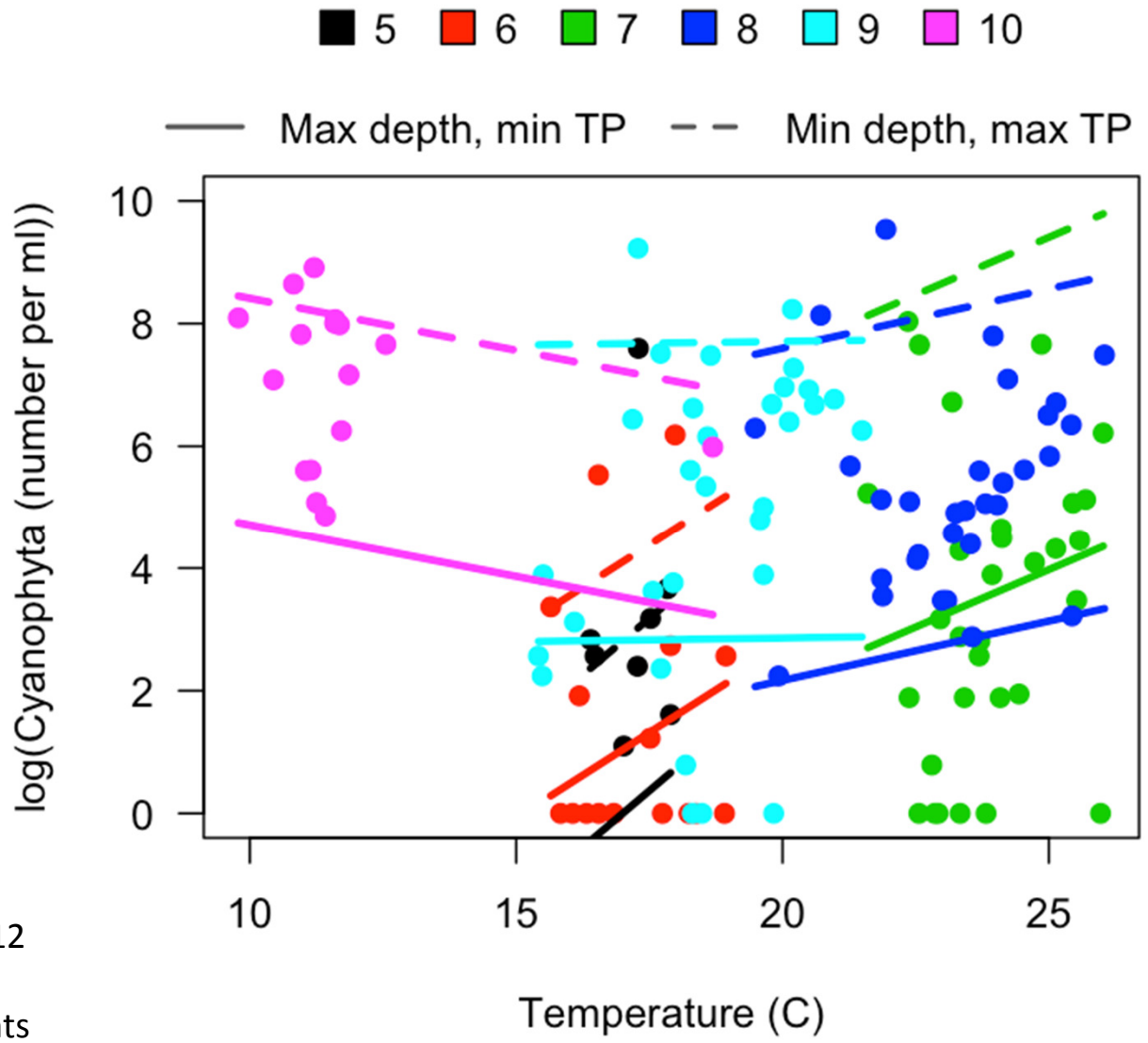




Sept 2005 – Sept 2012
8 sites
135 site-sample events



Sept 2005 – Sept 2012
8 sites
135 site-sample events



Sept 2005 – Sept 2012
8 sites
135 site-sample events