Microbes/Cyanobacteria Working Group

Todd Miller, Lucas Beversdorf, Clara Ruiz Gonzalez, Chelsea Weirich, Francesco Pomati, Zofia Taranu, Medina Kadiri, Marieke Beaulieu, Jen Klug, Nicholas Myers, Kenneth Chiu, Michael Kehoe…and people that sent cyanotoxin samples

Cyanotoxins

- Determined driver data for cyanotoxin spatial variability:

1. <u>Lake Profile</u>

GPS Coordinates

Lake Depths (mean, maximum) & Area

Surface Elevation

Shape

GIS: Land use – ID categories & shoreline development

Mean chlorophyll/TP/TN/DOC

Trophic status

Mixing

Zebra mussel colonization

Bathymetry

Weather: temperate zone, avg annual rainfall

<u>2. Sample Metadata</u>

Phytoplankton counts (biovolume)

Water temp/DO by depth

Chemistry

Secchi

- Creating toxin profile for each lake: combining data from individual samples for basic statistics
- Using multiple years – treating samples from individual years in one lake as multiple lake profiles

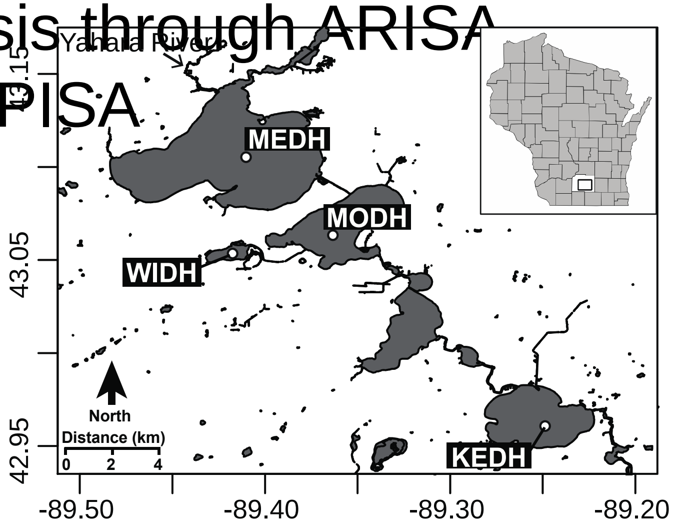
Spatiotemporal Cyano-Heterotroph Correlation

- Questions:
  - Are there specific cyanobacterial and heterotrophic bacterial taxa interactions in lakes over space and time?
  - Under which circumstances do we find stronger links between pairs of taxa?
  - Can we determine causality from these relationships with our spatial and temporal datasets (e.g. using structural equation modeling or convergent cross-mapping)?

Temporal & Spatial Datasets

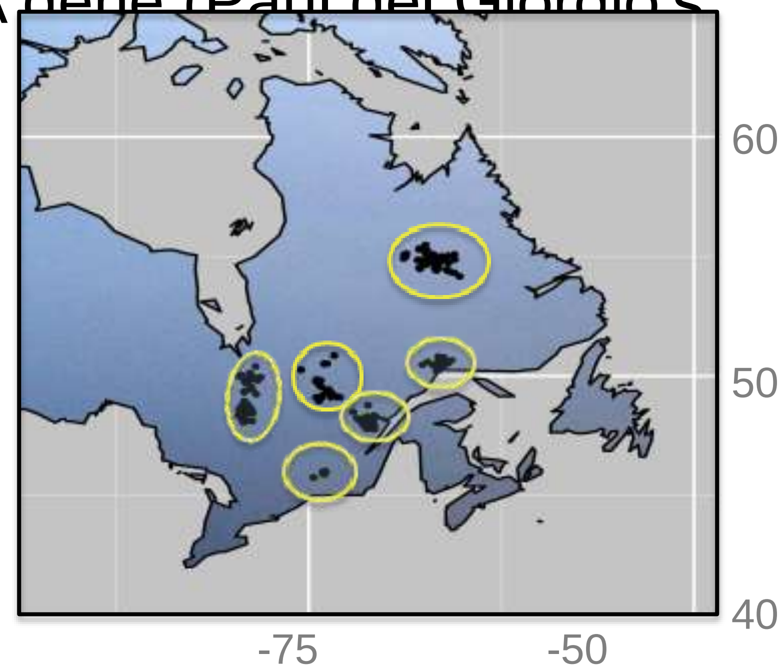
10-year (87 samples) Microbial Observatory project from Lake Mendota LTER data

