EPA Region 3 Mid-Atlantic State's Algae Identification Workshop

GORDON "MIKE" SELCKMANN INTERSTATE COMMISSION ON THE POTOMAC RIVER BASIN AUGUST 10, 2016

### Today's objectives

Gain knowledge and experience identifying the general types of plants and algae found growing in Mid-Atlantic streams and rivers.

Understand the basic distinguishing features between filamentous green algae, cyanobacteria (blue-green algae), submerged aquatic vegetation (SAV) and emergent macrophytes.

Discuss/define future needs relating to freshwater primary production in EPA Region 3

# Topics of Discussion

- 1. What are "algae?" / What is an algae bloom?
- 2. Identifying "Bloom likely regions"
- 3. Field ID Methods
- 4. Rapid/Course resolution in-field ID
- 5. Resources for field biologists
- 6. Future work utilizing field-level ID





► Colloquial:

Any excessive growth of photosynthetic organisms viewed in a negative connotation

### ► Scientific:

Dominant primary producers world-wide Base of the food web in most aquatic systems

# "Algae"

- Diverse group of plants that can be...
  - ► Unicellular
  - Colonial
  - Multi-cellular
  - Pseudofilamentous
  - ► Filamentous
  - Pseudoparenchymatous
  - Parenchymatous
  - Coenocytic/Siphonous



# "Algae"

- Diverse group (polyphyletic) of nonflowering organisms that contain chlorophyll
  - Lack true stems, roots, leaves, and vascular tissue (stomata, xylem, phloem)



# So what are we defining as "Algae" today?

### FGA

- Benthic, filamentous green algae (Chlorophyta)
- BGA
  - Benthic blue-green (Cyanobacteria)

Other non-algae photosynthetic organisms

- SAV
  - Submerged Aquatic Vegetation\*
- EAV
  - Emergent Aquatic Vegetation



# What constitutes an "algae bloom?"

A "bloom" is an arbitrary concentration that depends on the impact

### Positive

Seasonal blooms, especially in spring, support aquatic food webs, including fish and shellfish

### Negative

- Taste and odor of drinking water
- Recreational impairment
- Animal deaths & anoxic zones
- Human health concerns



# What constitutes an "algae bloom?"

A bloom in region 3 states we are concerned with aquatic uses

### Negative

- Taste and odor of drinking water
- Recreational impairment
- Animal deaths & anoxic zones
- Human health concerns



# Topics of Discussion

- 1. What are "algae?" / What is an algae bloom?
- 2. Identifying "bloom likely regions"
- 3. Field ID Methods
- 4. Rapid/Course resolution in-field ID
- 5. Resources for field biologists
- 6. Future work utilizing field-level ID

# What causes/limits algae blooms?

### Ultimate (Landscape) variables

Proximate variables

Biological responses



FIGURE 14 Conceptual model of ultimate (landscape) and proximate (stream) variables that control benthic algal communities, their consumers, and interactions in streams (solid lines = strong effects; dashed lines = weaker effects; double arrows indicate feedback interactions. Reproduced with permission from Biggs, B. J., in Stevenson, R. J. et al., Eds., Algal Ecology: Freshwater Benthic Ecosystems. Copyright © 1996 by Academic Press.

### WVDEP 2008 Greenbrier River Study

### Monitoring data showed

- Acceptable Nitrogen levels
- Abundant Phosphorus
- Phosphorus availability and algal growth were favored by
- Alkalinity & Hardness
  - High Alkalinity (>40 mg/L) primarily  $CO_3^{2-}$  and  $HCO_3^{-}$
  - Low Hardness (<100 mg/L) primarily Ca<sup>2+</sup>, Mg<sup>2+</sup>

### Clear Water

- Low Flow
- Warm Temperature

Assessment of Filamentous Algae in the Greenbrier River and Other West Virginia Streams James Summers, WVDEP-DWWM December 17, 2008

During the summer of 2007, WVDEP received numerous complaints regarding the amount of algae in the Greenbrier River. Most of the complaints centered on the Caldwell to Alderson section of the river; and at least one complaint was received about the level of algae further upstream in the Denmar area. Several employees of WVDEP were familiar with the problem and indicated that the algae bloom had been occurring at various intensities for decades; some asserted that the algae had been getting worse, and perhaps starting earlier, than it had historically.

In September 2007, a meeting within the WVDEP Division of Water and Waste Management was held to discuss the problem. Results of water quality samples from the Watershed Assessment Branch sample database (WAB-Base) were summarized at the meeting. The WAB-Base results showed elevated levels of phosphorus in Howard Creek. Howard Creek flows into the Greenbrier River at Caldwell where the algae problem was reported to begin. WAB-Base results also showed that phosphorus levels in Howard Creek were significantly higher below the White Sulphur Springs sewage treatment plant (WSS STP) than above the plant.

The WSS STP had a history of solids "washout" which resulted in sludge beds in Howard Creek. Seven golf courses and a fish hatchery are located on Howard Creek, upstream of the WSS STP. Additionally, significant cattle pasturing occurs in the Greenbrier basin upstream of Howard Creek, and the gradient of the river lessens somewhat near Caldwell. It was suggested that the soil particles from

> dient section on vater column. as no consensus in

Nutrient Impacts in West Virginia Rivers and Streams

The Importance of Hardness in Developing Phosphorus Criteria

eld work for this biological, and he only violation of at several uality standard for tant source res. One outcome k and the the algae problem.

er River and in the "lower all data was d a storm event , and a winter nich included d fish hatchery.



