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Oklahoma Scenic Rivers Joint Phosphorus Study: Interim Report, 8 April 2016

Principal Investigator:

Ryan S. King

Professor, Department of Biology, Center for Reservoir and Aquatic Systems Research, Baylor University, Waco, TX 76798

www.baylor.edu/aquaticlab

Joint Study Committee Members:

Brian Haggard; Co-Chair (University of Arkansas)
Marty Matlock (University of Arkansas)
Ryan Benefield (Arkansas Natural Resources Commission)

Derek Smithee; Co-Chair (Oklahoma Water Resources Board)
Shellie Chard-McClary (Oklahoma Dept. of Environmental Quality)
Shanon Philips (Oklahoma Conservation Commission)

CRASR
Center for Reservoir & Aquatic Systems Research

Study Framework

"to determine the total phosphorus threshold response level....at which any statistically significant shift occurs in

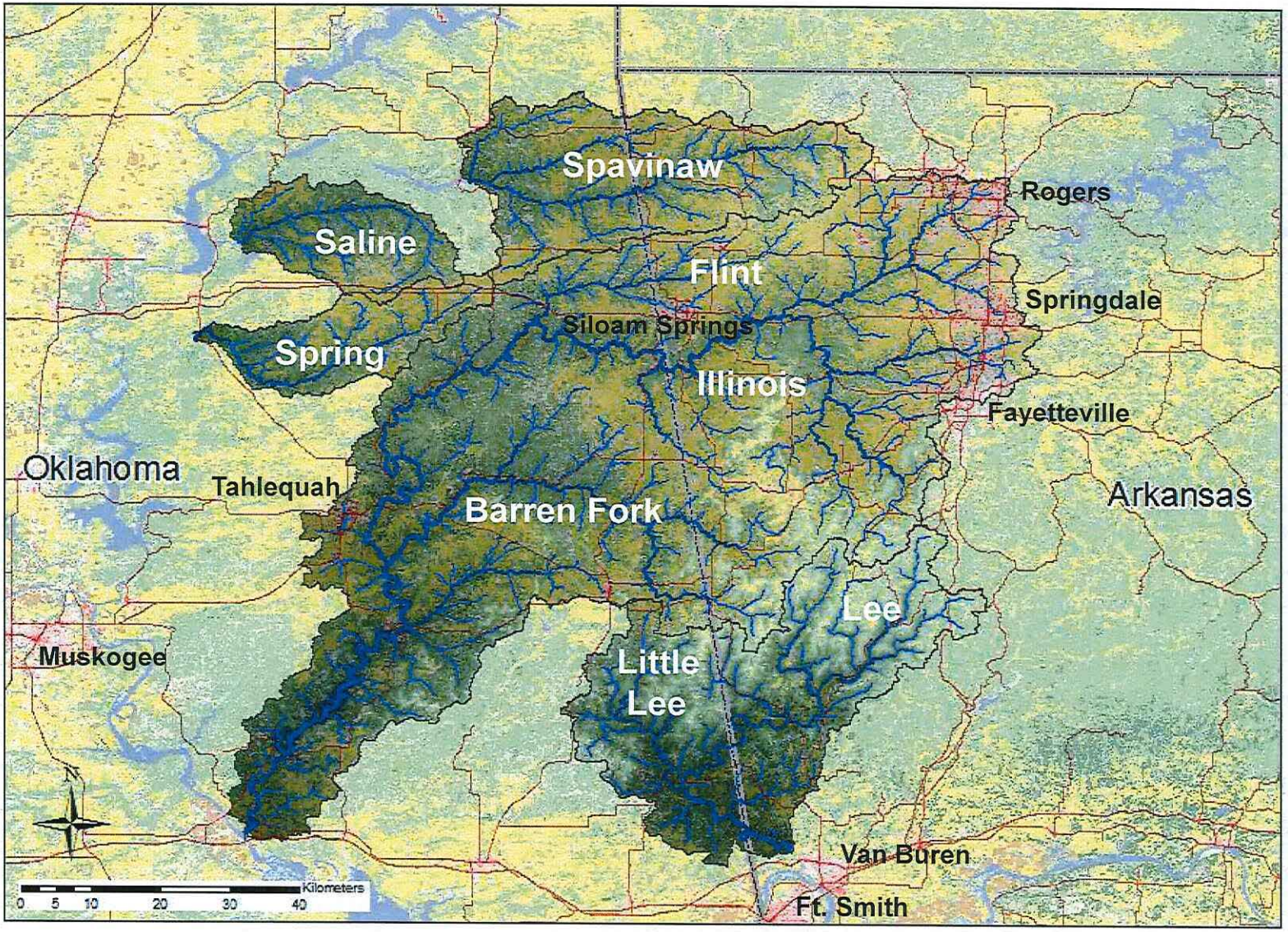
1. algal species composition OR
2. algal biomass production

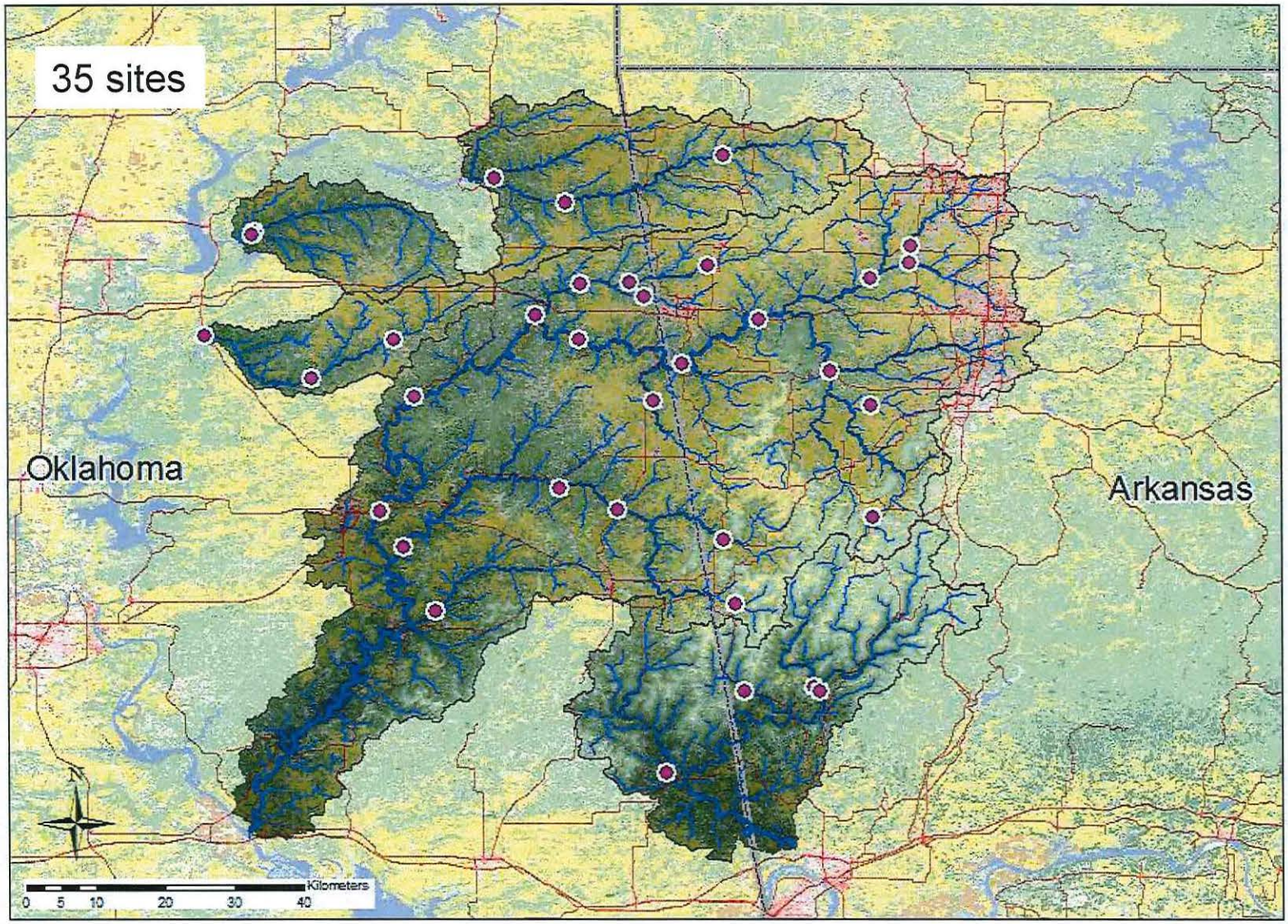
...resulting in undesirable

1. aesthetic OR
2. water quality

...conditions in the Designated Scenic Rivers."

Second Statement of Joint Principles and Actions, p.2, Mandatory Study Components


Spavinaw
Saline
Flint
Spring
Siloam Springs
Illinois
Rogers
Springdale
Fayetteville
Oklahoma
Tahlequah
Barren Fork
Arkansas
Lee
Muskogee
Little
Lee
Van Buren
Ft. Smith
N
Kilometers
0 5 10 20 30 40