Community composition analysis through ARISA and APISA

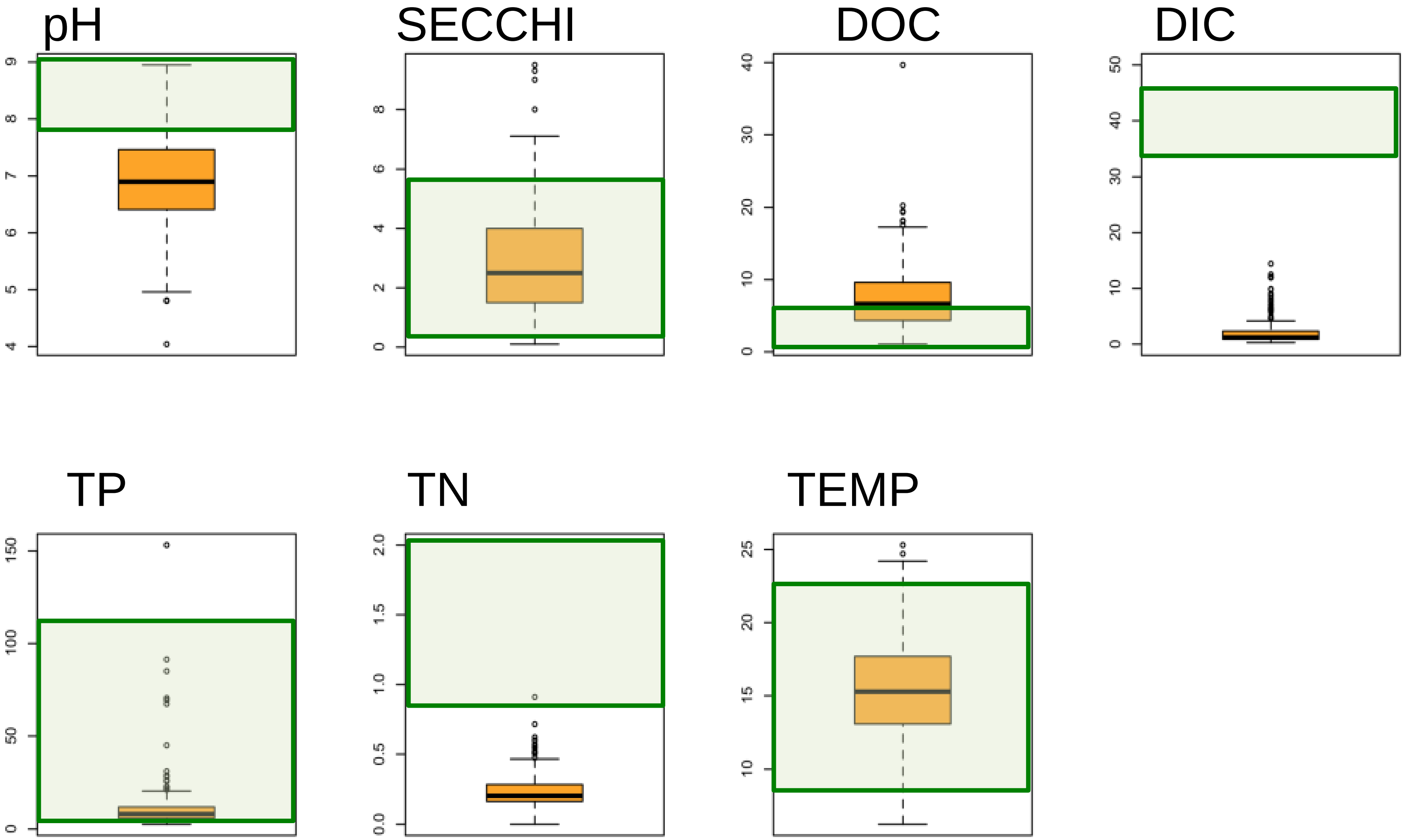


200 boreal lakes from N Québec
(summer time)

