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=a07ei35krt8ddf6f1e
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
Remediation and Restoration Strategies

Floodplain Remediation – Metals

Nutrient reduction

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

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


E-Mail/Supplee: msupplee@mt.gov

† Paper No. JAWRA-1-0156-P of the Journal of the American Water Resources Association (JAWRA). Discussions are open until six months from print publication.

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

Marc Peipoch | Herbert Maurice Valett

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

W.K. Dodds, V.T. Smith, B. Zander
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)
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

- nutrient enrichment
- hydrology and disturbance
- biological control (top-down)
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)

From: USGS Report (Knudsen et al. 2001)
Spatial and Temporal Variation in inorganic N abundance

NO$_3$-N (mg/L)
Nitrate Grand Means

NO$_3$-N (mg L$^{-1}$)

0.0 0.1 0.2

0 40 80 120 160 200

Deer Lodge  Garrison  Bonita

[Graph showing nitrogen levels in different locations]
Nutrient Concentrations 2000-2020
Changing abundance of nutrients with distance downstream

NO$_3$-N (mg/L)

SRP (mg/L)

Atomic N:P
Nutrient-diffusing substrates bioassays indicate N-limitation of algal growth during summer.
II) Biological patterns: floods and bloom structure

![Graphs showing biological patterns in Deer Lodge, Garrison, and Bonita over years.](image-url)
Benthic Organic Matter (g/m²)

**summer BOM:**
Swan
Bitterroot
Big Hole
Boulder
(n = 47)

6.7 g/m²
Correlations suggest temporally congruent river behavior over 20 years.
Bloom intensity and river discharge: Influence of maximum flows

$r^2 = 0.12$
$p = 0.004$
Benthic Organic Matter (g AFDM/m²)

$Q_{max} (m^3/s)$

$r^2 = 0.15$

$p = 0.002$

Deer Lodge
Garrison
Bonita
III) Biological patterns: bloom progression

The Bad (filamentous green algae)

The Ugly (Bluegreen algae)

Filamentous algal biomass (g/m²)

Epilithic algal biomass (g/m²)

Epilithic phycocyanin (g/m²)

2020
III) Biological patterns: segregation of functional groups

Filamentous Algae Biomass (g/m²)

Phycocyanin Standing Stocks (µg/m²)
Bloom progression – bluegreen abundance and N-fixation

N fixation
\( (\text{mg/m}^2/\text{h}) \)}
**Longitudinal succession of summer algal blooms in the UCFR**

**Upstream**
- high N:P
- green

**Downstream**
- low N:P
- bluegreen?

**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 rhopalodanian diatoms

- 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

Mayfly

Rhithrogena

Helicopsyche
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.