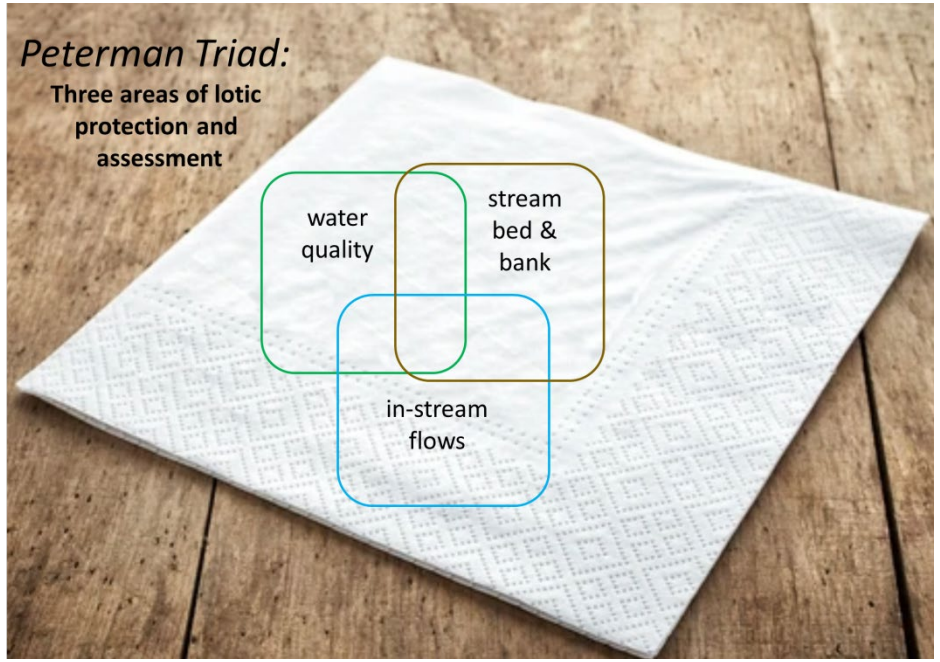
Welcome to the UCFWG Topic Discussion Monthly Meeting

June 10, 2021

- **This Month's Guest Speaker:** H. Maurice Valett, Professor, Division of Biological Sciences, University of Montana, Missoula

Topic: Historic and contemporary assessment of algal blooms in the Upper Clark Fork River



- **This Month's Guest Speaker: TBD**

Next Month's Topic: Floodplain perspectives on restoration

❑Announcements

❑UCFWG Spring Newsletter

UCFWG Spring Newsletter (June 7 2021)

Connect with Andrew Hauer (Andrew.Hauer@mso.umt.edu) or Madison Boone (Madison.boone@montana.edu) if needed

❑email Communications

If you are on the UCFWG mailing list and are NOT receiving regular emails, contact Andrew Hauer

❑Announcements

❑UCFWG Communications Poll

A poll addressing UCFWG Communications has been initiated (see Spring Newsletter, independent email from AFH, UCFWG.org).
https://umt.co1.qualtrics.com/jfe/form/SV_e35DSAhcYzLPvPU

❑Virtual UCFWG Habitat Workshop, Friday June 10

Email communication regarding Habitat Workshop, see Spring Newsletter, UCFWG.org

(contact Taylor Gold Quiros: Taylor.goldquiros@umontana.edu)

http://events.constantcontact.com/register/event?llr=ojtowebbb&oeidk=a07ei35krta8ddf6f1e

❑Announcements

- **August Field Workshop – remediation and restoration practices**

  Dry Cottonwood Creek Ranch – Thursday August 19th

  More information forthcoming

- **July Research Jamboree – information and social**

  Clark Fork Coalition @ the Dry Cottonwood Creek Ranch – Late July
  Date TBD

  More information forthcoming

Valett Aquatic Ecosystem Laboratory (VAEL)
University of Montana

DEQ
Montana Department of Environmental Quality

NATURAL RESOURCE DAMAGE PROGRAM
MONTANA DEPARTMENT OF JUSTICE

Marc Peipoch, Stroud Water Ctr

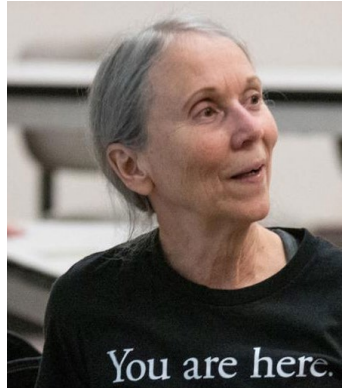
Rafael Feijo de Lima

Claire Utzman

D|B|S
Division of Biological Sciences

MONTANA NSF EPSCoR
Consortium on Environmental Water Systems (CREWS)

Vicki Watson

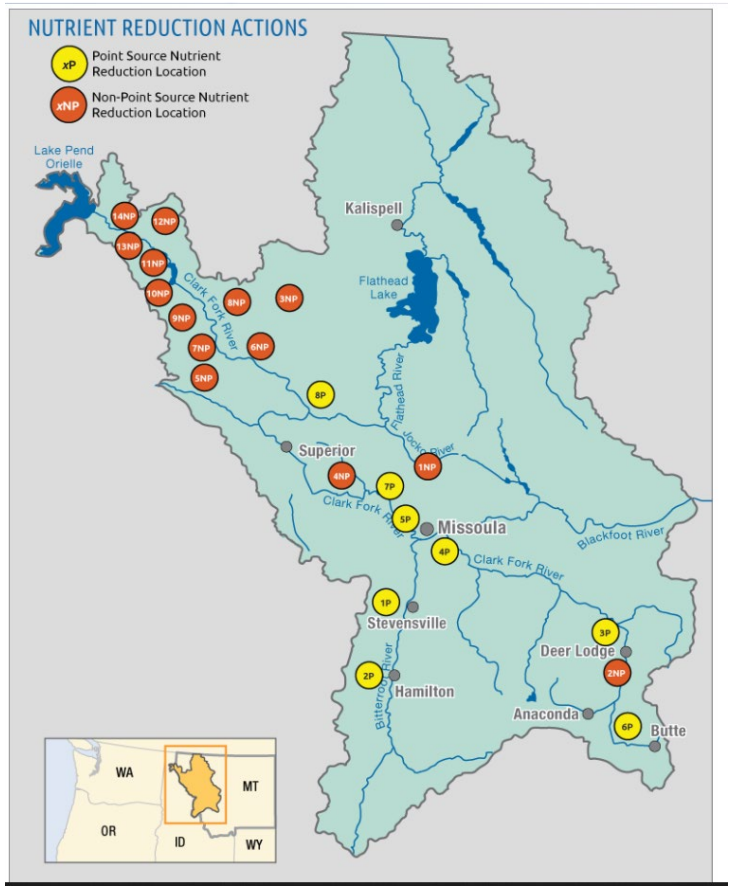


MONTANA STATE UNIVERSITY

UNIVERSITY OF MONTANA

Remediation and Restoration Strategies

Floodplain Remediation – Metals



Nutrient reduction

https://clarkfork.org/our-work/what-we-do/monitor-watershed-health/nutrient-monitoring/voluntary-nutrient-reduction-program/

ELSEVIER

Water Research

Volume 31, Issue 7, July 1997, Pages 1738-1750

Developing nutrient targets to control benthic chlorophyll levels in streams: A case study of the Clark Fork River

W.K. Dodds [1], V.H. Smith [2], B. Zander [3]

Show more

JAWRA

JOURNAL OF THE AMERICAN WATER RESOURCES ASSOCIATION

AMERICAN WATER RESOURCES ASSOCIATION

Response of Algal Biomass to Large-Scale Nutrient Controls in the Clark Fork River, Montana, United States†

Michael W. Suplee, Vicki Watson, Walter K. Dodds, Chris Shirley

First published: 20 June 2012 | https://doi.org/10.1111/j.1752-1688.2012.00666.x | Citations: 15

(E-Mail/Suplee: msuplee@mt.gov)

† Paper No. JAWRA-11-0156-P of the *Journal of the American Water Resources Association* (JAWRA).
Discussions are open until six months from print publication.

RESEARCH ARTICLE

WILEY

Trophic interactions among algal blooms, macroinvertebrates, and brown trout: Implications for trout recovery in a restored river

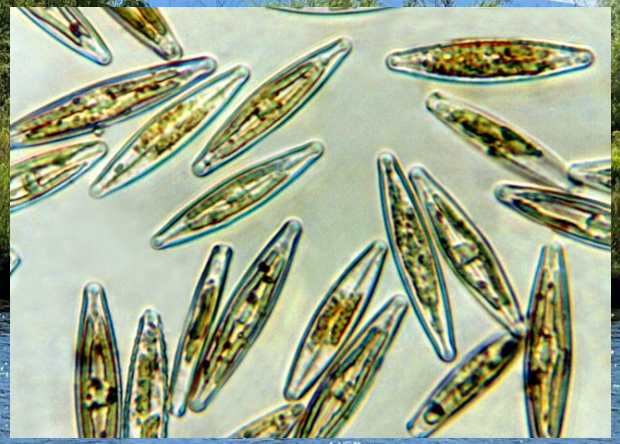
Marc Peipoch[1] | Herbert Maurice Valett[2]

River algae:

- ❑ Protists (not plants)
- ❑ Photosynthetic (generate organic matter from sun)
- ❑ Physiologically plastic (high tolerance)
- ❑ Ecologically important (biogeochemistry, food web)

The Good, Bad, and Ugly

The Good (diatoms)



The Bad
(filamentous green algae)