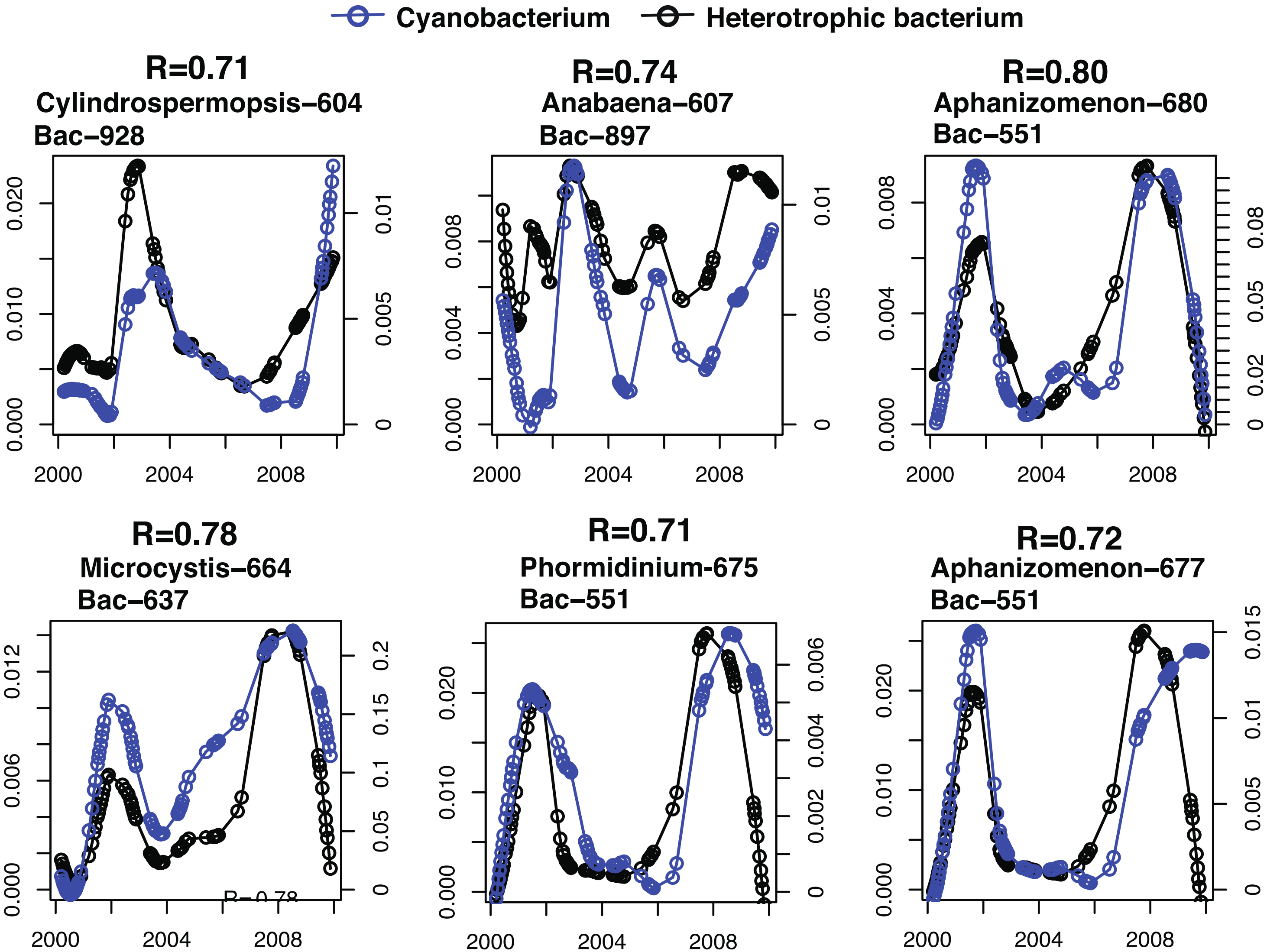
Illumina sequencing of the 16S rRNA gene (Paul del Giorgio's data)