35 sites
Oklahoma
Arkansas
Kilometers
0 5 10 20 30 40

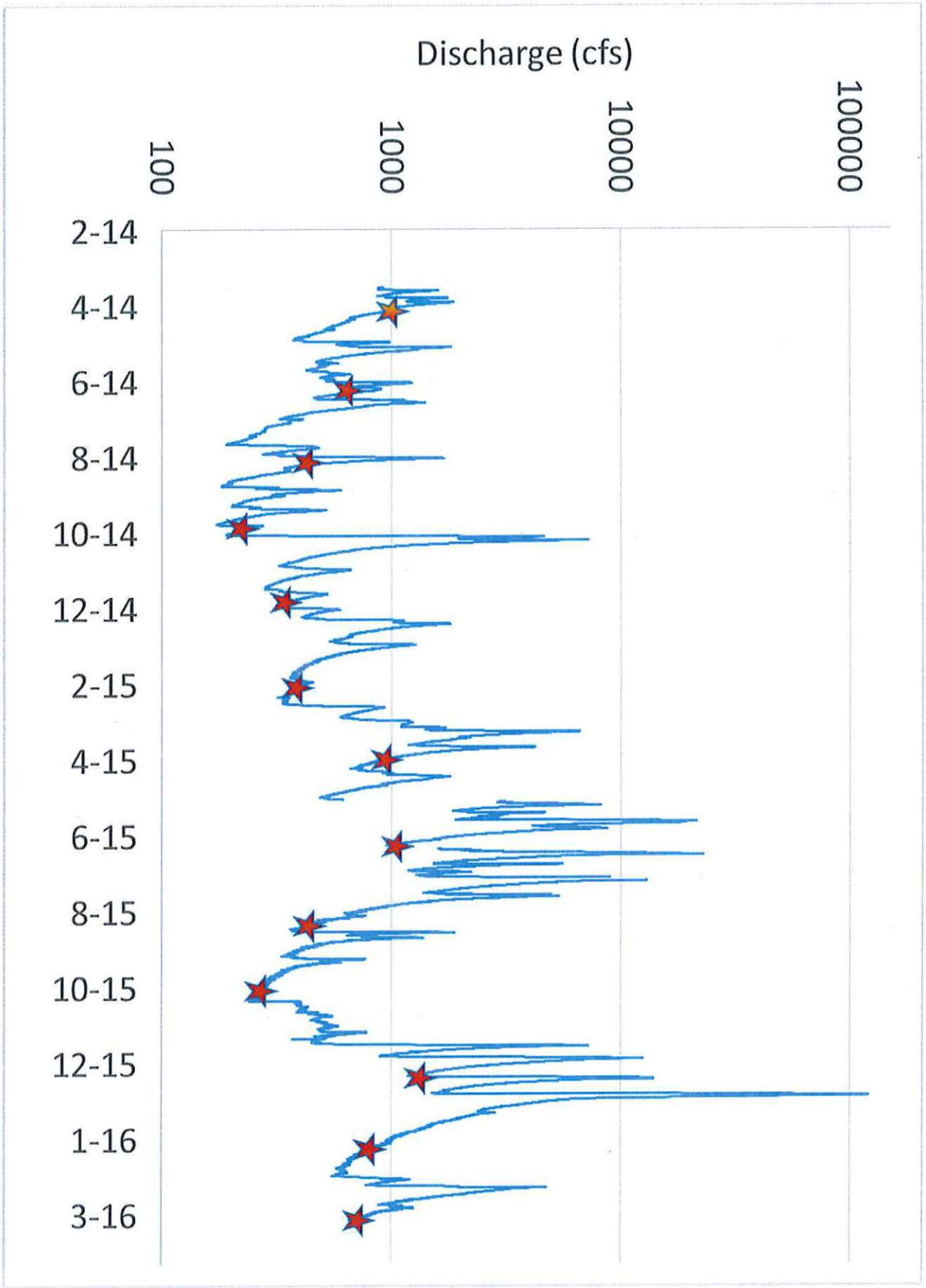
Sampling Frequency

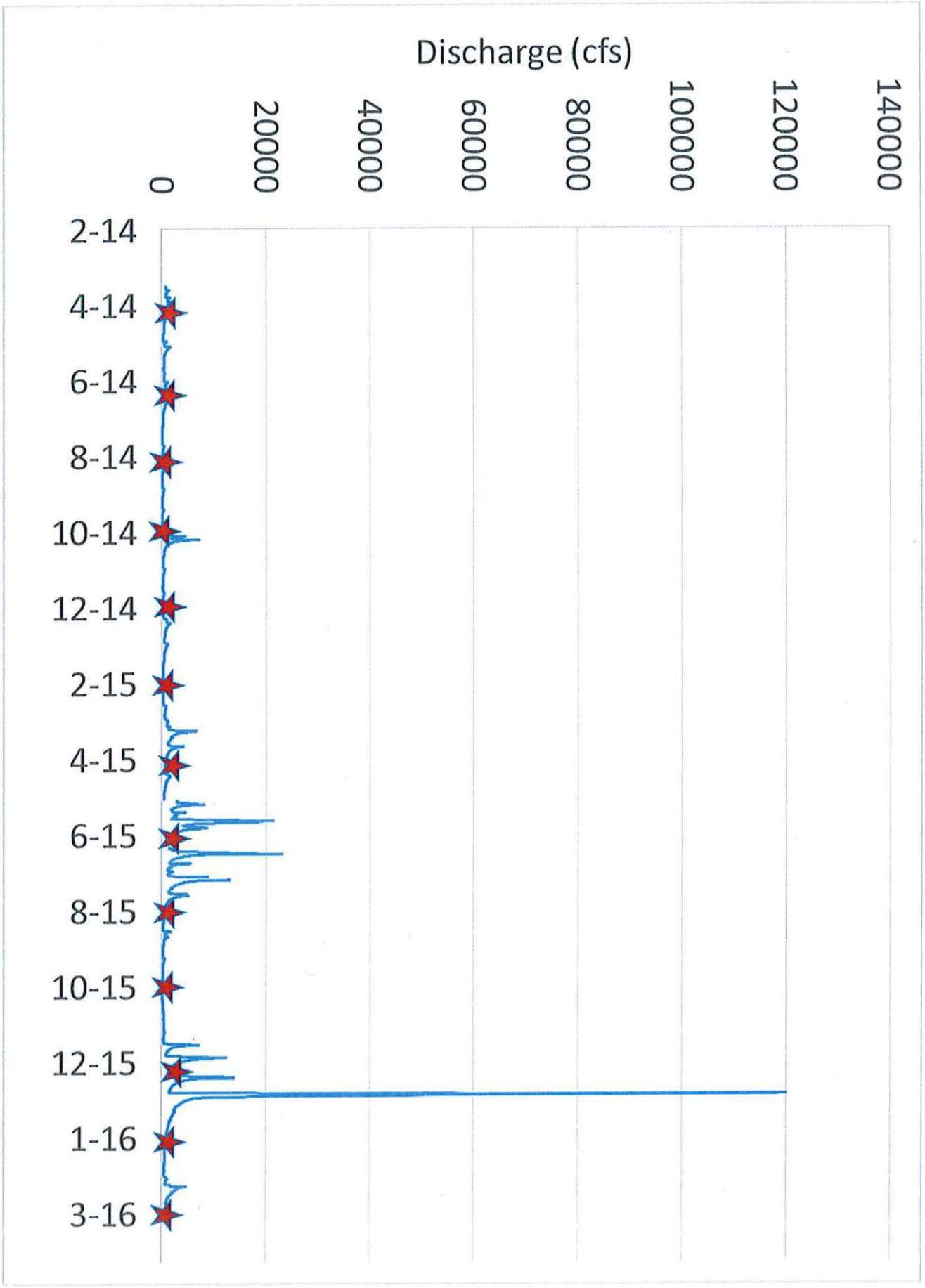
Sampling scheduled bimonthly. Proposed sampling was to result in 12 events in 2 years. All 12 sampling events have been completed.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2014				Site selection		X		X		X		X
2015		X		X		X		X		X		X
2016		X		X	Final analyses & report writing							

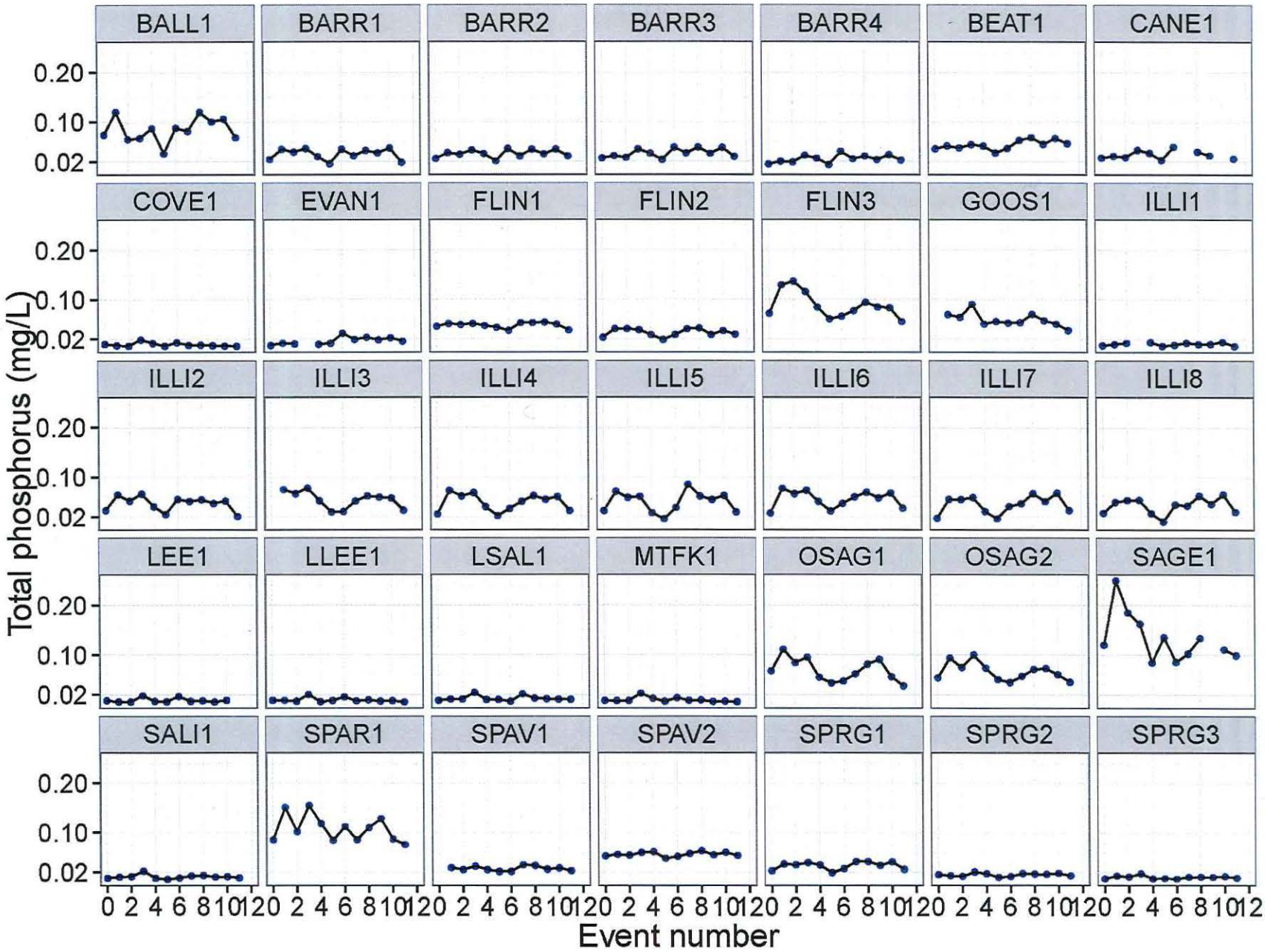
Data status report

Event	TP	TN, DOC, DNP	Benthic CHLA/ AFDM	Sestonic CHLA/ TSS	Ben-thic CNP	Soft spp.	Dia-tom spp.	Hess	Diel DO
Jun-14	X	X	X	X	X	X	X	X	N/A
Aug-14	X	X	X	X	X	N/A	N/A	X	X
Oct-14	X	X	X	X	X	X	X	X	N/A
Dec-14	X	X	X	X	X	N/A	N/A	X	N/A
Feb-15	X	X	X	X	X	X	N/A	X	N/A
Apr-15	X	X	X	X	X	X	X	X	N/A
Jun-15	X	X	X	X	X	?	?	X	N/A
Aug-15	X	X	X	X	X	?	?	X	X
Oct-15	X	X	X	X	X	?	?	X	N/A
Dec-15	X	X	X	X	X	?	?	X	N/A
Feb-16	X	X	X	X	X	?	?	80%	N/A
Apr-16						?	?		