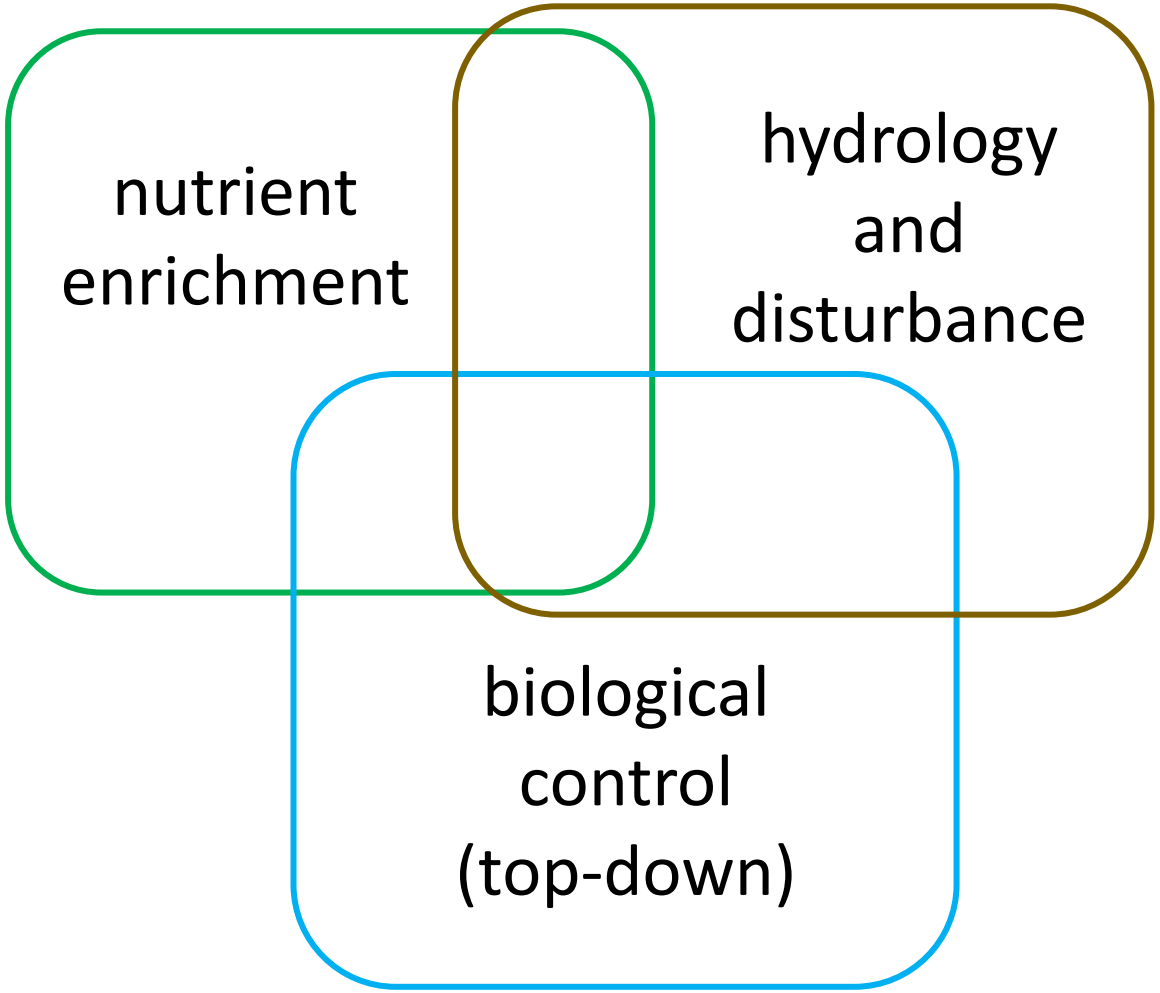
The Ugly
(Bluegreen algae, Cyanobacteria)

Valett Aquatic Ecosystem Laboratory (VAEL)
University of Montana

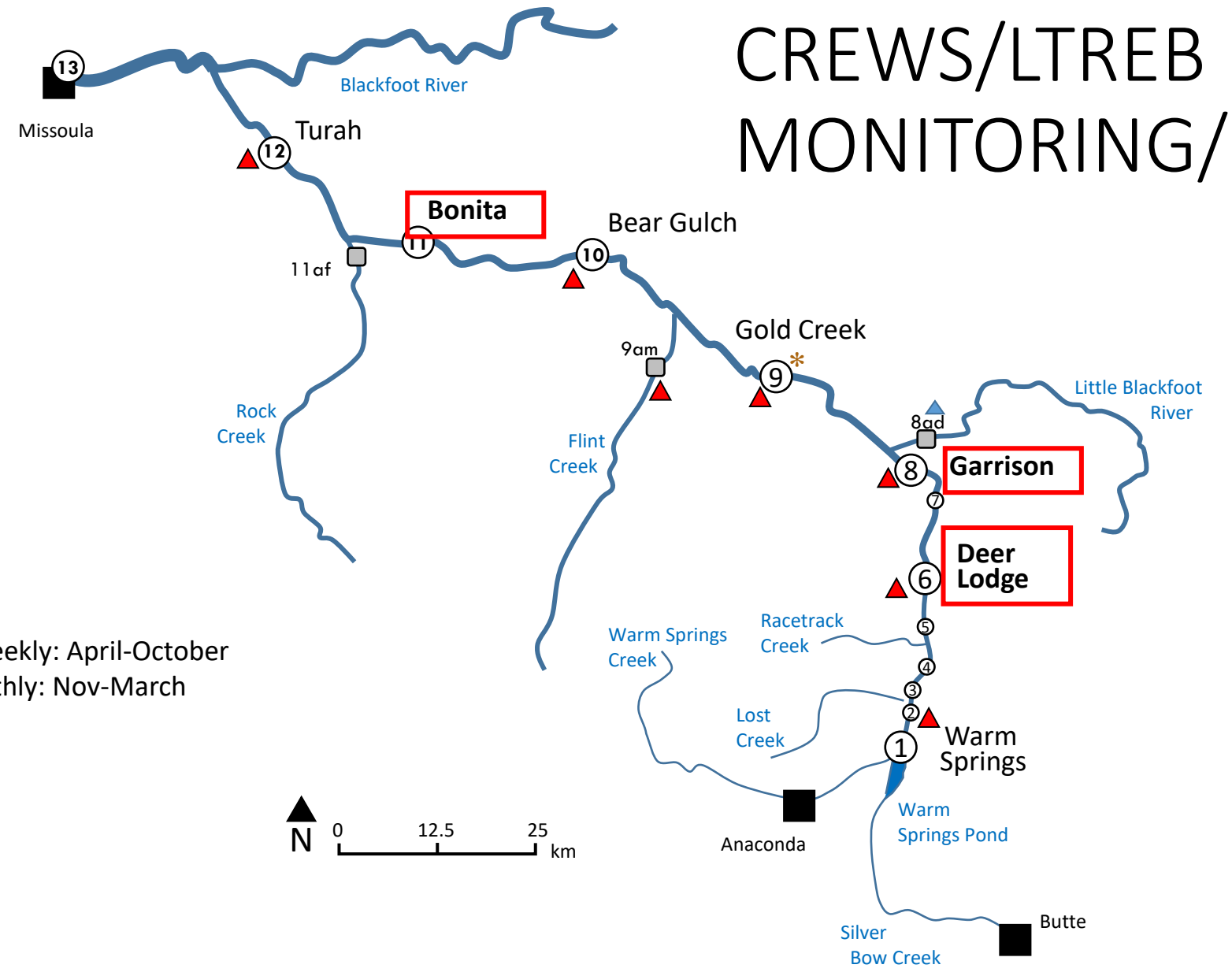
What features regulate riverine algal blooms (RABs) and primary production along the UCFR?

What are the implications of RABs for river food webs and apical predators?

Algal bloom Triad



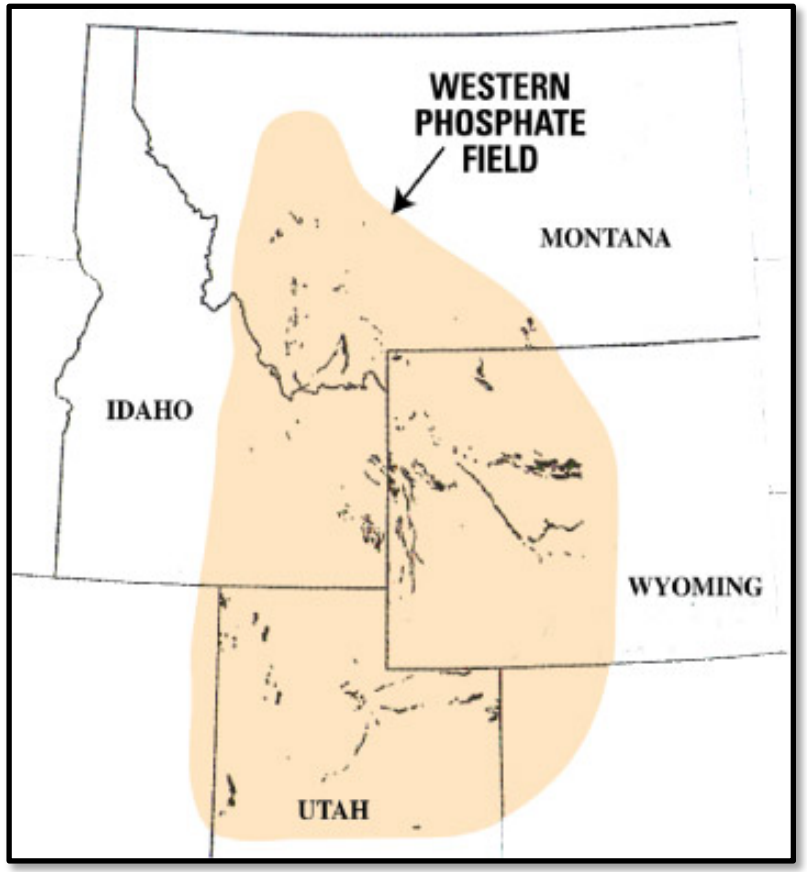
CREWS/LTREB MONITORING/FIELD SITES



Bi-weekly: April-October
Monthly: Nov-March

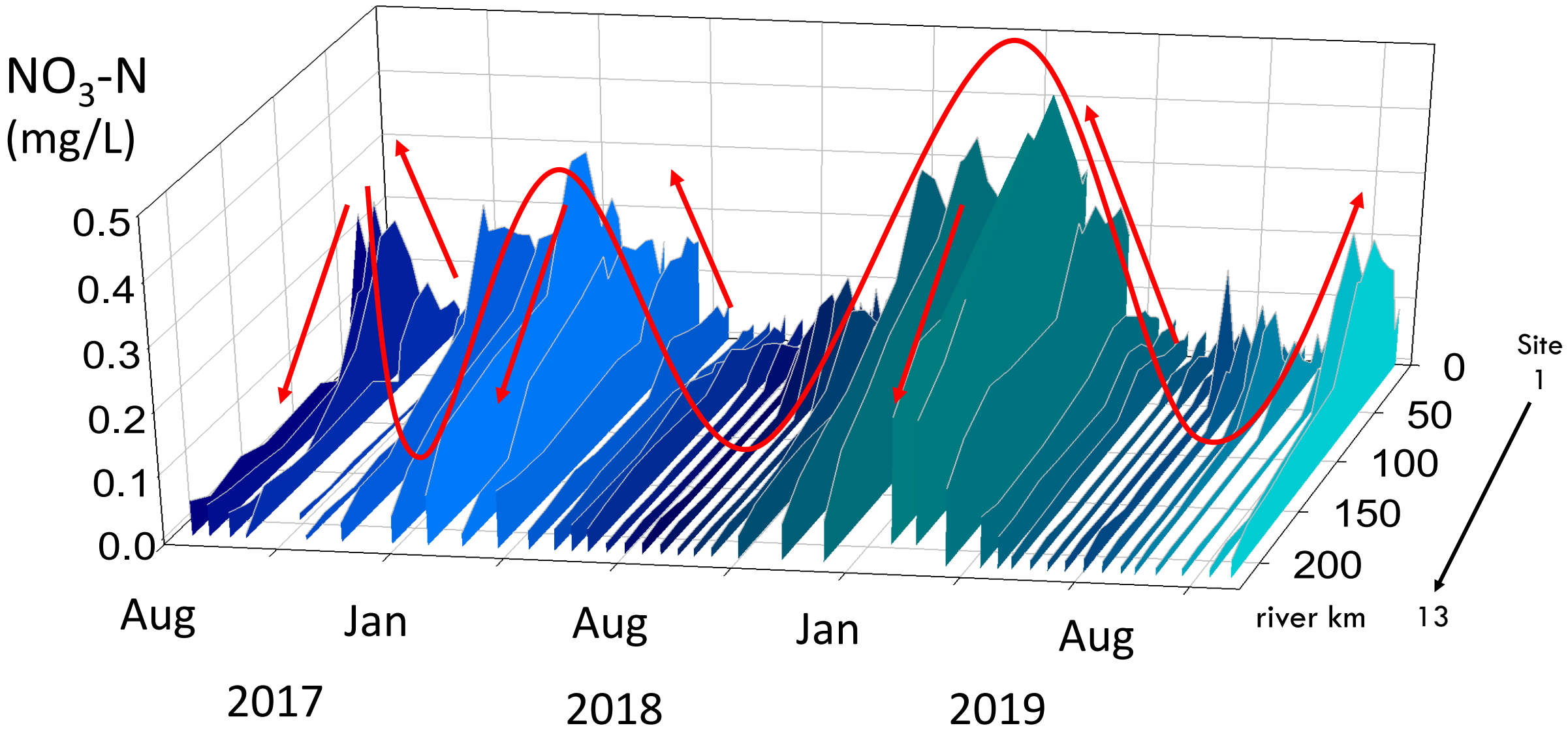
I) Biogeochemical Template: Nutrient enrichment and the importance of nitrogen (N) and phosphorus (P)