SPATIAL vs TEMPORAL variability in environmental variables



Positive Associations Between Cyanobacteria and Heterotrophic Bacteria in Lake Mendota 2000 - 2010



Notes

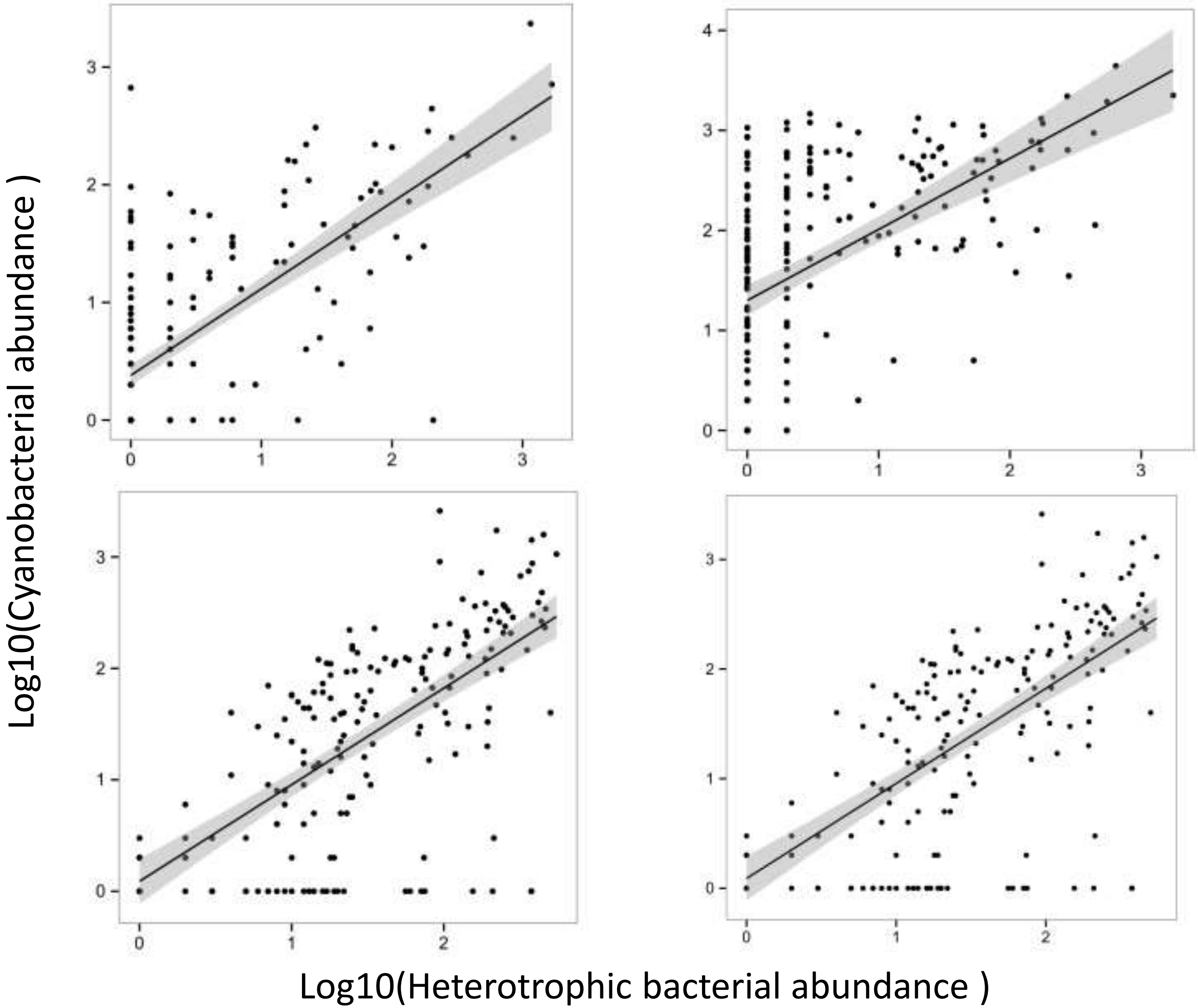
Cyanobacterial genotypes can be identified to genus, bacteria cannot