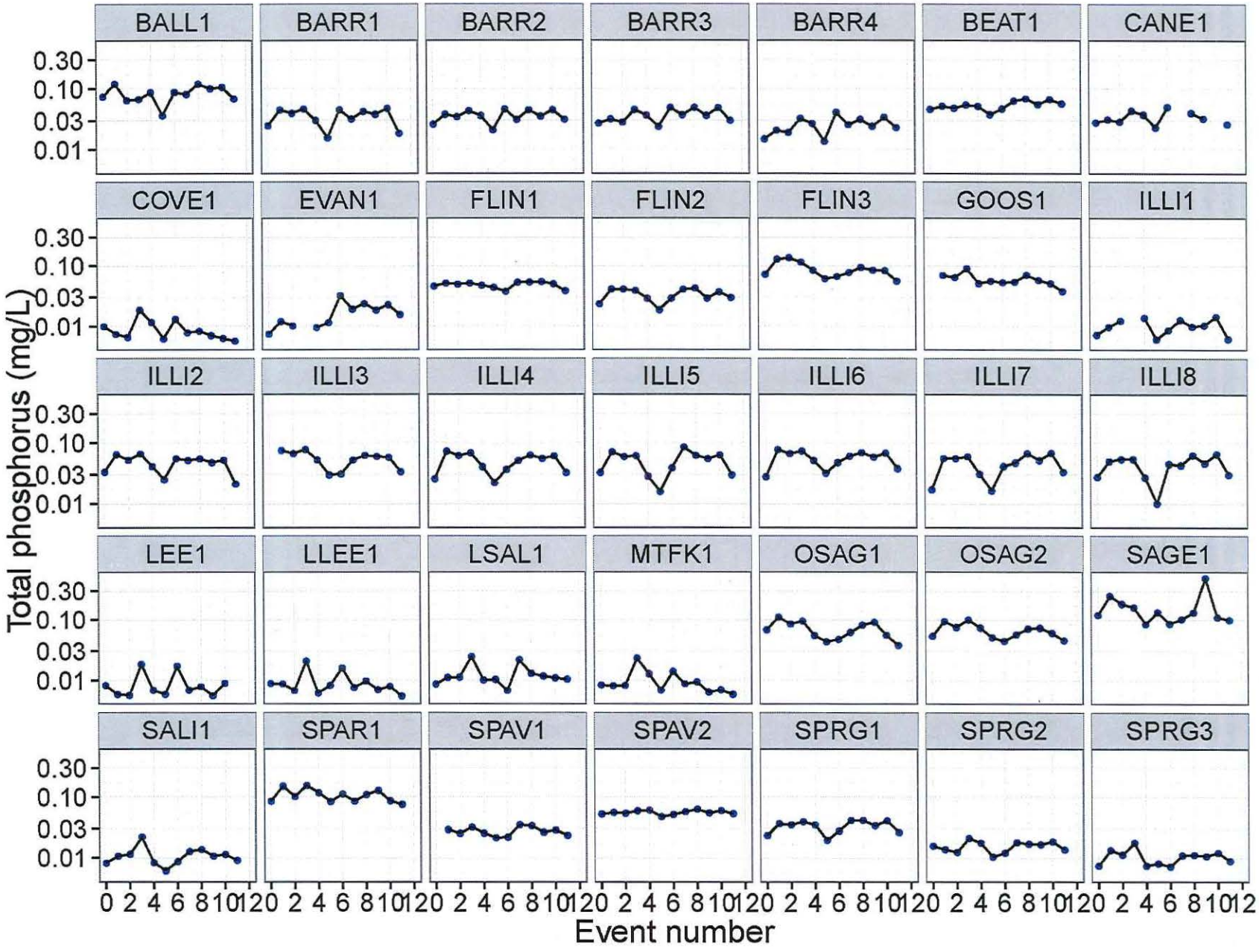

Discharge (cfs)
100
1000
10000
100000
2-14
4-14
6-14
8-14
10-14
12-14
2-15
4-15
6-15
8-15
10-15
12-15
1-16
3-16

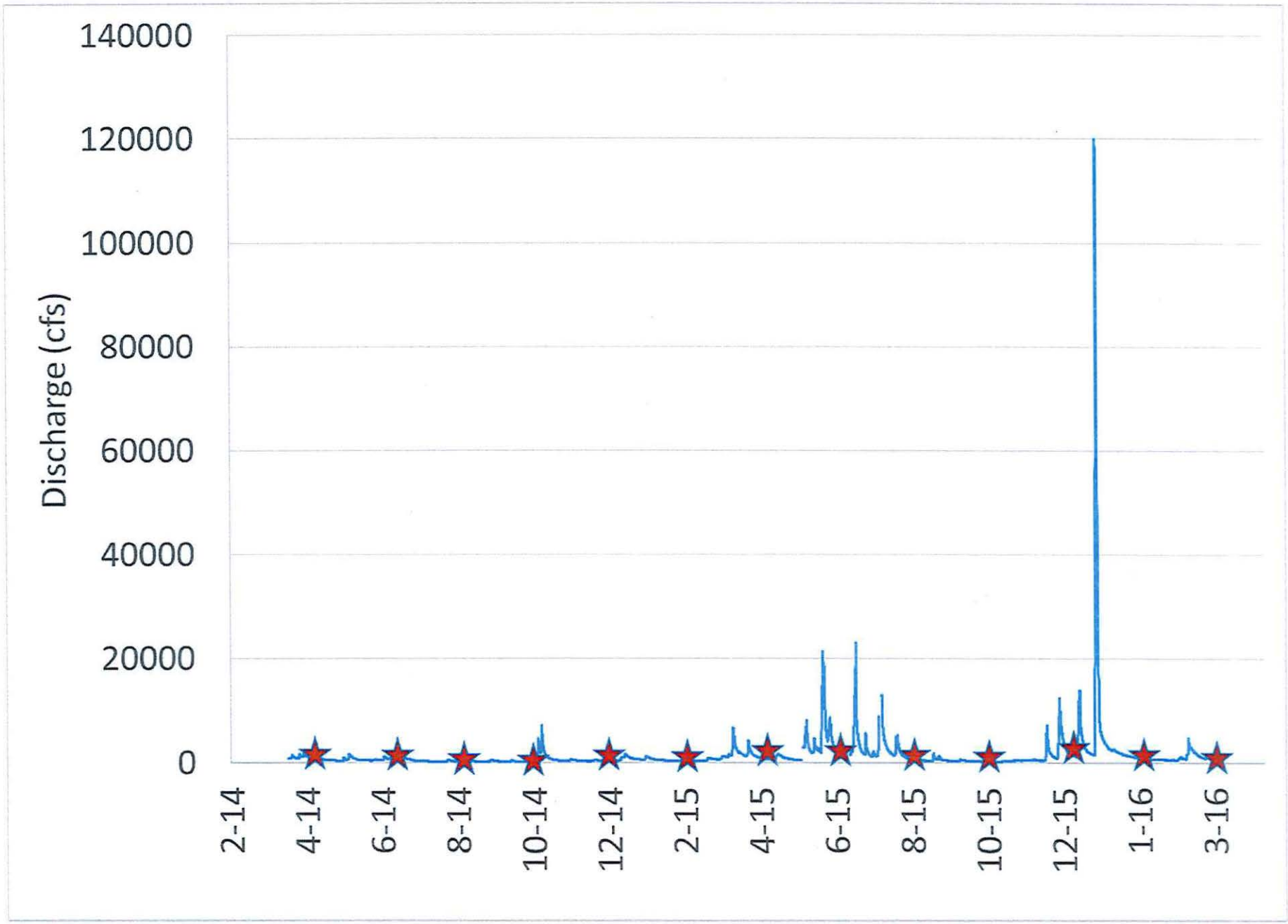

Discharge (cfs)
0
20000
40000
60000
80000
100000
120000
140000
2-14
4-14
6-14
8-14
10-14
12-14
2-15
4-15
6-15
8-15
10-15
12-15
1-16
3-16