# Topics of Discussion

- 1. What are "algae?" / What is an algae bloom?
- 2. Identifying "bloom likely regions"
- 3. Field ID Methods
- 4. Rapid/Course resolution in-field ID
- 5. Resources for field biologists
- 6. Future work utilizing field-level ID

- Run through fingers:
- Action: With an open hand, scoop up the algae
- ► What we are looking for:
  - Robustness: Is the algae able to span the gap between fingers without breaking
  - Texture: Is the algae Course and strong or fine and fragile



- Suspend collected specimen
- Action: Place specimen in a clear cup (or cupped in hands with water)
- ► What we are looking for:
  - 1. Geometric patterning
  - 2. Branching/feathering
  - 3. Density of mat
  - 4. Robustness of mat
  - 5. Color



- De-water the sample
- Action: squeeze algal sample
- ► What we are looking for:
  - Robustness: Do filaments...
    - Stick together?
    - Spring back to decompressed shape?
    - Destroyed?
  - Does it have a odor?





### Specimen Preservation:

- Buffered 2.5% glutaraldehyde (long term)
- Buffered formaldehyde (long term)
- ► Lugol's solution
- Collected in river water from sample site and put on ice (short term).
  - Do not collect cyanobacteria in this way.
  - Single samples to reduce biomass as much as possible
  - ▶ 15 weeks maximum



# Topics of Discussion

- 1. What are "algae?" / What is an algae bloom?
- 2. Identifying "bloom likely regions"
- 3. Field ID Methods
- 4. Rapid/Course resolution in-field ID
- 5. Resources for field biologists
- 6. Future work utilizing field-level ID

# Rapid Field ID: Cyanobacteria

### Cyanobacteria ID should NOT be determined with field observations due to the visual similarities between species

What to look for:

- Color: blue-green, dark green, brown or red.
- Short filaments; do not fill the water column (except in shallow glides).
- ▶ "Foot" often attached to a periphyton mat.
- ► Frequently lacks rigidity and feel slimy.
- Manifests as a tuft or a fuzzy-looking benthic mat
- Releases from benthic attachment on bright, sunny days



# Rapid Field ID: Cyanobacteria





# Rapid Field ID: Filamentous Green Algae (FGA)

### Hydrodictyon sp.

- ► Low Flow
- Does not attach well to substrate
- Key descriptor is hexagonal "net-like" structure



### Cladophora sp.

- Found in all flow environments
  - Low: appears feathery (branching)
  - High: appears long and loses branching
- Does attach well to substrate



### Spirogyra sp.

- ► Low flow
- Deeper green than cladophora or hydrodictyon
- Very fragile globular form
  - Almost the same density as the surrounding water



Rhizoclonium sp. And Oedogonium sp.

- Low Flow
- Epiphytic
- Large tangled mats will take on bulbous forms as i establishes on SAV



### Rhizoclonium sp.

### Oedogonium sp.





### Rapid Field ID: Vascular plants

► SAV



Emergent





# Rapid Field ID: Periphyton

### Community

- ▶ Including green and blue-green algae, fungi, protists, and heterotrophic bacteria in freshwaters.
- Greater diversity of algal taxa than the macroscopic filamentous forms
- Filamentous algae often start out as members of periphyton and then outgrow the community
- Resistant to high flows, responsive to pollutant stressors, good at removing (sequestering) nutrients from water column, especially phosphorus



# Topics of Discussion

- 1. What are "algae?" / What is an algae bloom?
- 2. Identifying "bloom likely regions"
- 3. Field ID Methods
- 4. Rapid/Course resolution in-field ID
- 5. Resources for field biologists
- 6. Future work utilizing field-level ID

# Field Biologist Resources

References recommended by Jeff Johansen (John Carroll University) - Taught the AMAAB algae workshop

Digital handout available outlining all methods and traits reviewed in this powerpoint.

Atlas of **Evanophytes** 

John Wehr, Robert Sheath & Patrick Kociolek Second Edition

Freshwater Algae of North America

Ecology and Classification



Edited by John D. Wehr, Robert G. Sheath, and J. Patrick Kociolek



# Underwater Grasses

in Chesapeake Bay & Mid-Atlantic Coastal Waters

Identifying Submerged

Aquatic Vegetation

Guide to

Bergstrom et al.

František Hindák

# Topics of discussion

- 1. What are algae? What is an algae bloom?
- 2. Field ID Methods
- 3. Rapid in-field ID
- 4. Resources for field biologists
- 5. Future Work: Course-resolution macrophyte reporting

### Future Work: Courseresolution macrophyte reporting



### Submit a Report to ICPRB

Use the Water reporter app to take a picture of an area that you think is negatively impacted by plant growth in your river (Algae, vegetation, cyanobacteria, etc). Make sure to do the following:

Associate the report with Interstate Commission on the Potomac River Basin

/ U

Use the hashtag: #ICPRBalgae

 $\checkmark$ 

If the algae is affecting your ability recreate use the hashtag: #NOrec



Estimate the area of the densest algae or plants region in 1000 ft of river by stating 20%, 40%, 60%, 80%, or 100% to let us know the level of severity



### **Interannual variability**

Year-to-year timing, location, intensity, and extent of FGA and BGA blooms are not predictable



# Questions/ Discussion

### Afternoon Agenda

- Lunch
- Afternoon

Microscope practice in broadbrush identification of algae and plants:

> "blue-green" "green" "vascular plant"