Bac-551 associates with two genotypes of Aphanizomenon and one Phormidinium

Bac-551 may be uniquely adapted to the "cyanosphere"

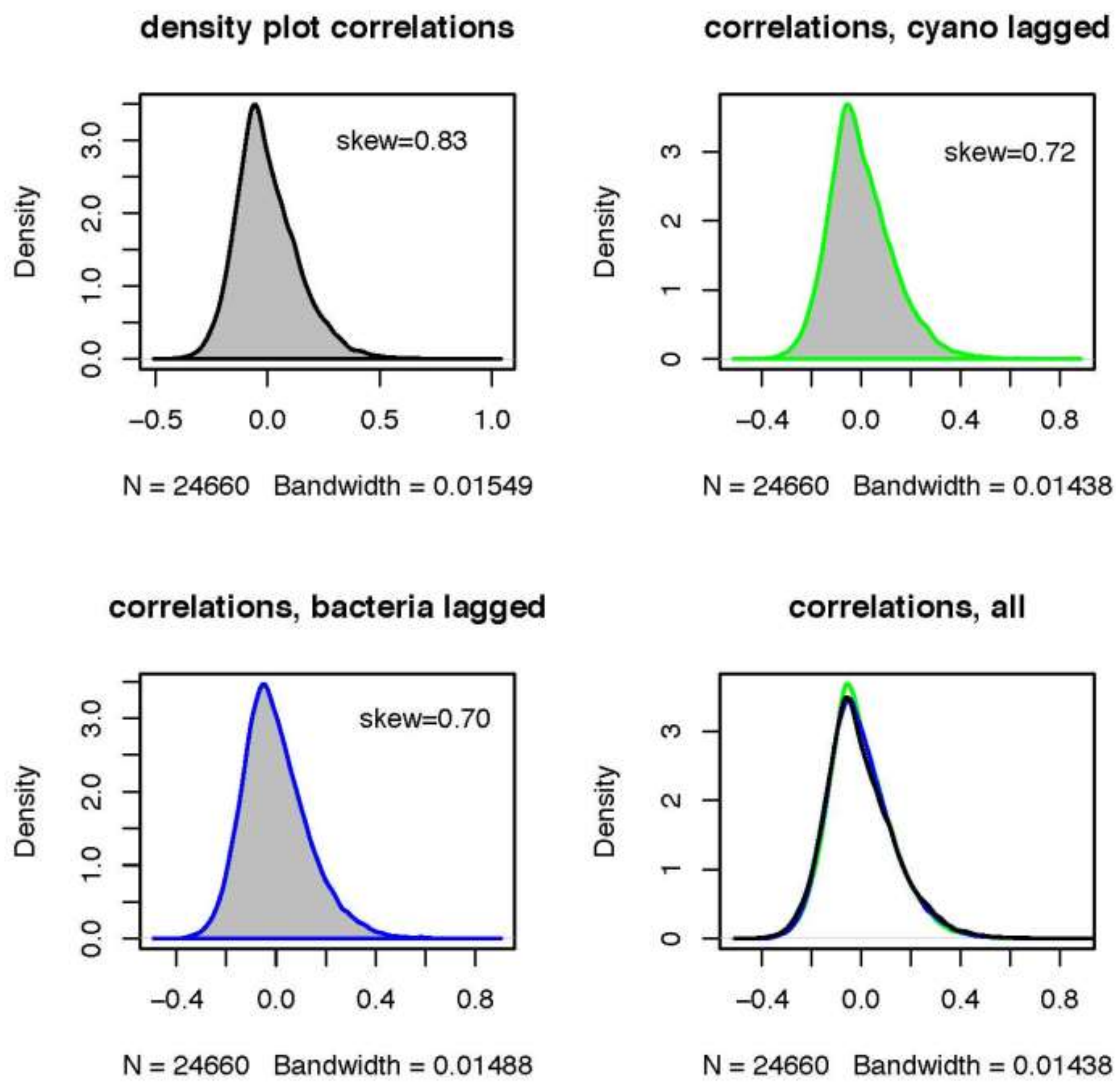
Associations may be just due to chance. Further research needed.