TP vs time by location

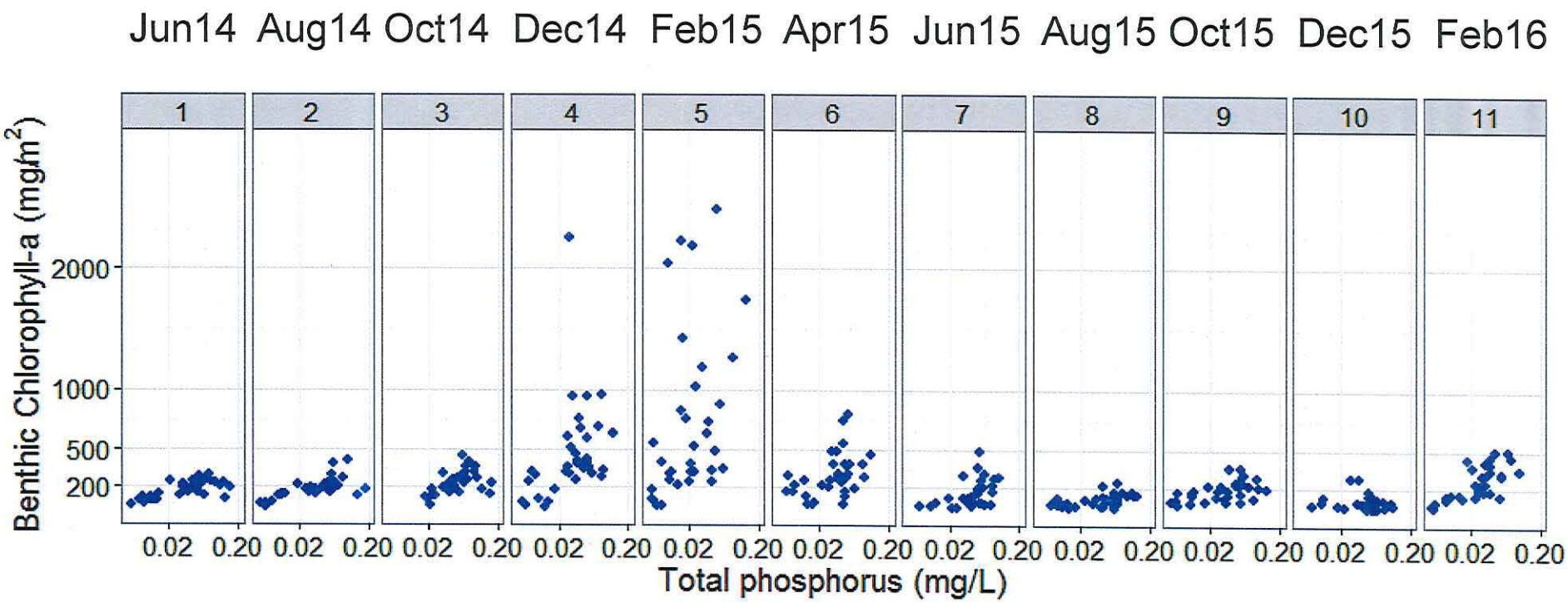


TP (log scale) vs time by location

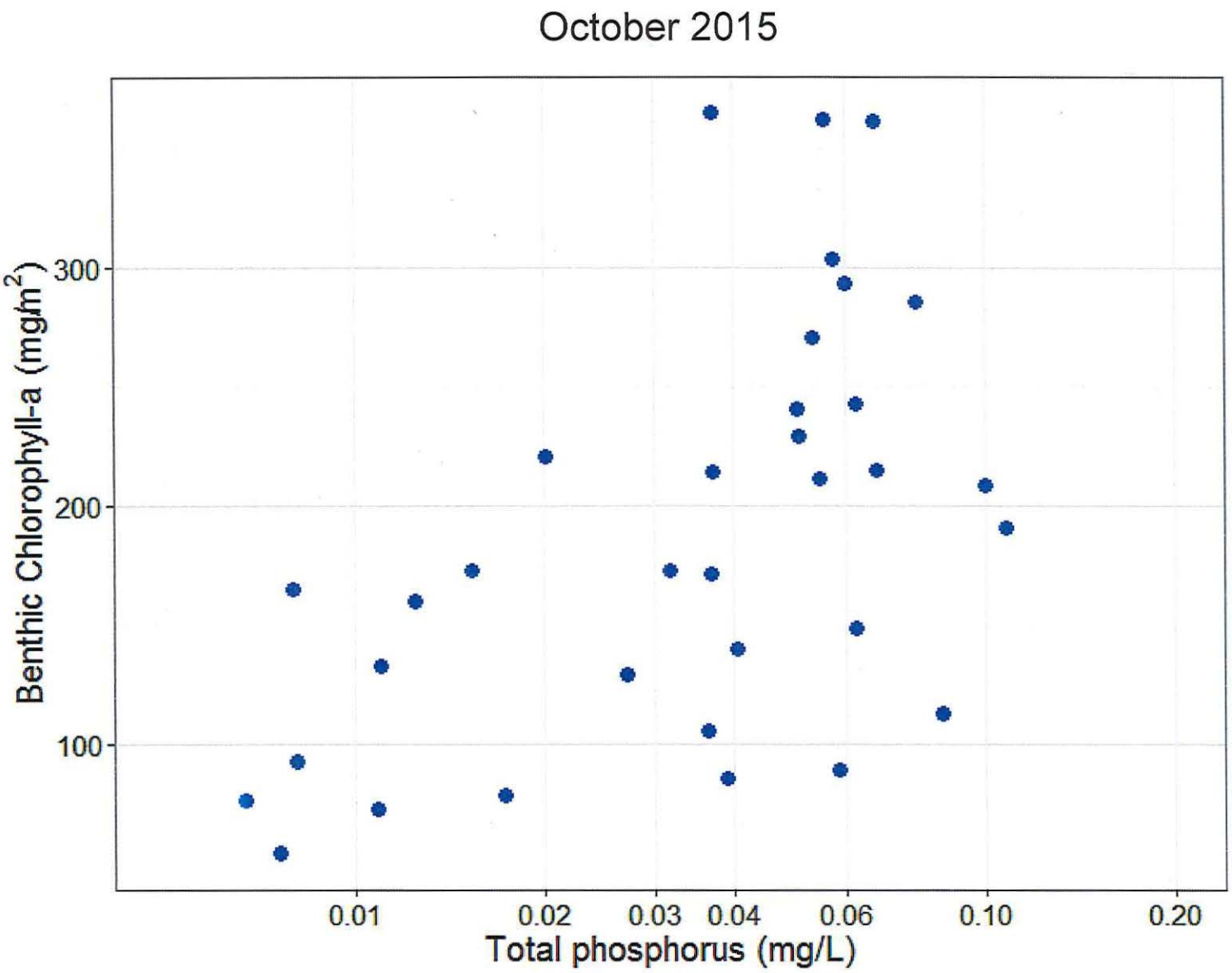



140000
120000
100000
80000
60000
40000
20000
0
Discharge (cfs)
2-14
4-14
6-14
8-14
10-14
12-14
2-15
4-15
6-15
8-15
10-15
12-15
1-16
3-16

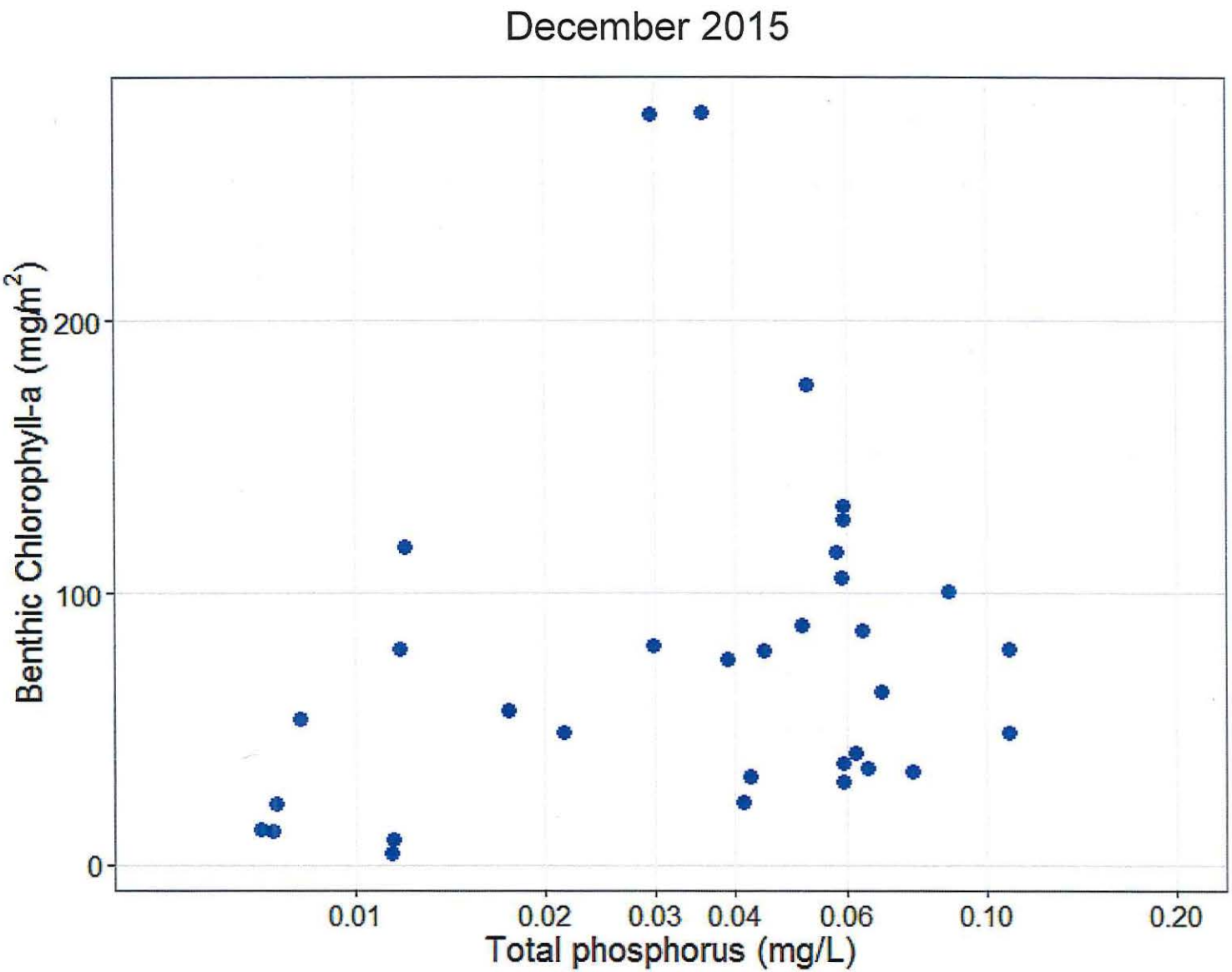
Benthic (Periphyton) Chlorophyll-*a* (mg/m^2) vs TP



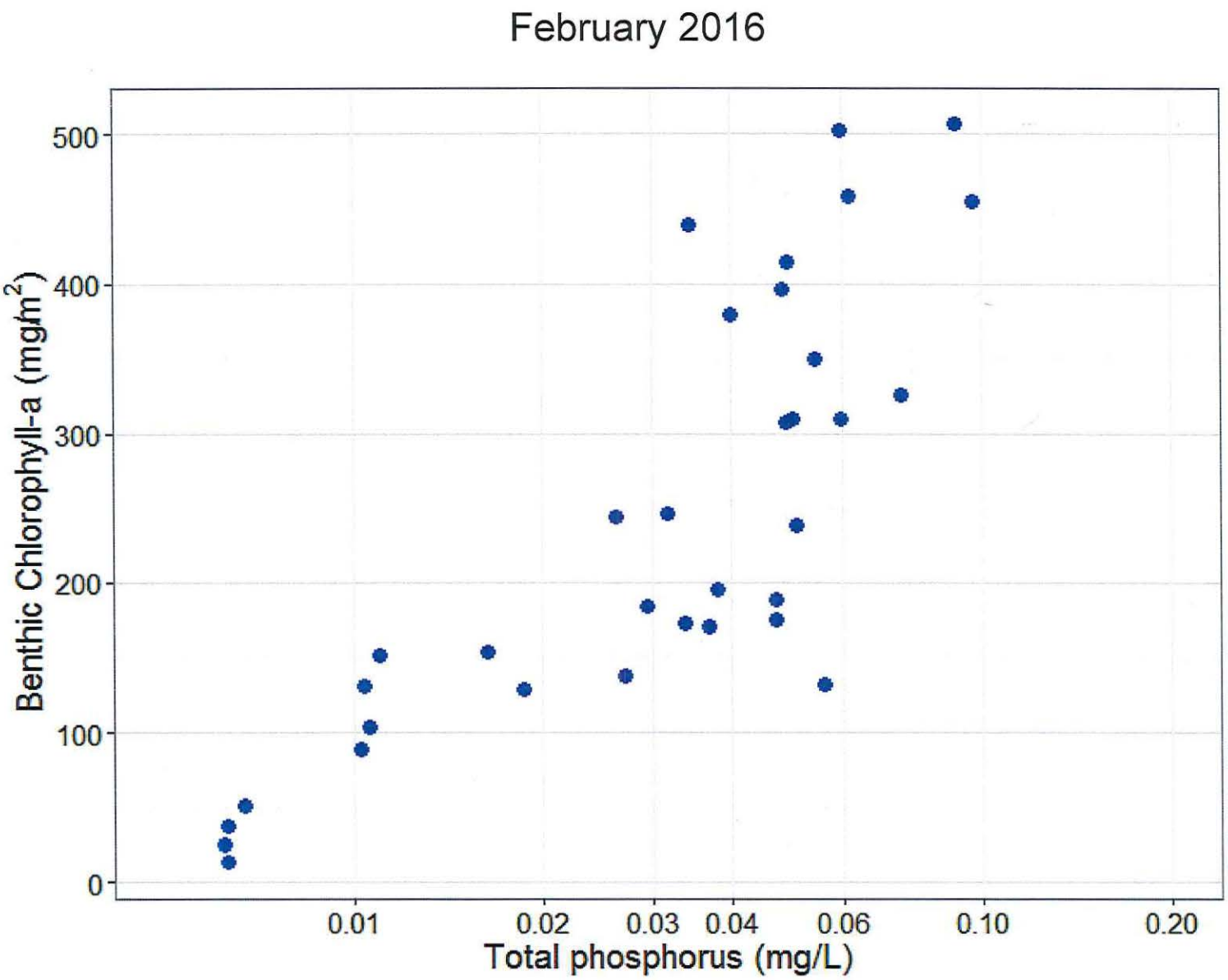
Benthic (Periphyton) Chlorophyll-*a* (mg/m^2) vs TP