Geogenic P Sources
Phosphoria Formation

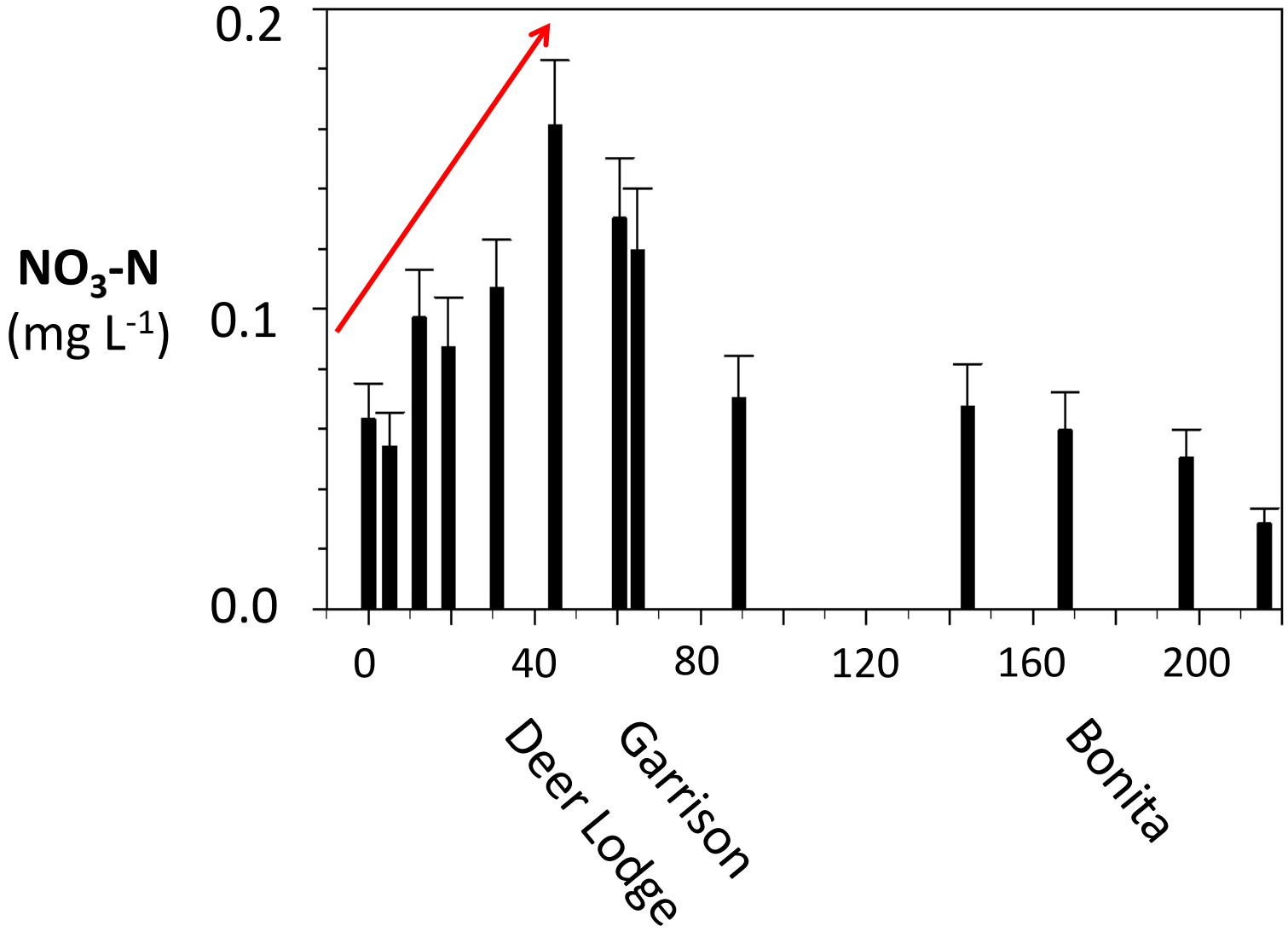


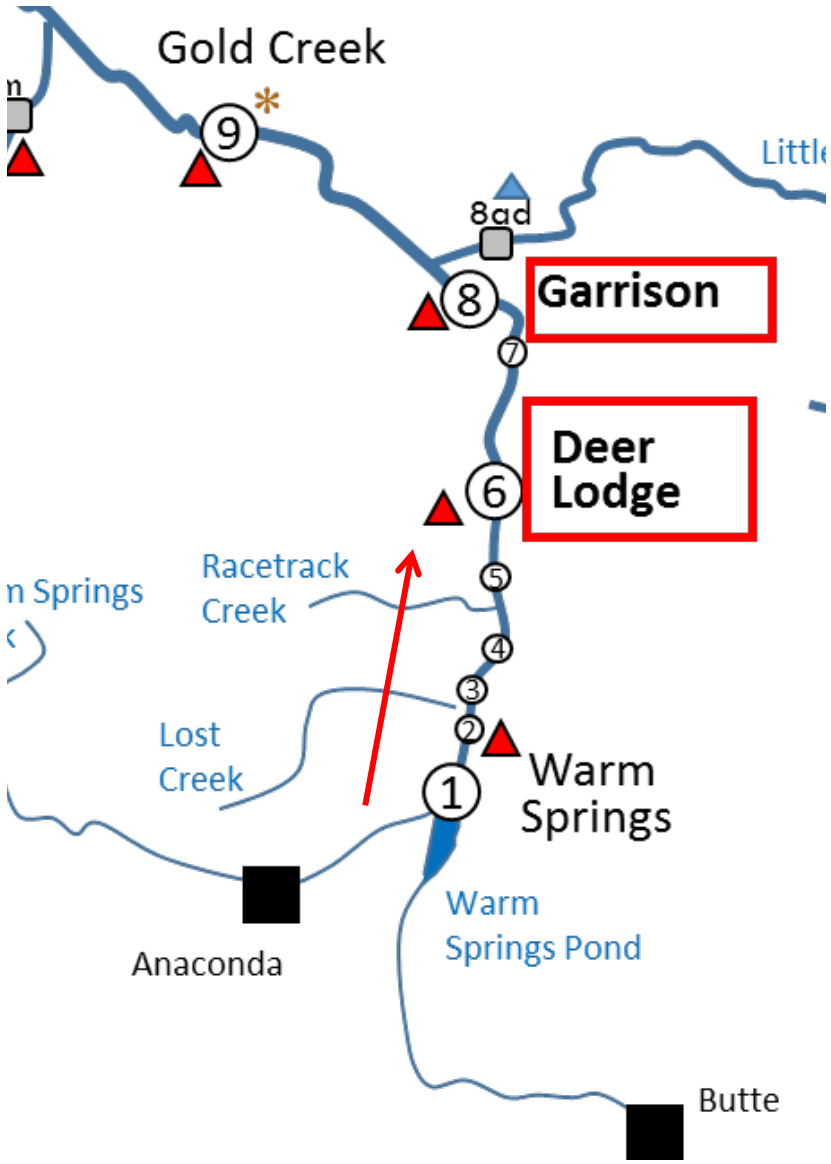
From: USGS Repot (Knudsen et al. 2001)