Covariation of cyanobacterial and heterotrophic bacterial taxa accross boreal spatial gradients



Spatiotemporal Cyano-Heterotroph Covariance

- Leaders: Lucas Beversdorf and Clara Ruiz Gonzalez
  - **emails: lucasjohn17@gmail.com**
    clara.ruiz.glez@gmail.com
- Next steps:
  - Add online to Project Tracker
  - Continue statistical analyses to define patterns between (cyano- and heterotrophic) bacterial taxa


density plot correlations
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Density
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2.0
3.0
−0.5
0.0
0.5
1.0
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correlations, cyano lagged
skew=0.72
Density
0
1
2
3
−0.4
0.0
0.4
0.8
N = 24660 Bandwidth = 0.01438
correlations, bacteria lagged
skew=0.70
Density
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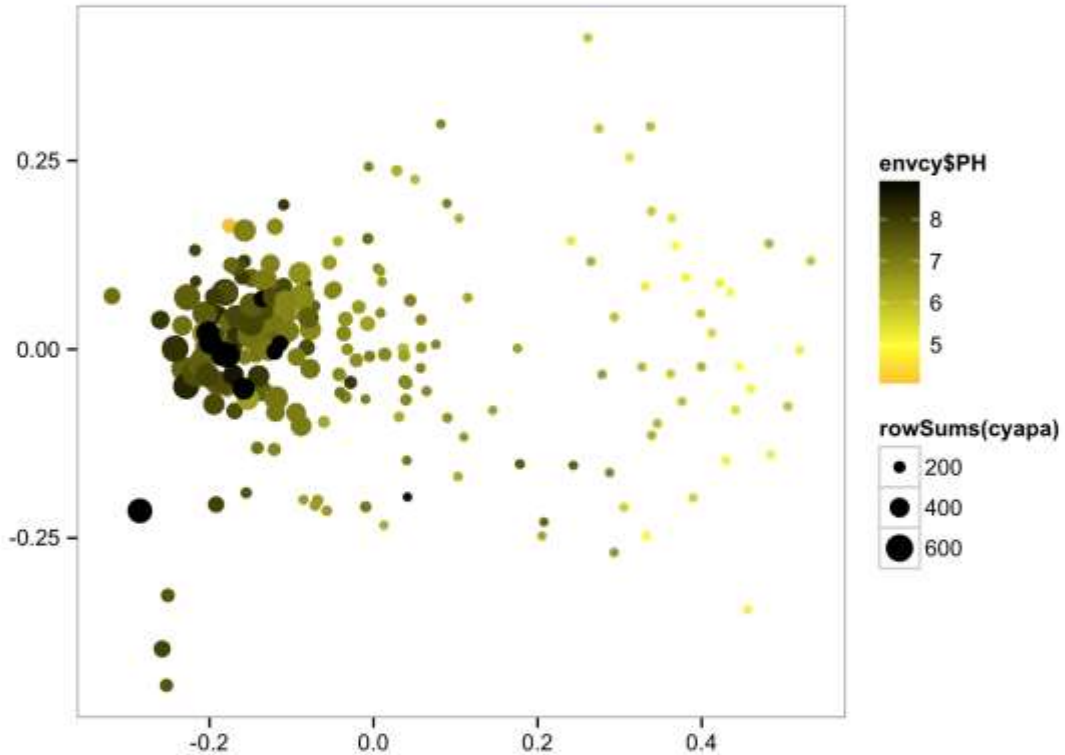
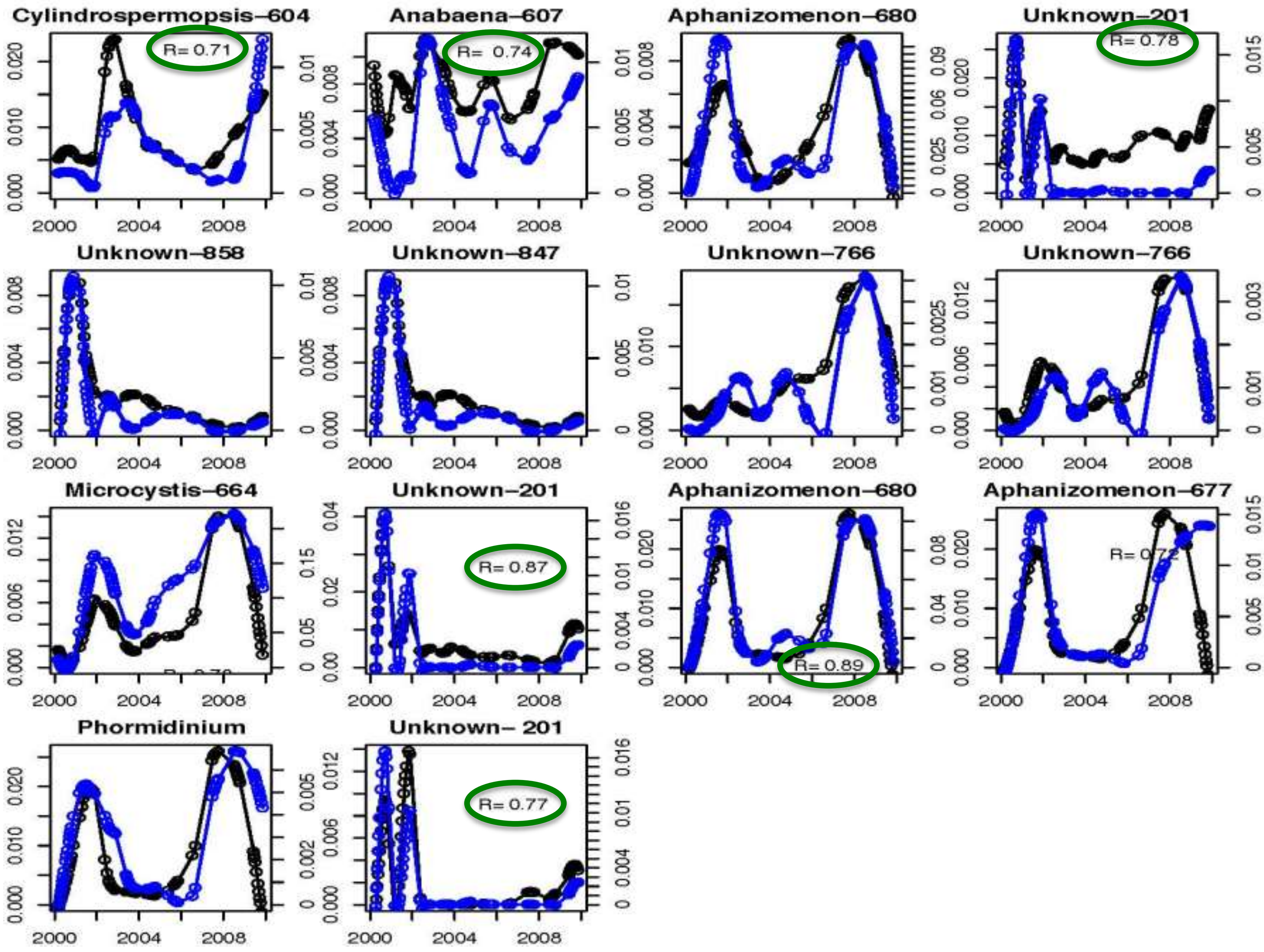
1.0
2.0
3.0
−0.4
0.0
0.4
0.8
N = 24660 Bandwidth = 0.01488
correlations, all
Density
0
1
2
3
−0.4
0.0
0.4
0.8
N = 24660 Bandwidth = 0.01438

Covariation of cyanobacterial and heterotrophic bacterial taxa accross **boreal spatial gradients**

Patterns in Cyanobacterial composition and diversity driven by environmental gradients




Cylindrospermopsis–604
R= 0.71
Anabaena–607
R= 0.74
Aphanizomenon–680
Unknown–201
R= 0.78
Unknown–858
Unknown–847
Unknown–766
Unknown–766
Microcystis–664
Unknown–201
R= 0.87
Aphanizomenon–680
R= 0.89
Aphanizomenon–677
R= 0.72
Phormidinium
Unknown– 201
R= 0.77