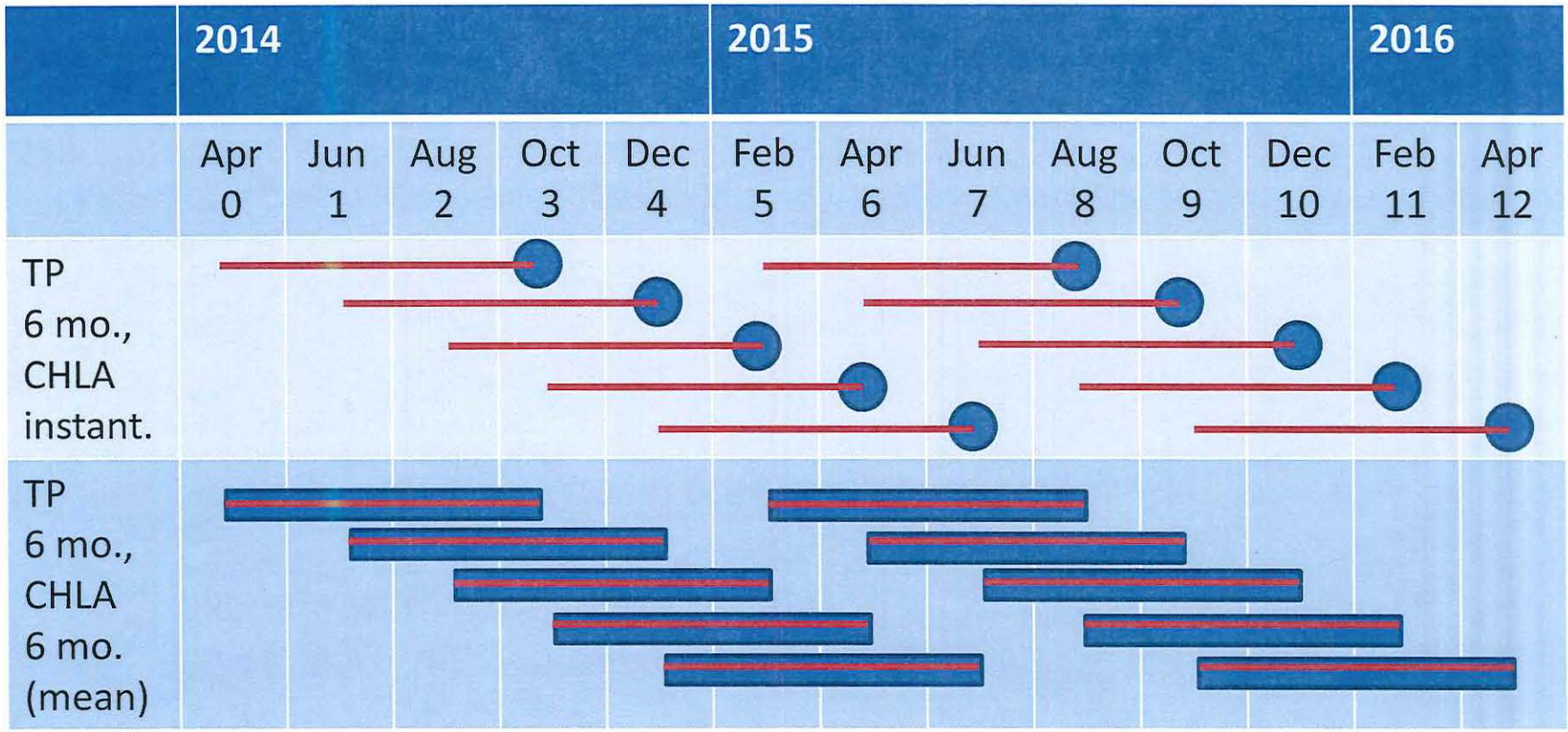
Benthic (Periphyton) Chlorophyll-*a* (mg/m^2) vs TP



Benthic (Periphyton) Chlorophyll-*a* (mg/m^2) vs TP



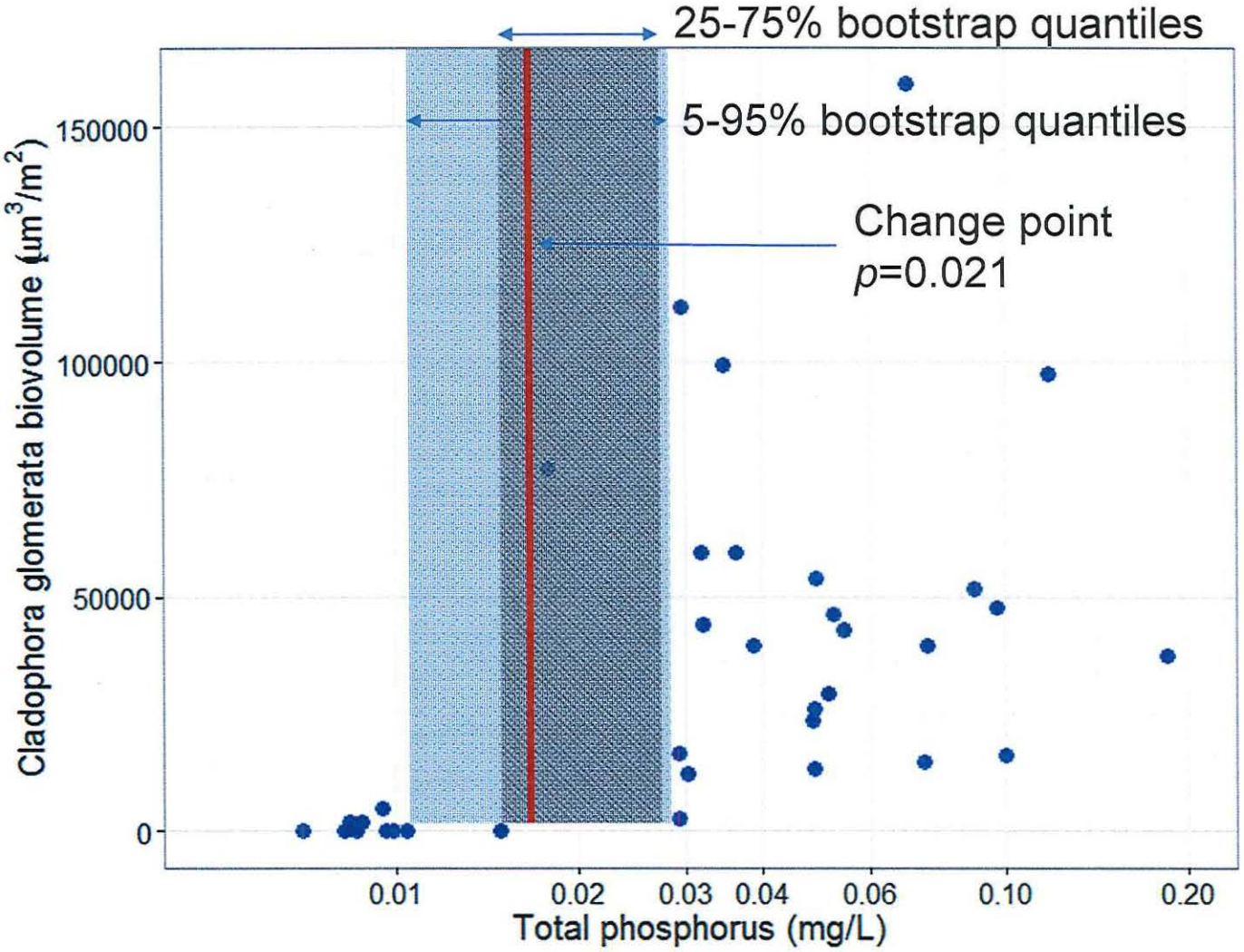
Duration of exposure (TP) vs. instantaneous/cumulative response (CHLA)



Change point analysis

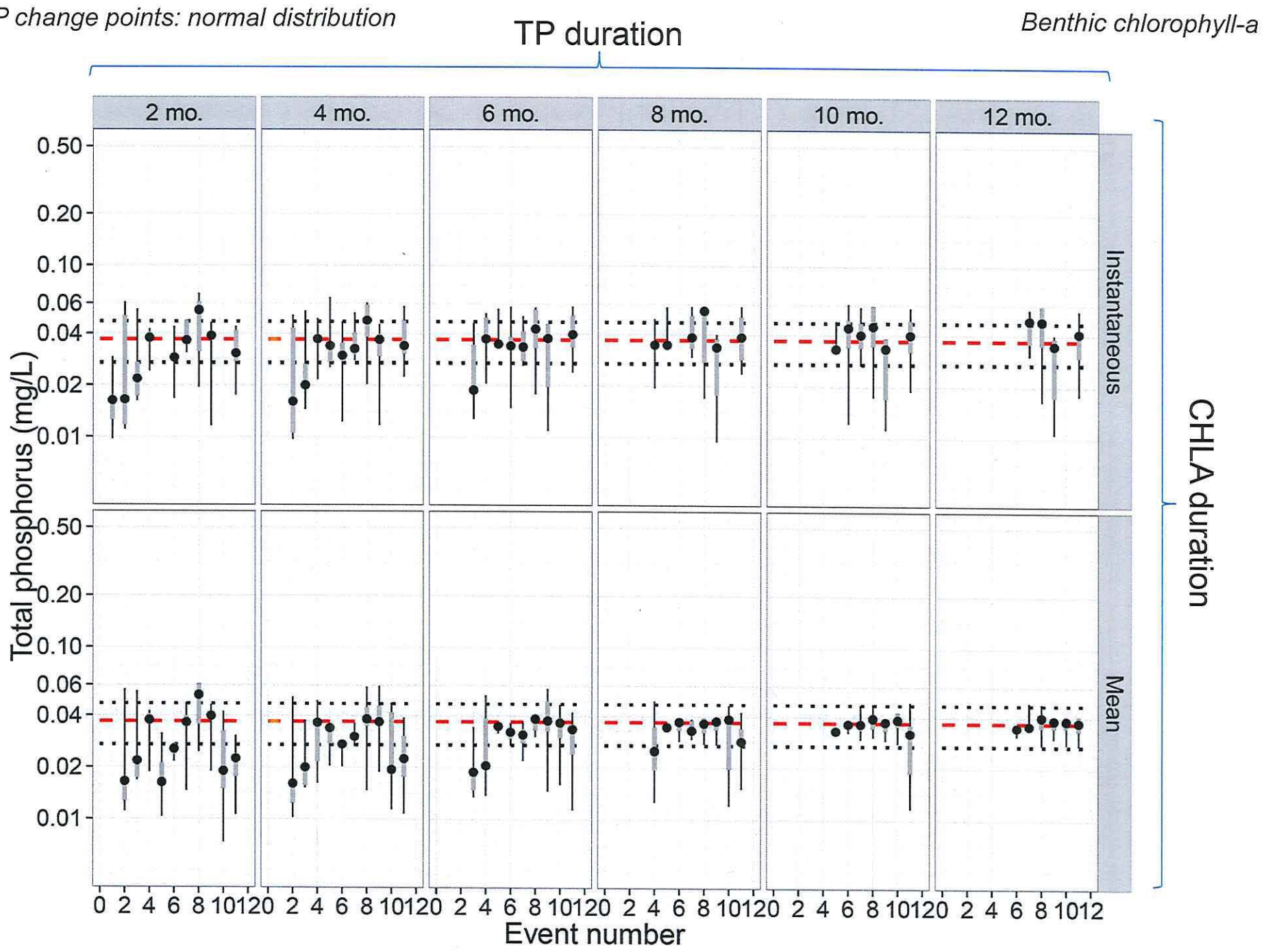
- "What value of TP splits the data into two groups with the largest difference in mean chlorophyll-a?"
- More technically, "what value of the predictor (x axis variable) results in the greatest reduction in variance (deviance) by splitting the response data into two groups."