Spatial and Temporal Variation in inorganic N abundance



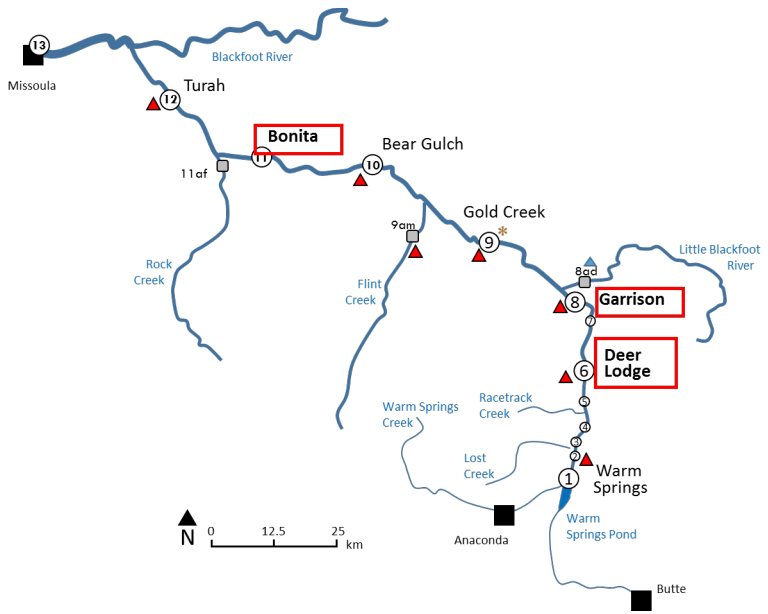
Nitrate Grand Means

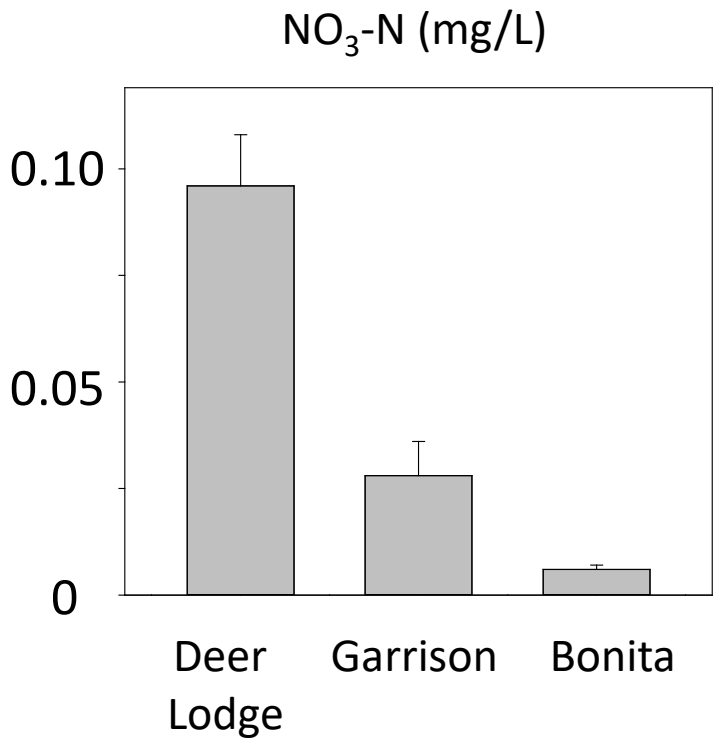


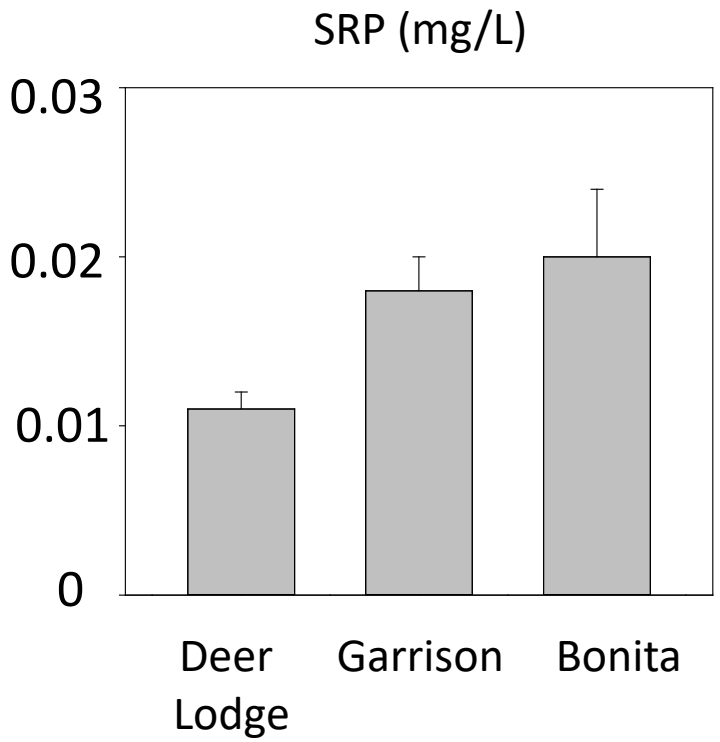


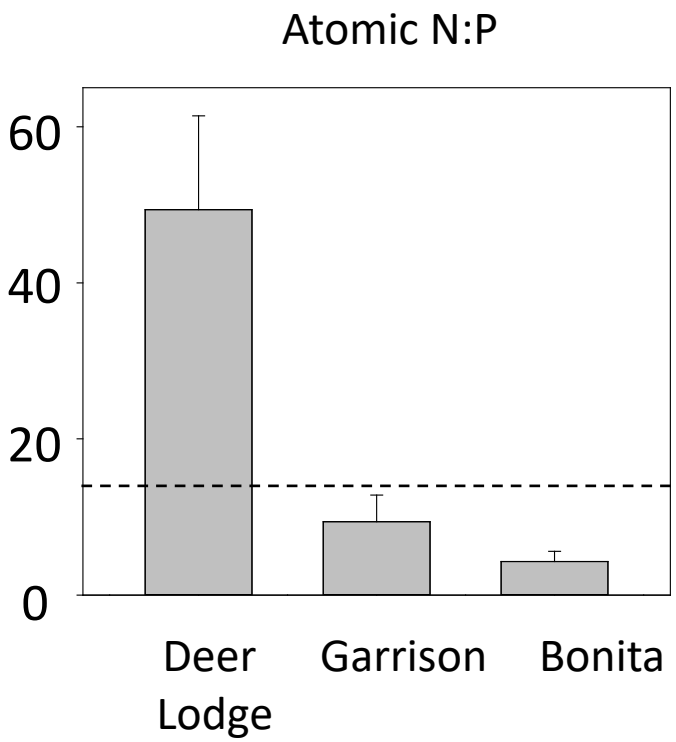
Nutrient Concentrations 2000-2020