Change point analysis



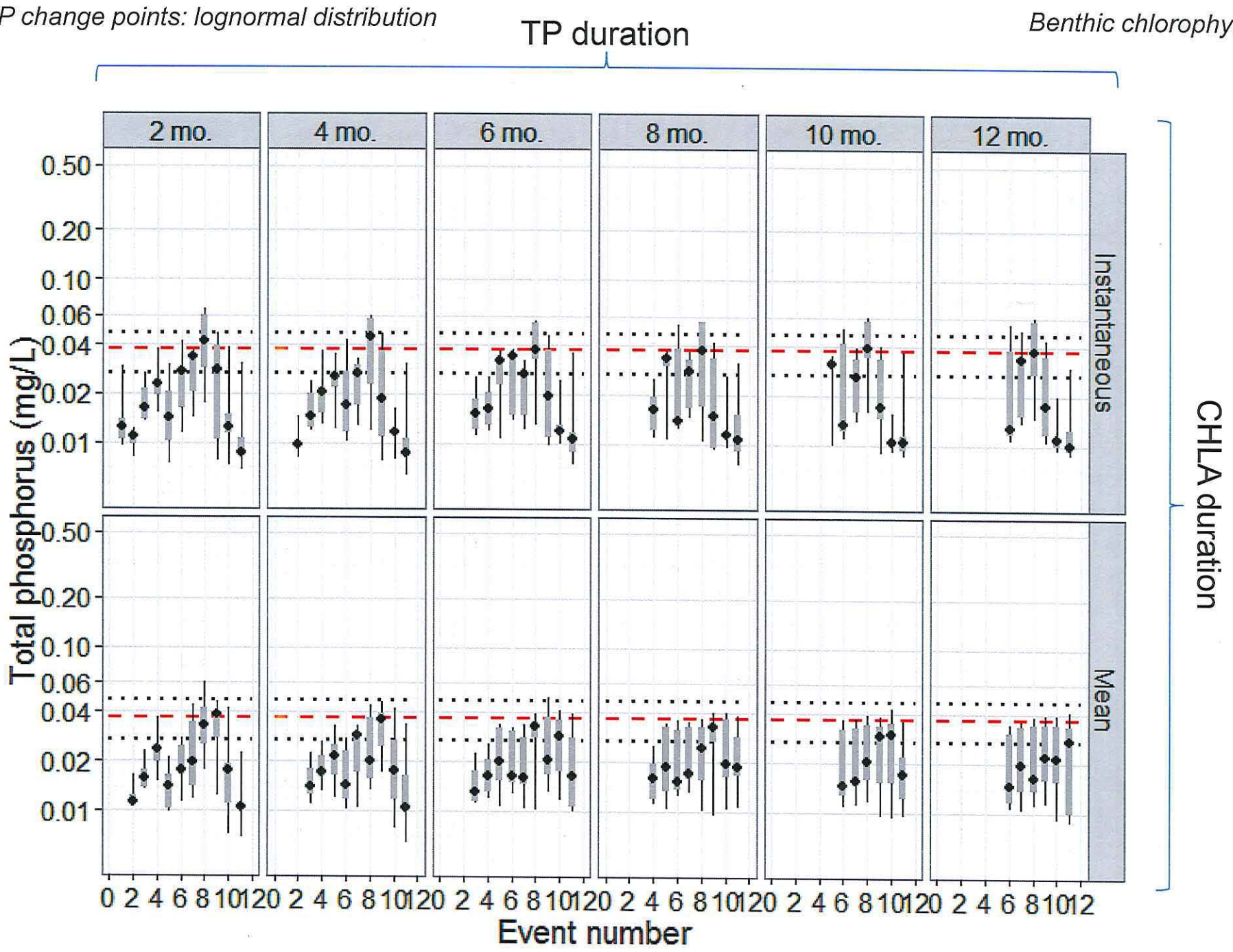
Change point analysis

- Deviance is calculated differently based on the appropriate probability distribution for each variable
  - Normal and lognormal distributions were used for benthic chlorophyll-a analyses
  - Poisson distribution was used for *Cladophora* biovolume (biovolume is converted from counts, hence Poisson or neg. binomial is appropriate)
  - Binomial distribution was used for proportion of biovolume as nuisance taxa

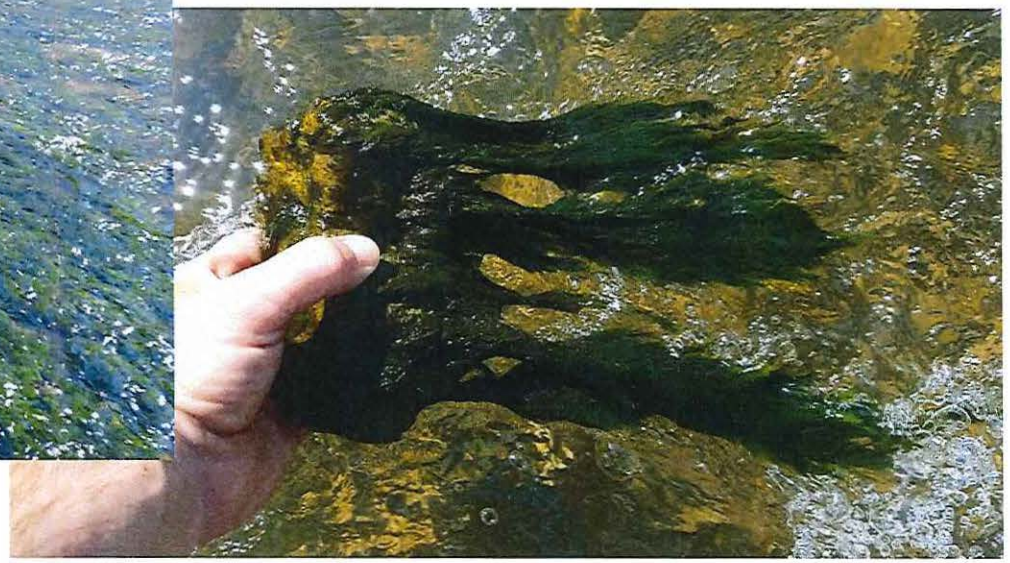

TP change points: normal distribution
TP duration
Benthic chlorophyll-a
2 mo.
4 mo.
6 mo.
8 mo.
10 mo.
12 mo.
Instantaneous
Mean
CHLA duration
Total phosphorus (mg/L)
0.50
0.20
0.10
0.06
0.04
0.02
0.01
0 2 4 6 8 10 12
Event number