Changing abundance of nutrients with distance downstream

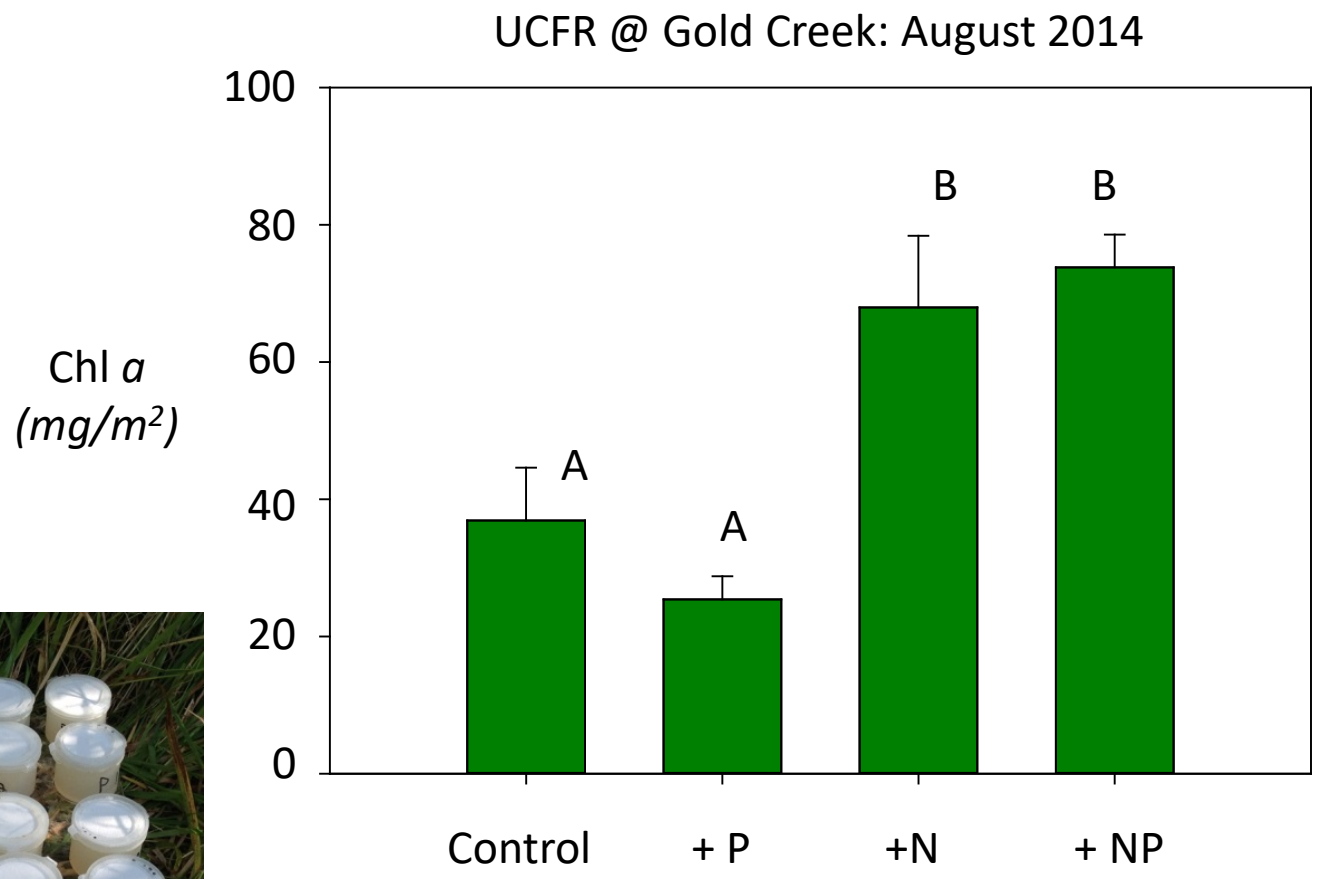






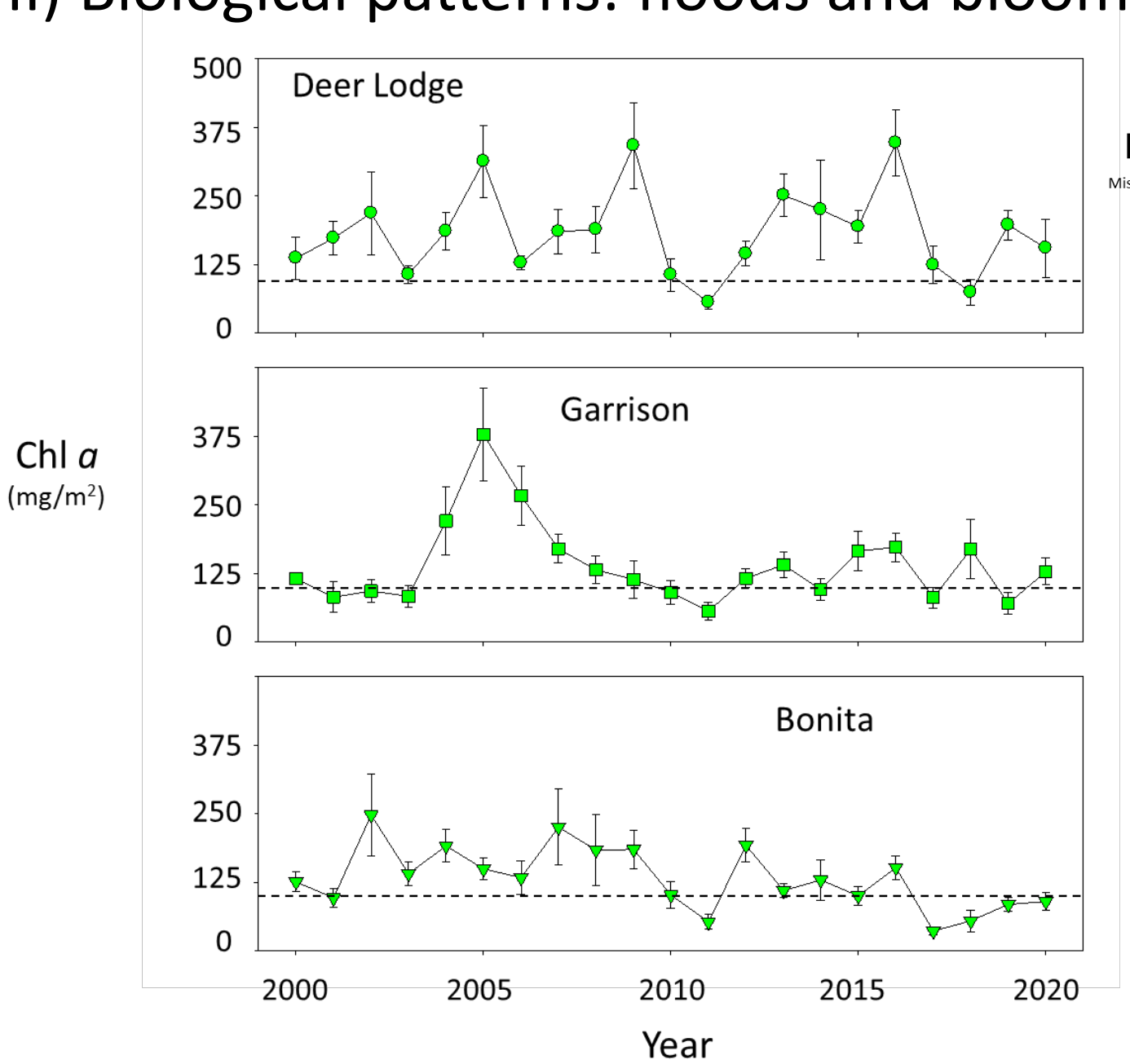


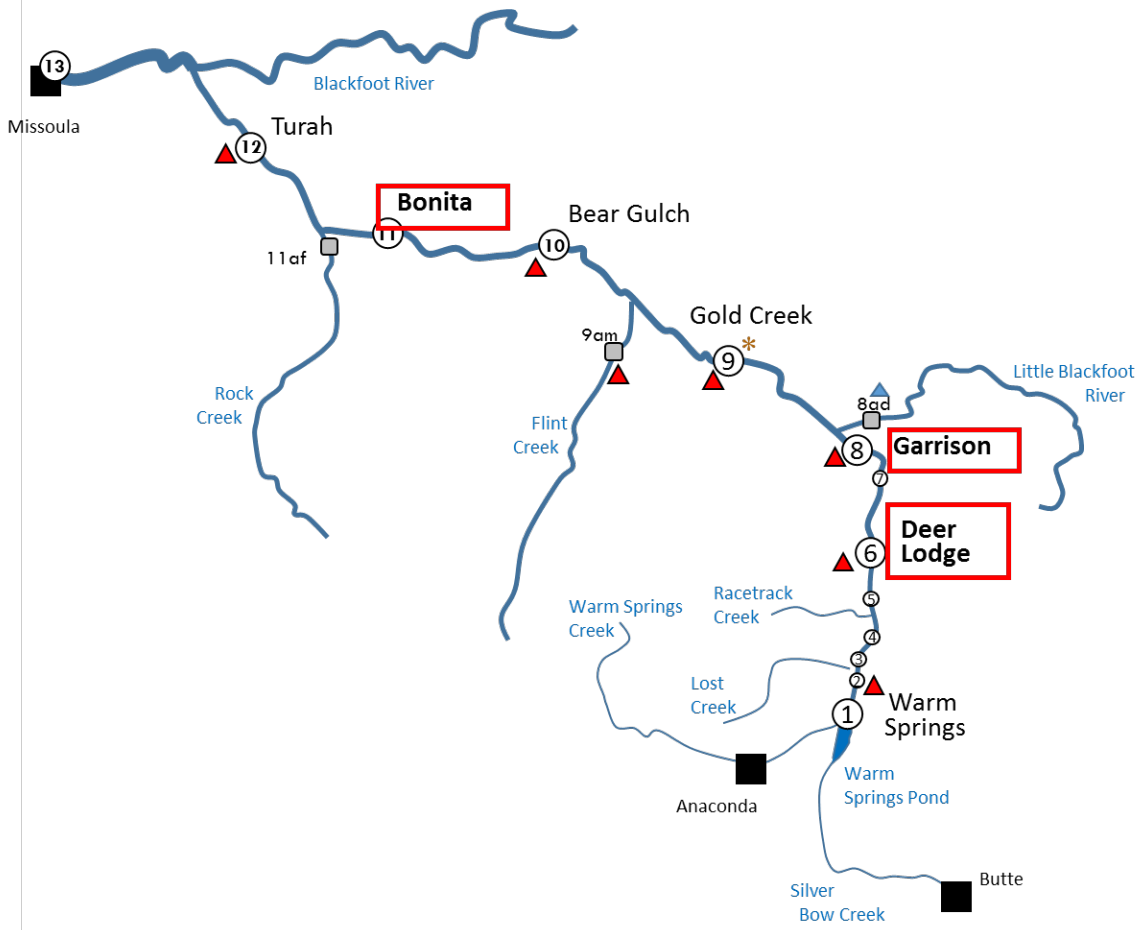
Nutrient-diffusing substrates bioassays indicate N-limitation of algal growth during summer

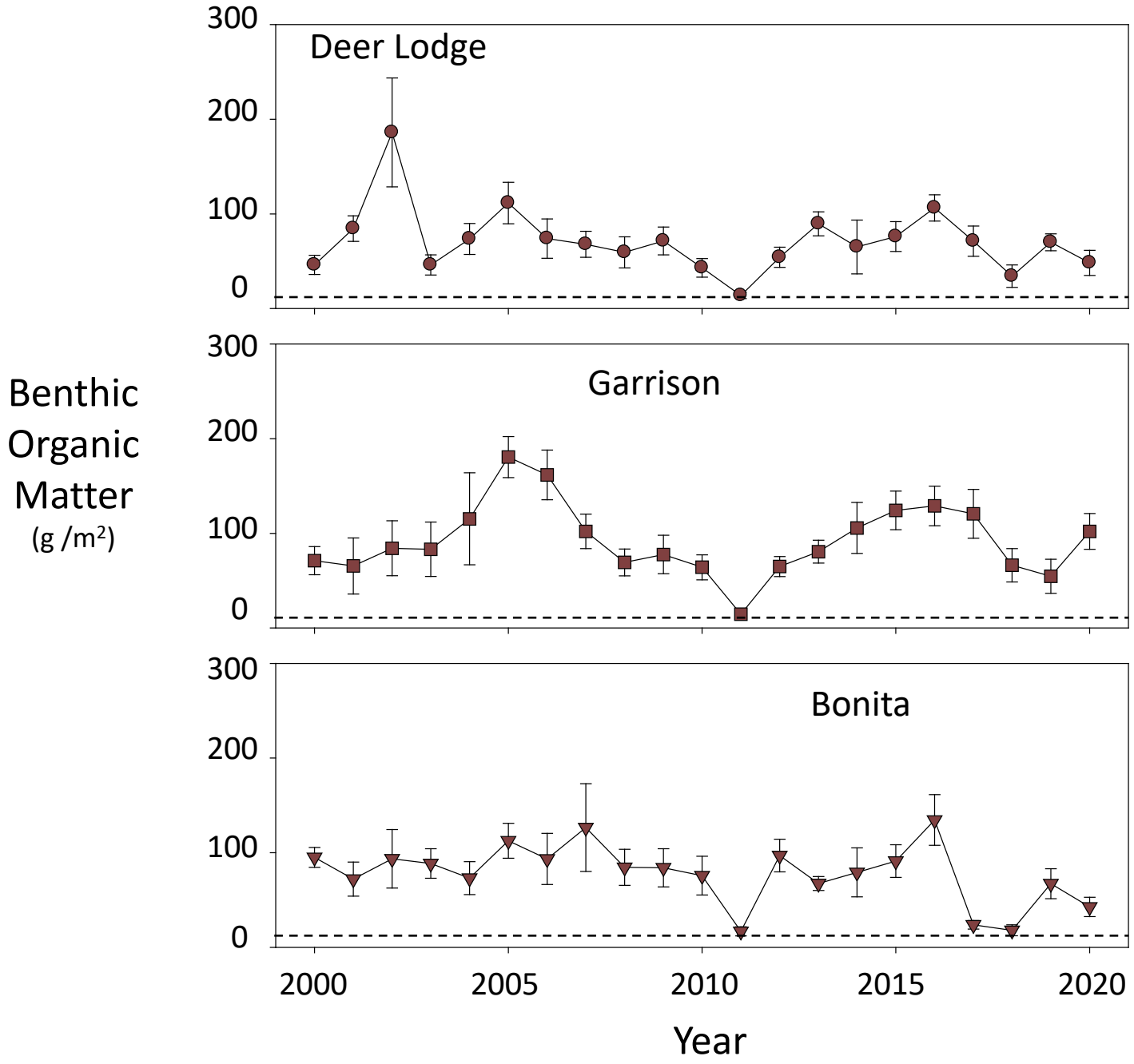


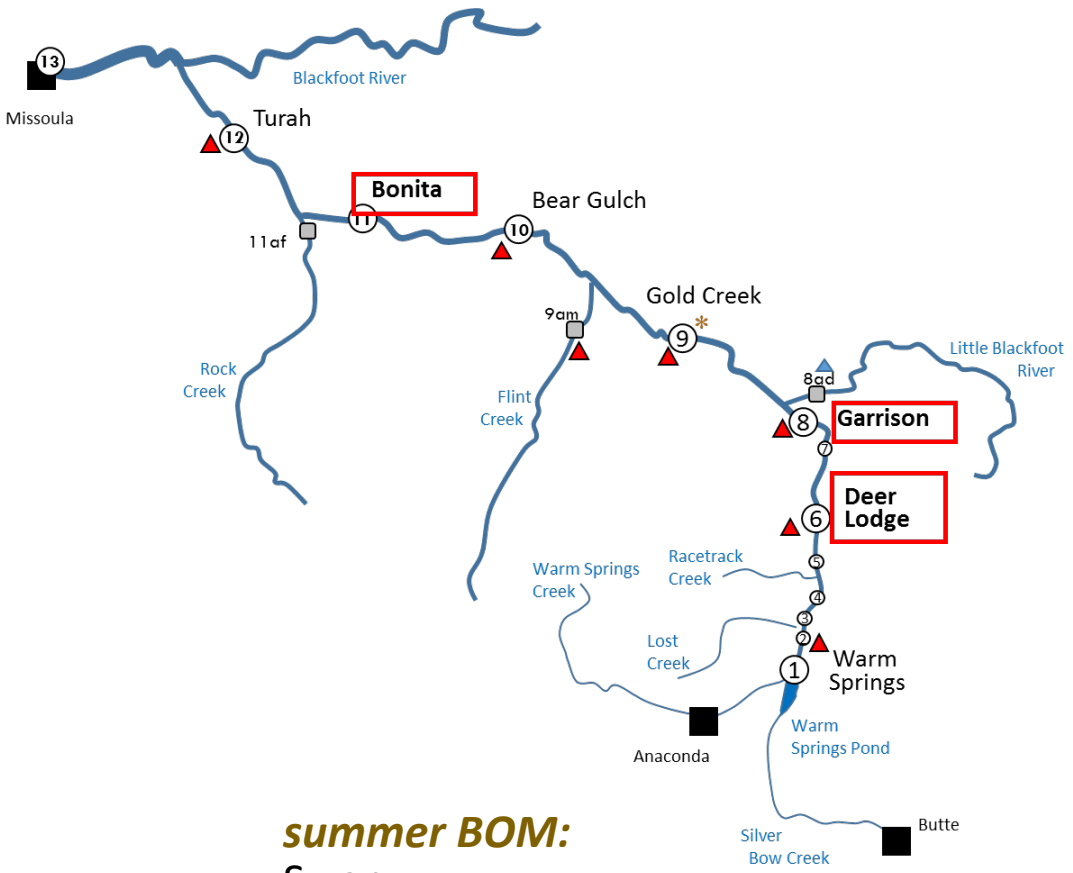
ANOVA & Tukey's HSD
P = 0.0011

II) Biological patterns: floods and bloom structure







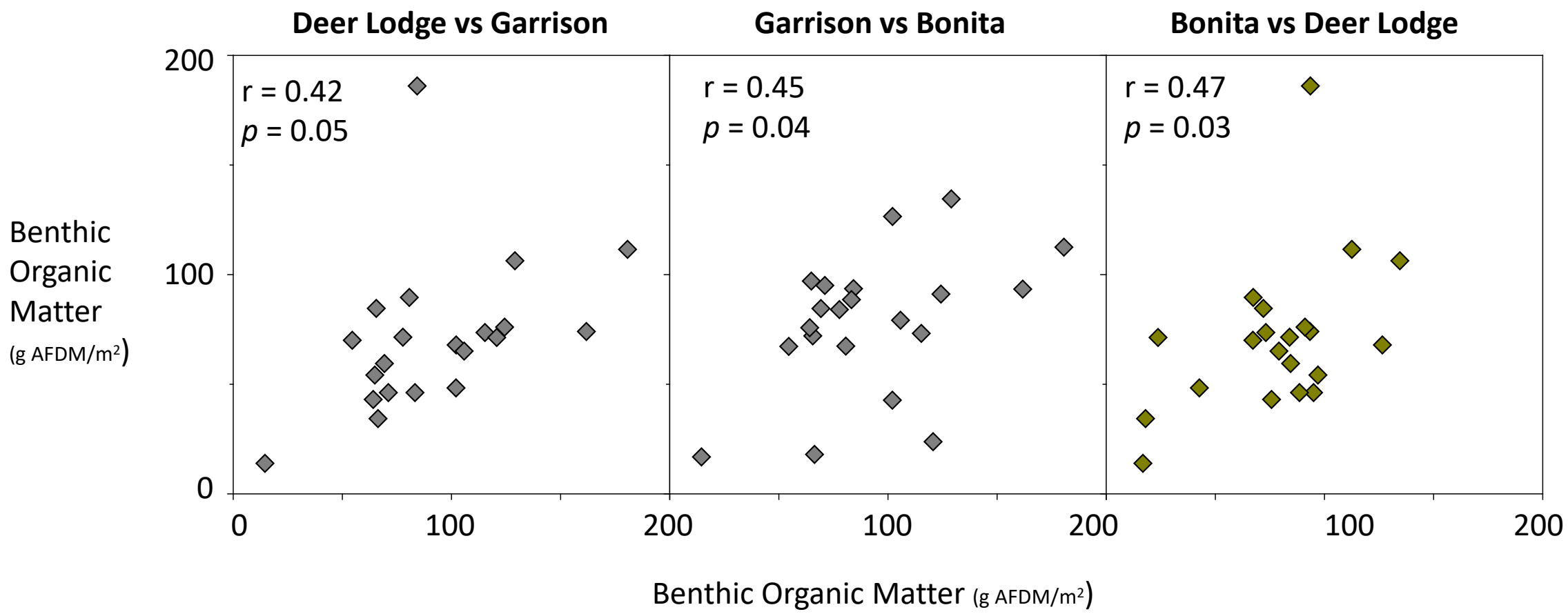


summer BOM:

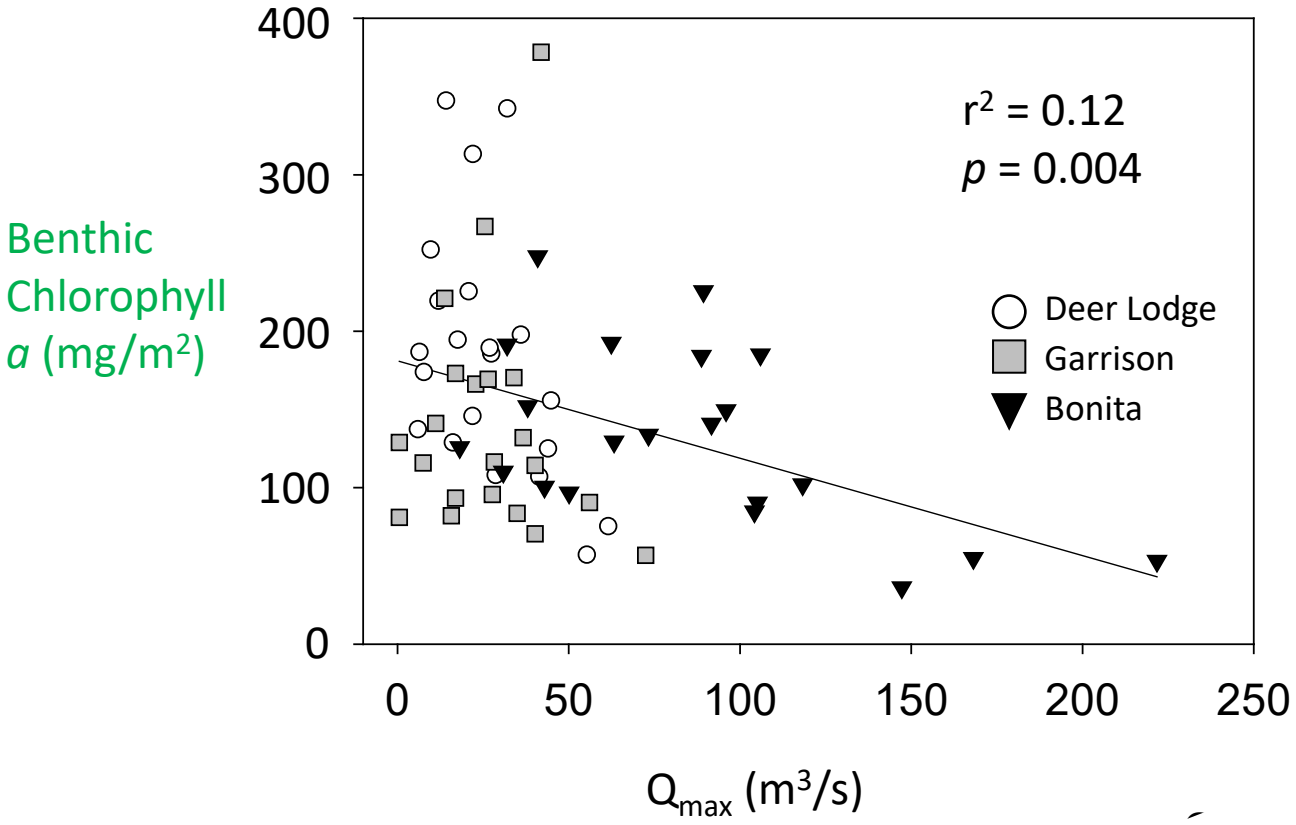
Swan
Bitterroot
Big Hole
Boulder
(n = 47)