TP change points: lognormal distribution

Benthic chlorophyll-a

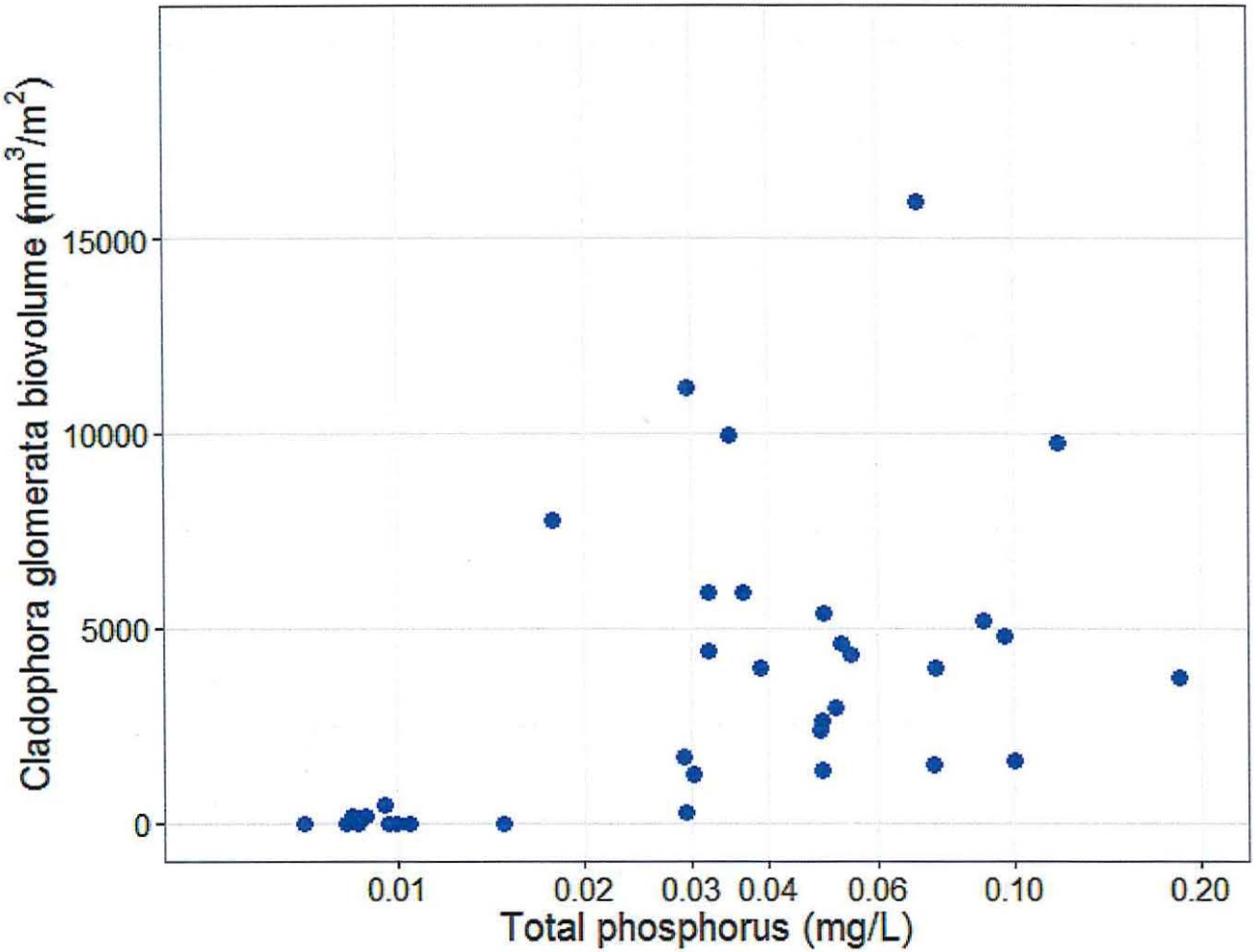


Cladophora glomerata biovolume ($\mu m^3/m^2$) vs TP

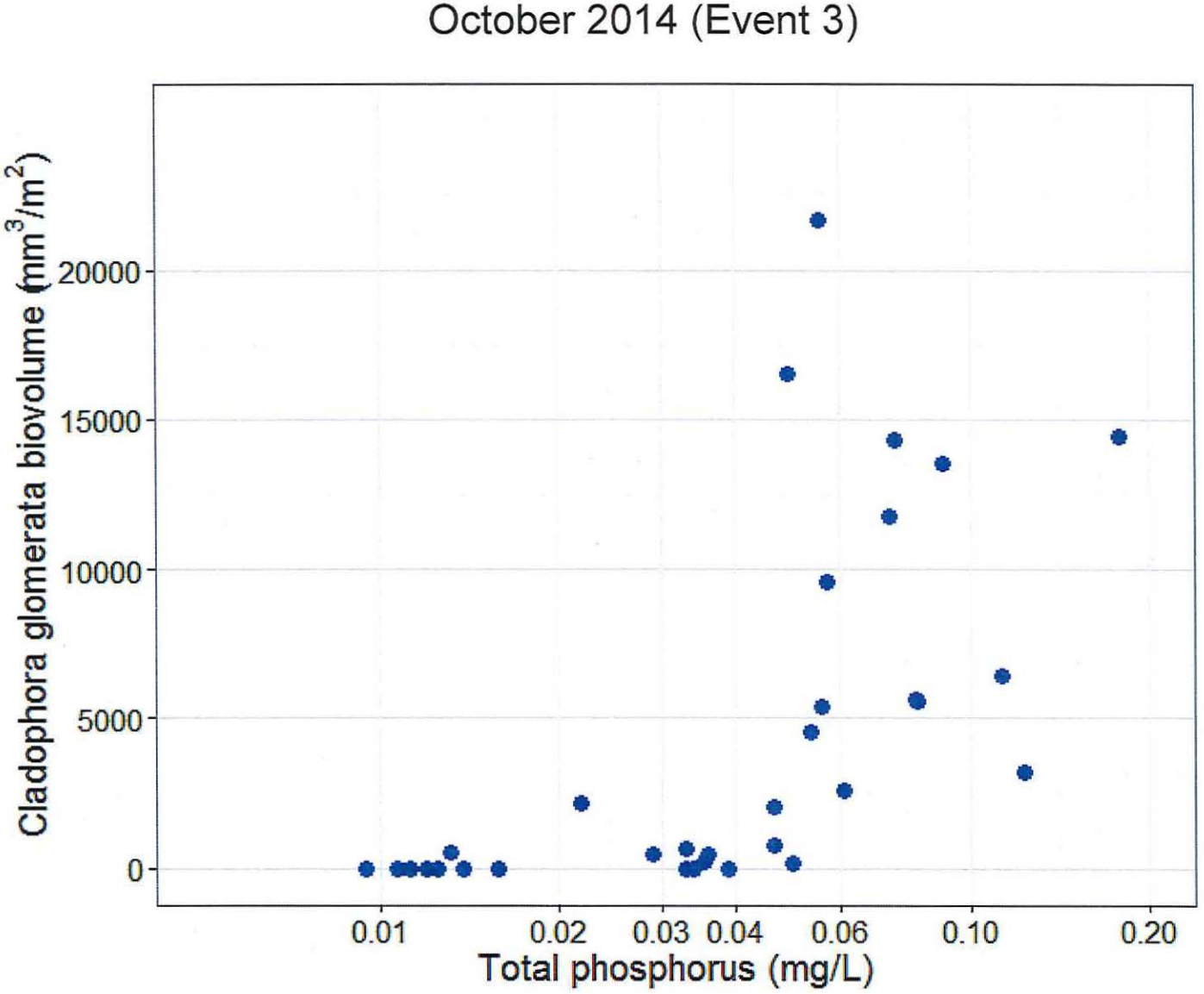


Cladophora glomerata biovolume (mm^3/m^2) vs TP

June 2014

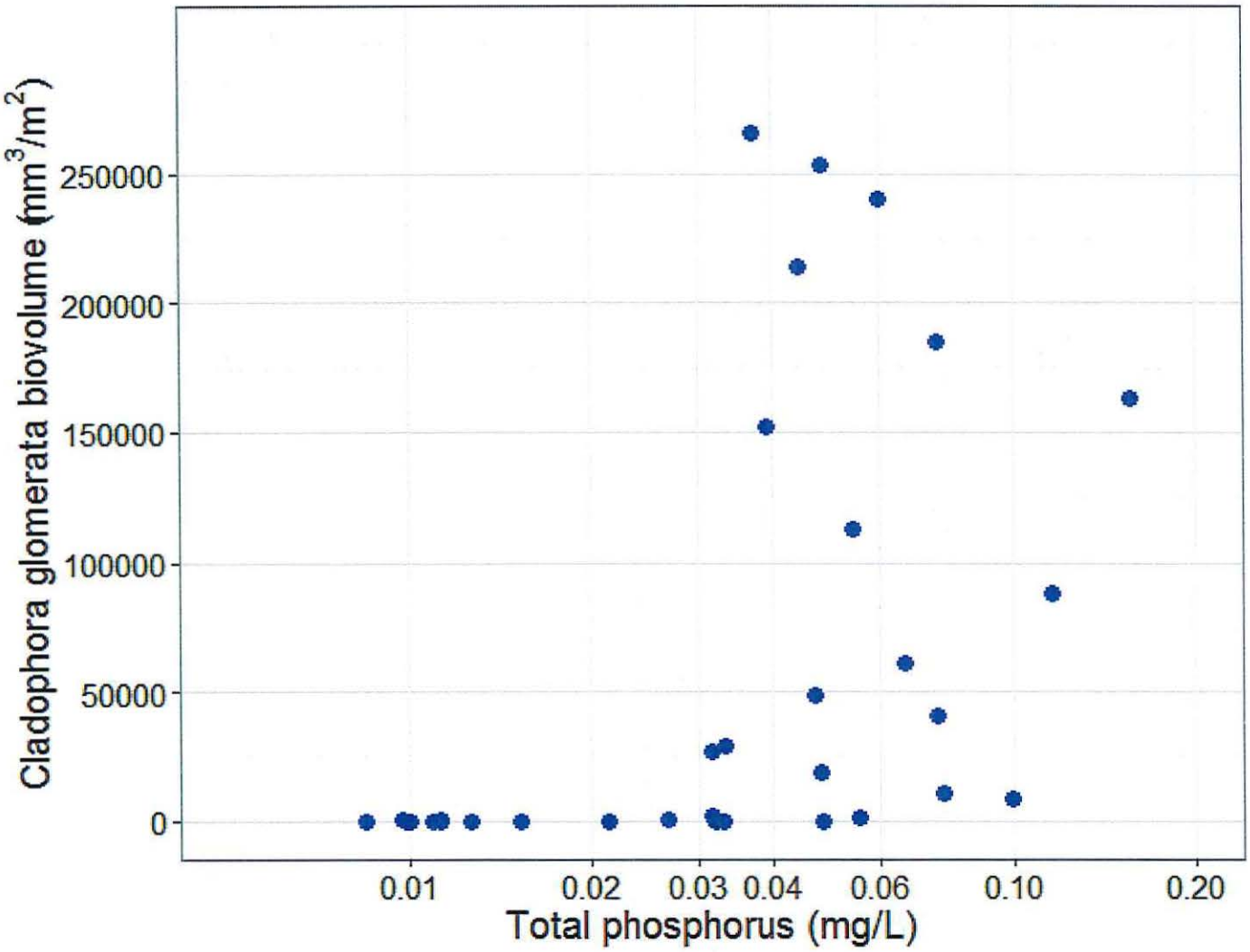


Cladophora glomerata biovolume (mm^3/m^2) vs TP



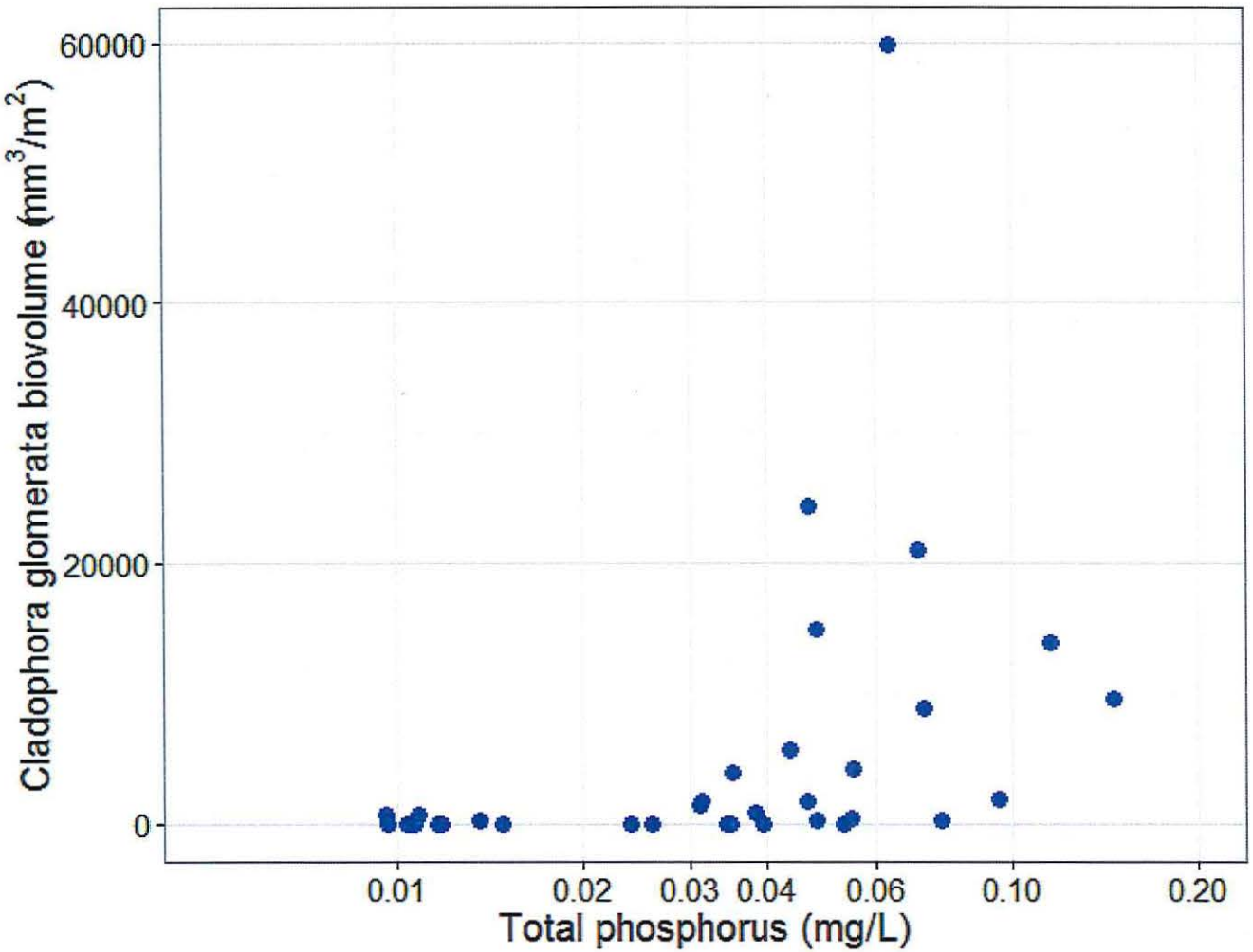
Cladophora glomerata biovolume (mm^3/m^2) vs TP