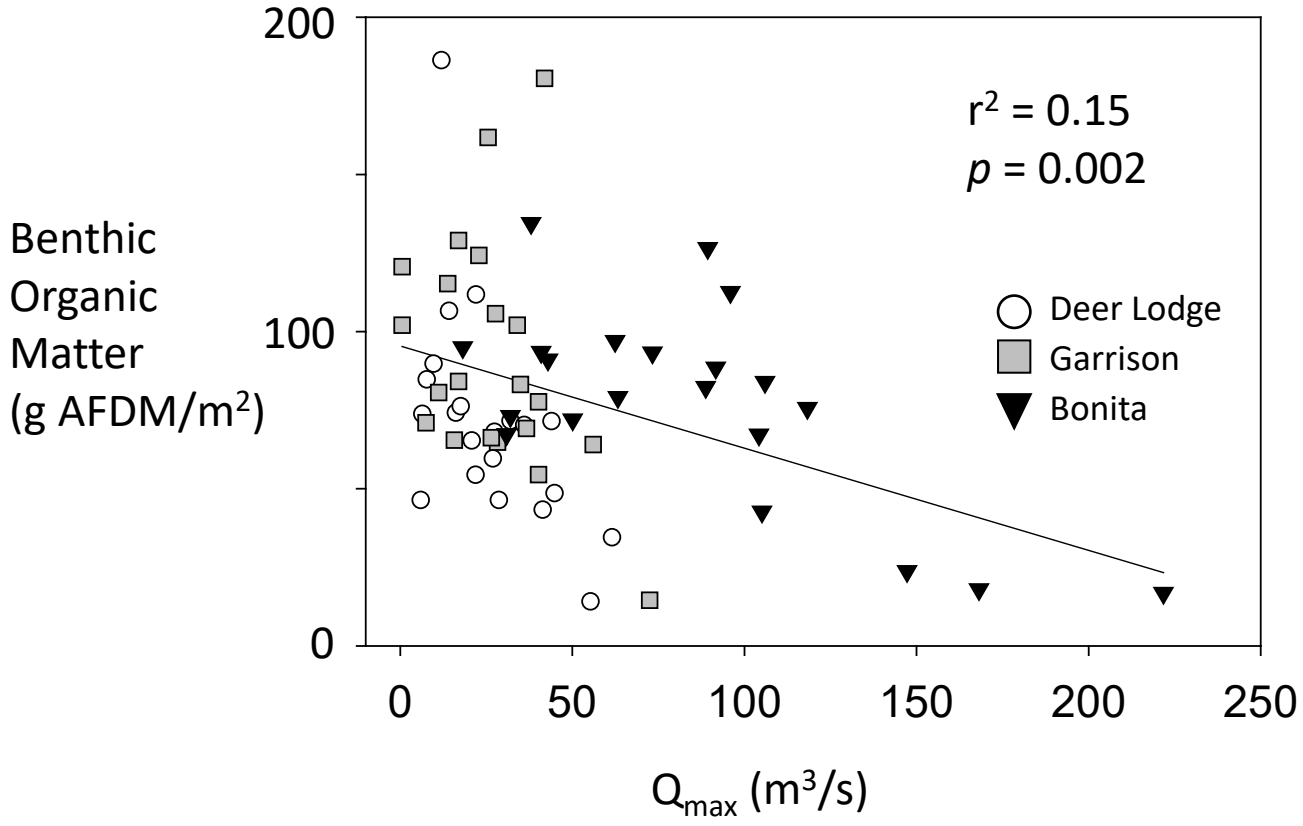
6.7 g/m²

Correlations suggests temporally congruent river behavior over 20 years



Bloom intensity and river discharge: Influence of maximum flows

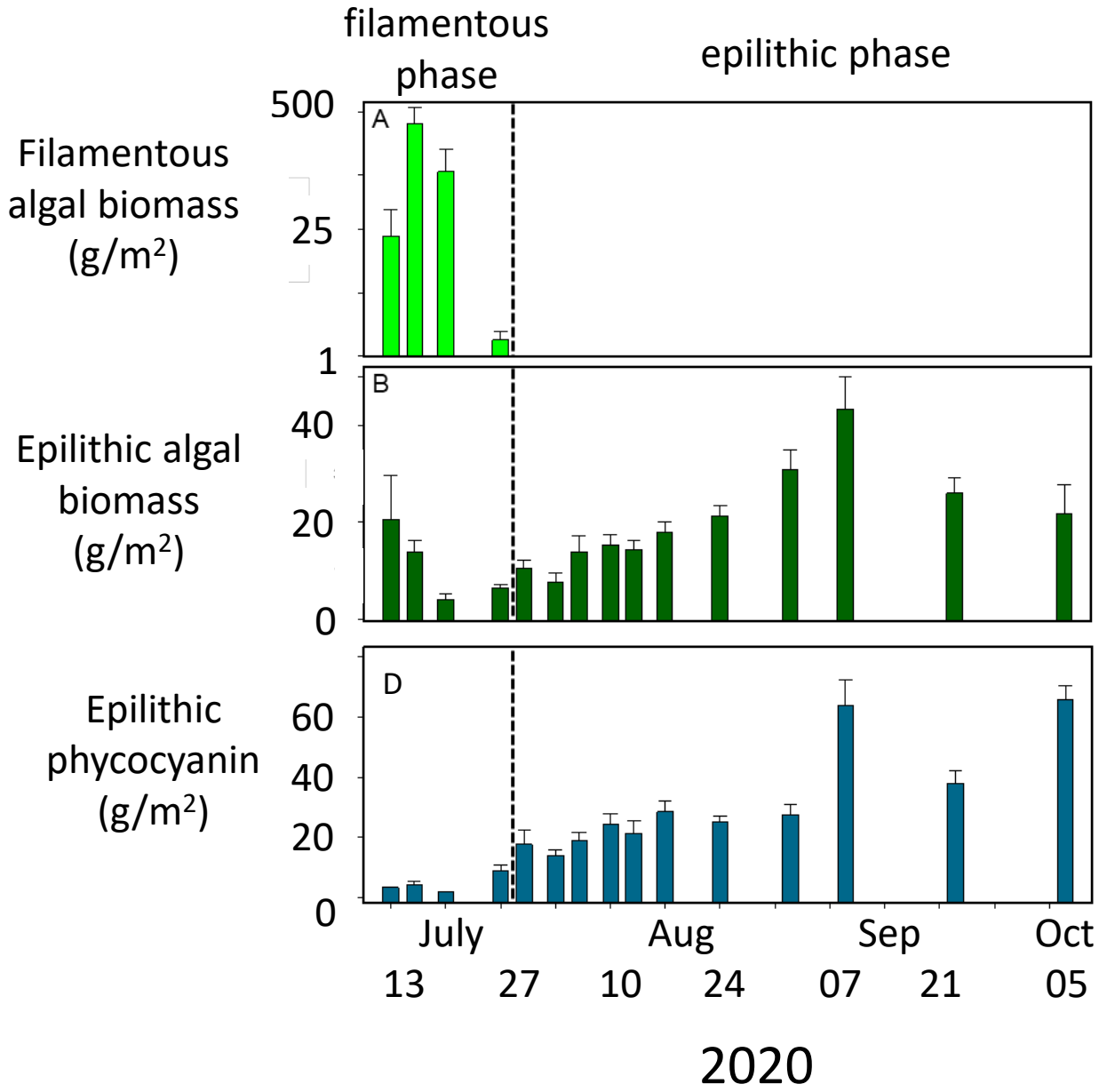



Benthic Organic Matter (g AFDM/m2)
200
100
0
0
50
100
150
200
250
Qmax (m3/s)
r2 = 0.15
p = 0.002
Deer Lodge
Garrison
Bonita

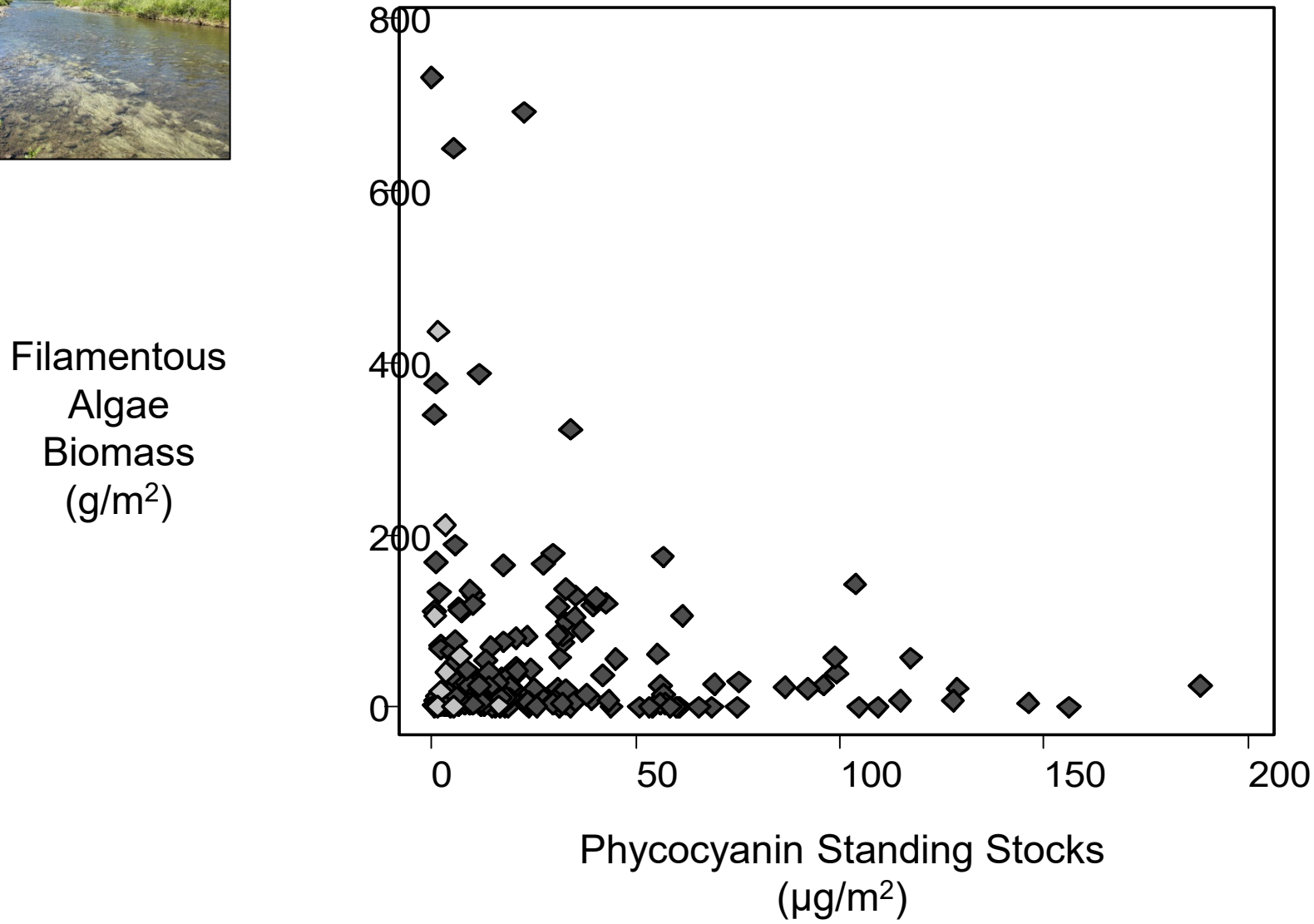
III) Biological patterns: bloom progression

The Bad
(filamentous green algae)

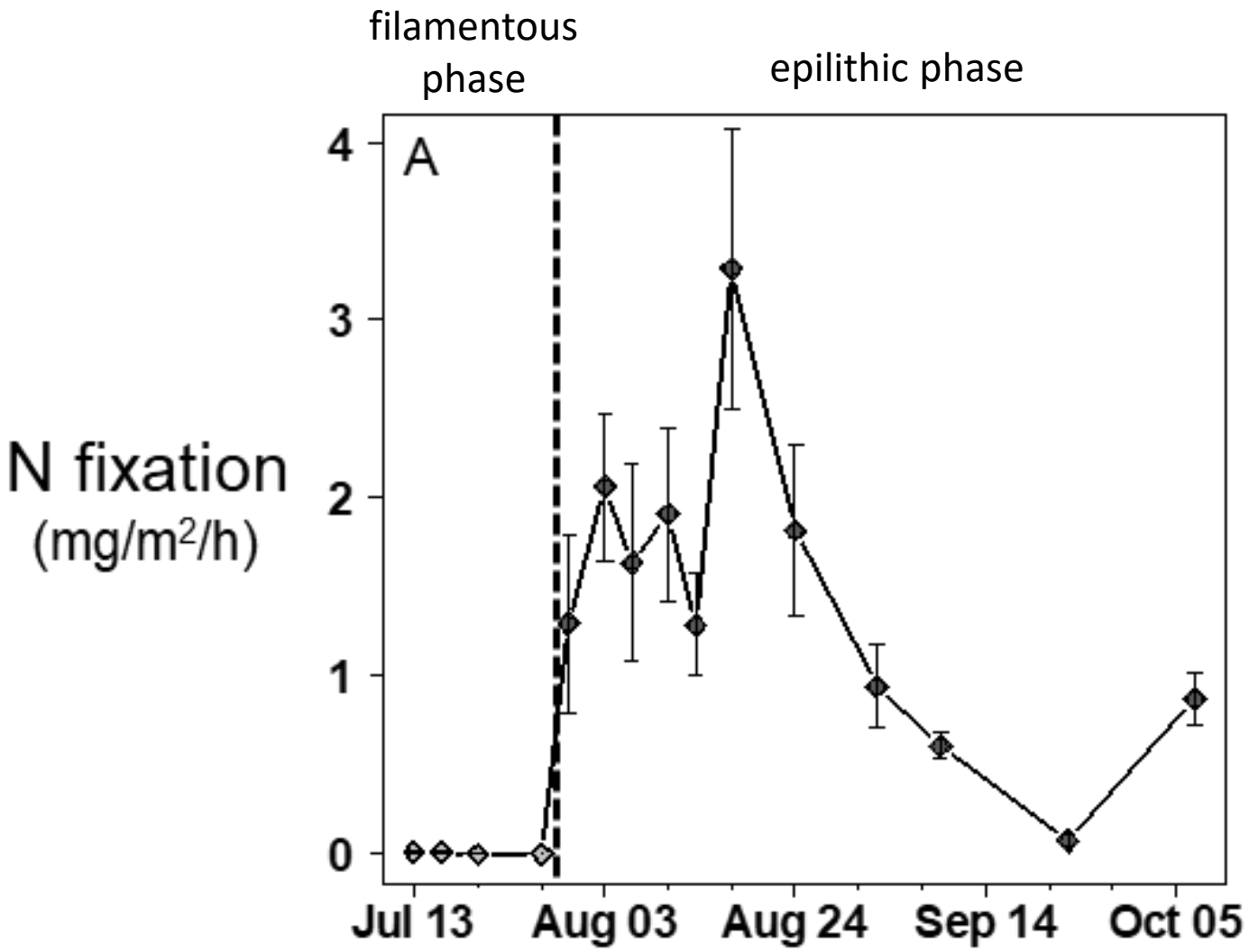
The Ugly
(Bluegreen algae)



III) Biological patterns: segregation of functional groups



Bloom progression – bluegreen abundance and N-fixation



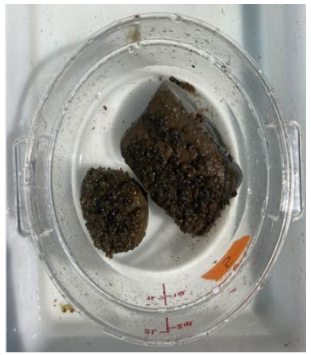
Longitudinal succession of summer algal blooms in the UCFR

Upstream
high N:P

green

Downstream
low N:P

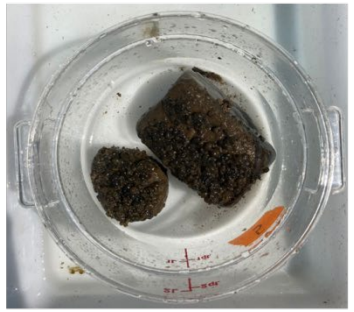
bluegreen?



Mid-late Summer

Later Summer

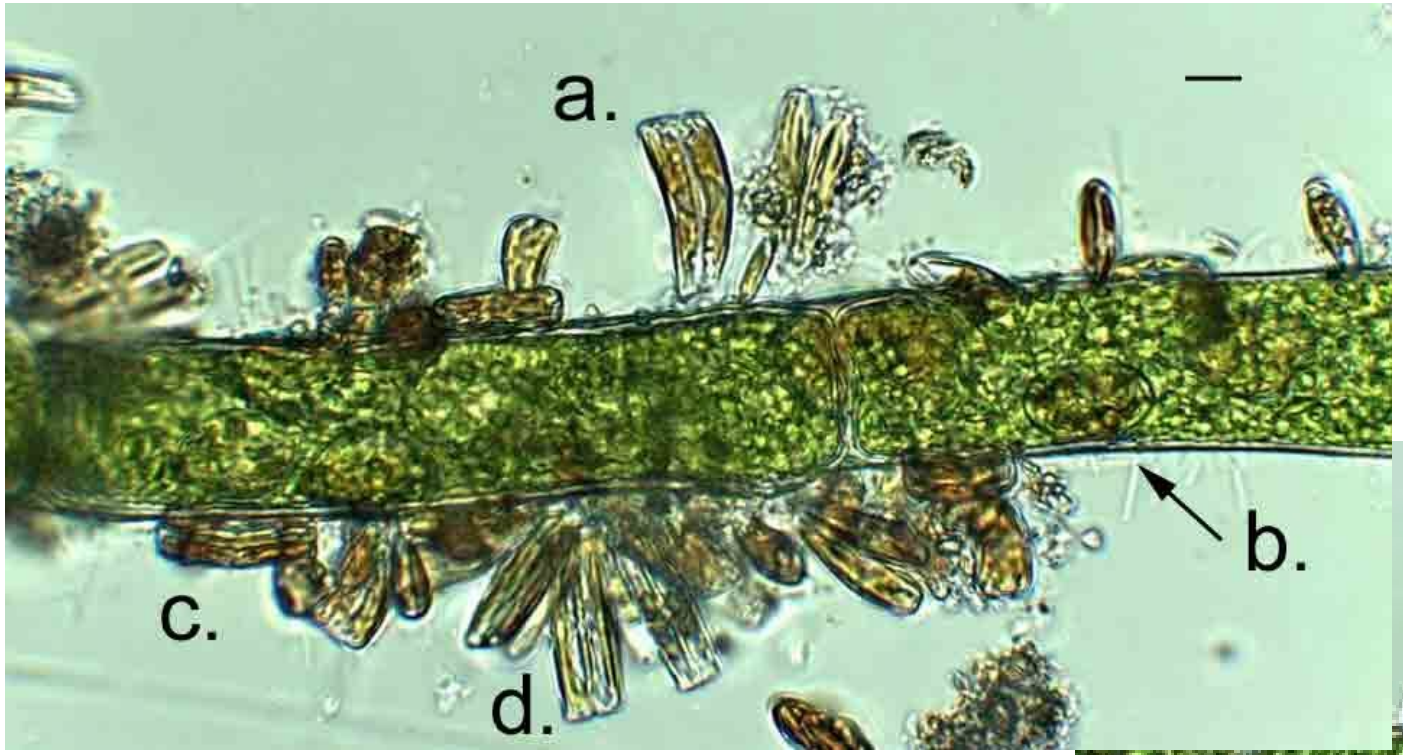
Successional progression of summer algal blooms in the UCFR



Mid-Summer

Late Summer

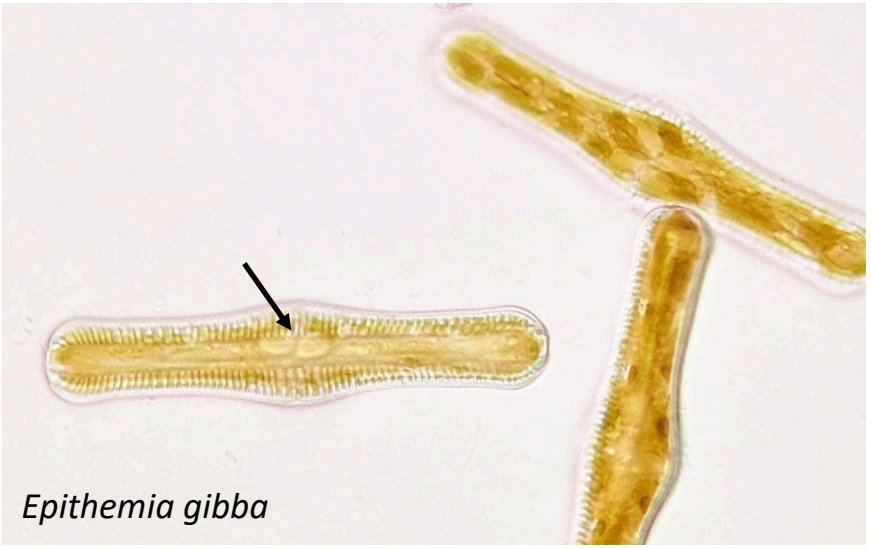
III) Biological patterns: The Good…diatoms and grazing

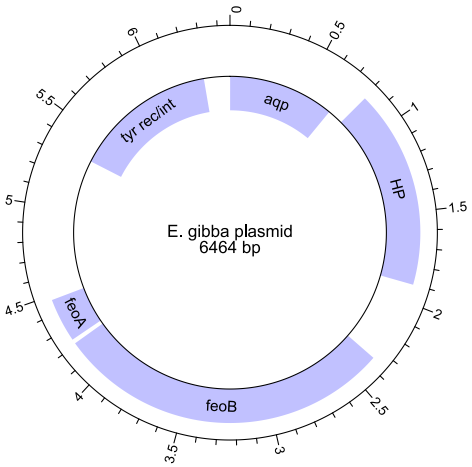


Cladophora
and epiphytic diatoms

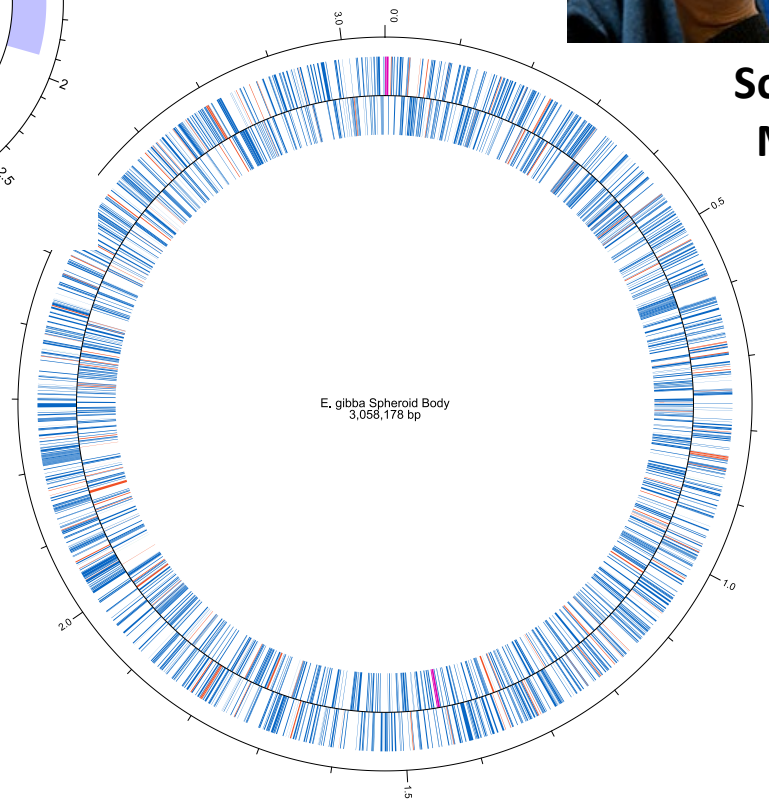
From Kelly 2014

An emerging N fixing organelle in rhopalodian diatoms





Scott Miller, UM



- The symbiont has lost the ability to harvest light and fix carbon but has retained N fixation genes
- An important source of fixed N to the UCFR
- N fixation requires large amounts of iron – the symbiont has a highly expressed plasmid for obtaining ferrous iron from its host

III) Biological patterns: The Good…diatoms and grazing

Grazers found in at least 50 of 120 sampling events over 30 years
Warm Springs, Gold Creek, and Turah, UCFR

Elmid beetles

Optioservus

Grazing control as shown in other rivers?

Caddisfly

Hydroptila

Caddisfly

Helicopsyche

Mayfly

Rhithrogena

IV) Conclusions

- ❑ Algal blooms in the UCFR are problematic for river health
- ❑ N appears to limit algal growth in late summer (more work needed)
- ❑ Blooms progress from green algae (bad) to bluegreen bacteria (ugly)
- ❑ Nutrients promote growth and relative abundance of nutrients influences the timing and composition of the bloom (keep this in mind as N drops)
- ❑ Diatoms and grazing may be an important part of bloom regulation and N-fixation
- ❑ Interactions between metals and nutrients are a key area of future research efforts that should help inform management decisions