February 2015 (Event 5)



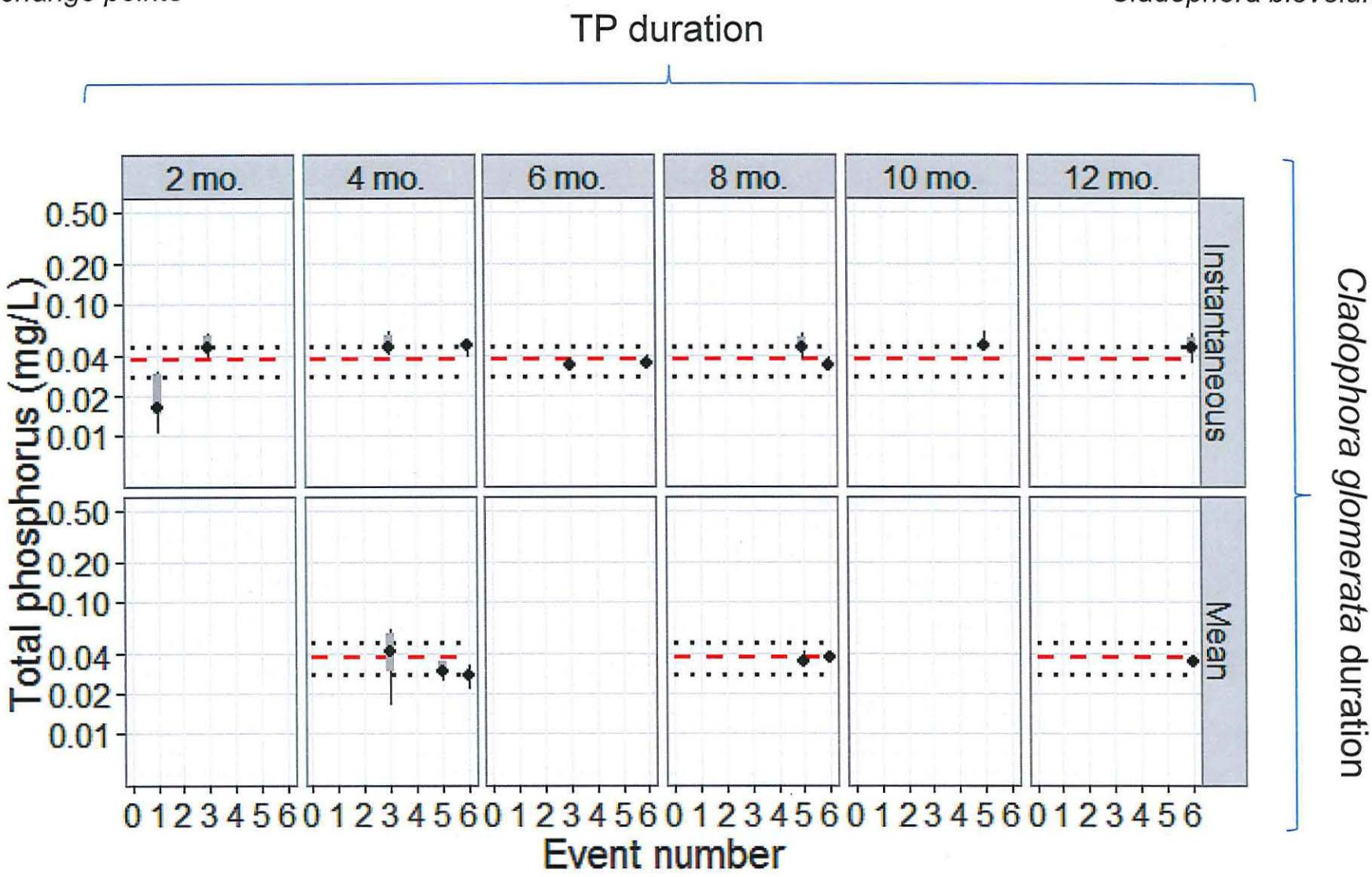
Cladophora glomerata biovolume (mm^3/m^2) vs TP

April 2015 (Event 6)



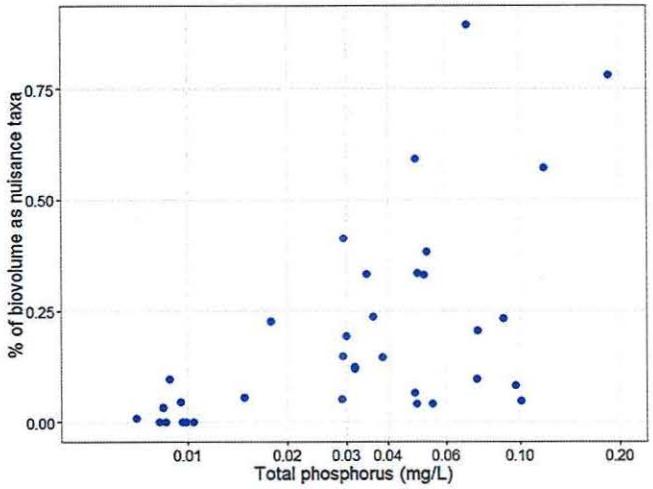
TP change points

Cladophora biovolume

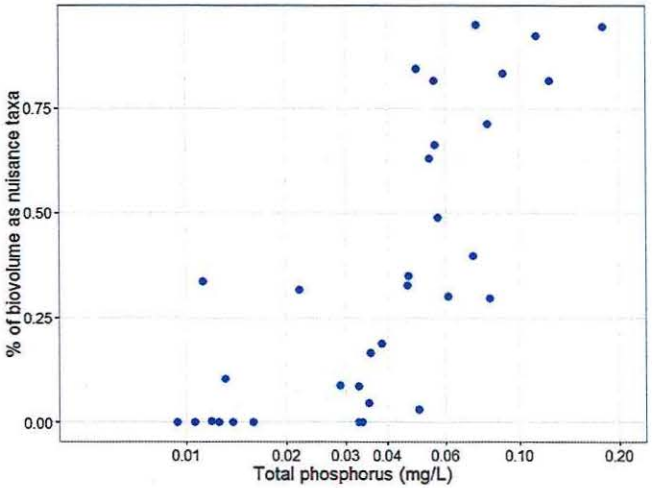


Proportion of biovolume as nuisance taxa vs TP

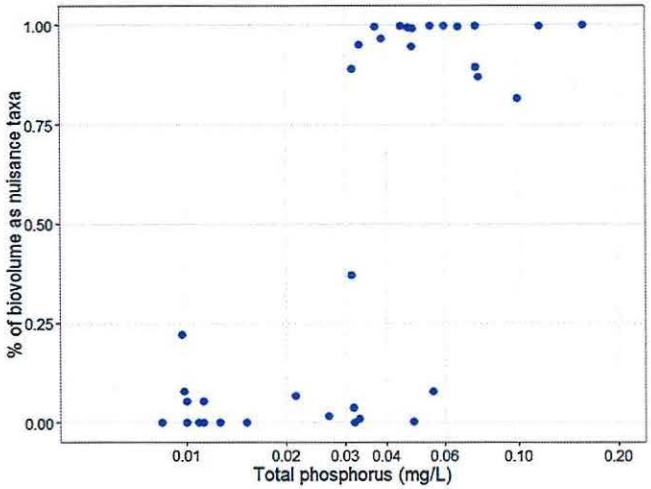
June 2014 (Event 1)



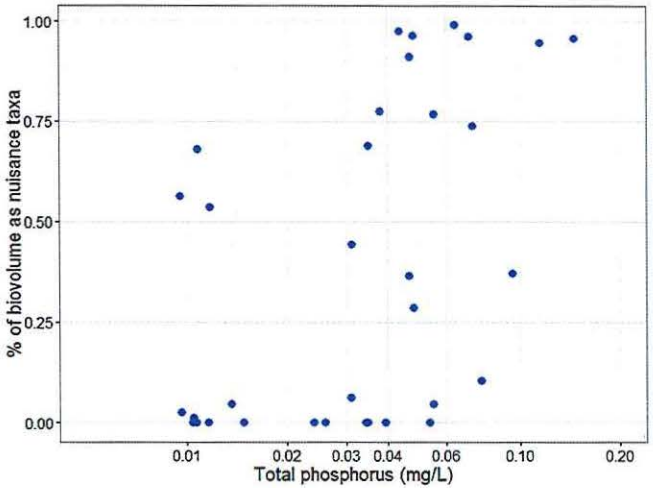
Oct 2014 (Event 3)



Feb 2015 (Event 5)



April 2015 (Event 6)



Data analysis status

- Proportion of nuisance taxa (binomial change point analysis) almost complete
- TITAN analysis in progress
  - Need clarification about TP and spp duration based on today's presentation
  - Results will change for cumulative spp analyses (aggregating multiple events) depending upon which 2 events are selected for final taxonomic analysis

Next steps

- Selection of events for soft algae (n=2) and diatom (n=1) taxonomic identification
- Duration(s) of TP and response variables for additional analyses
- Components of the final report
- Future meetings

Acknowledgments

- Baylor SRJS core team:
  - Dr. Jeffrey Back, instrument specialist and research associate
  - Morgan Bettcher, research technician (UNC '14)
  - Stephen Elser, research technician (ND '14)
  - Katherine Hooker, research technician (BU '14)
  - Stephen Cook, Ph.D. student, BU (2013- .)
  - Lauren Housley, M.S. student, BU (2014- .)
  - Caleb Robbins, Ph.D. student, BU (2012- .)
- Taxonomists
  - Dr. Stephen Porter (soft algae)
  - Dr. Barbara Winsborough (diatoms)