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

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INTERSTATE COMMISSION ON THE POTOMAC RIVER BASIN

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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

"Algae"

- 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

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What causes/limits algae blooms?

- Ultimate (Landscape) variables
- Proximate variables
- Biological responses

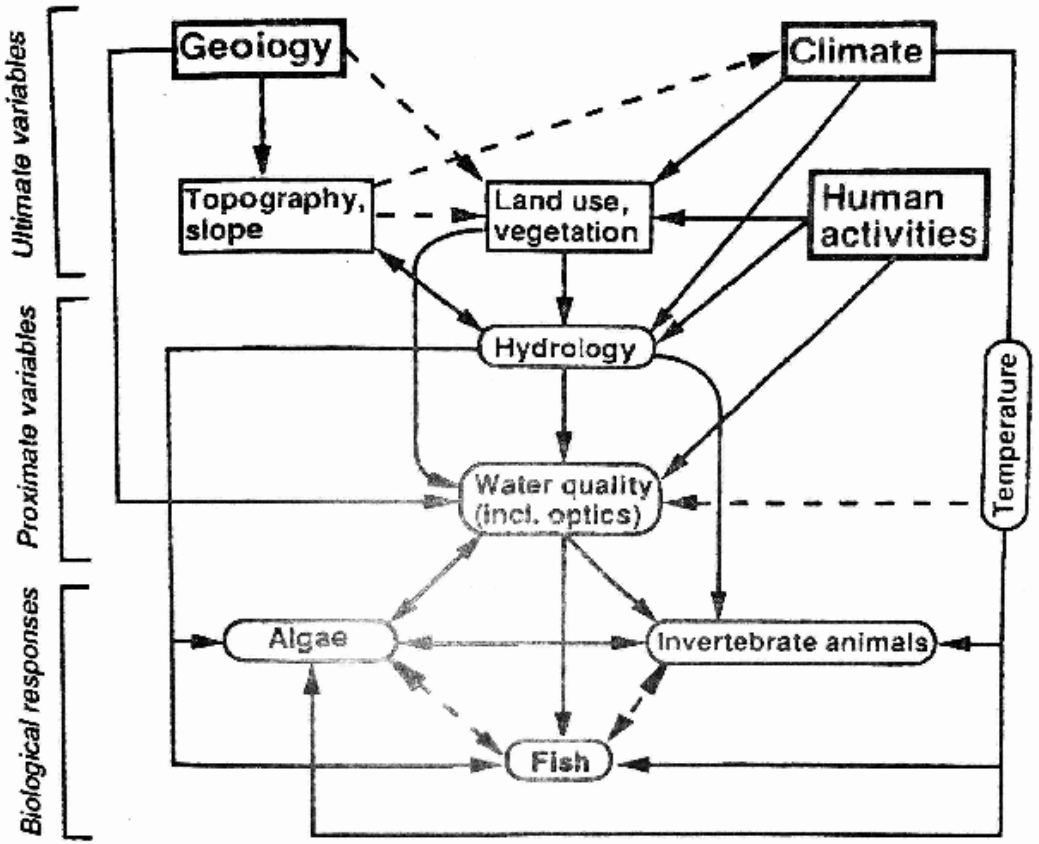


FIGURE 14 Conceptual model of ultimate (landscape) and proximate (stream) variables that control benthic algal communities, their consumers, and interactions in streams (solid lines = strong effects; dashed lines = weaker effects; double arrows indicate feedback interactions. Reproduced with permission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

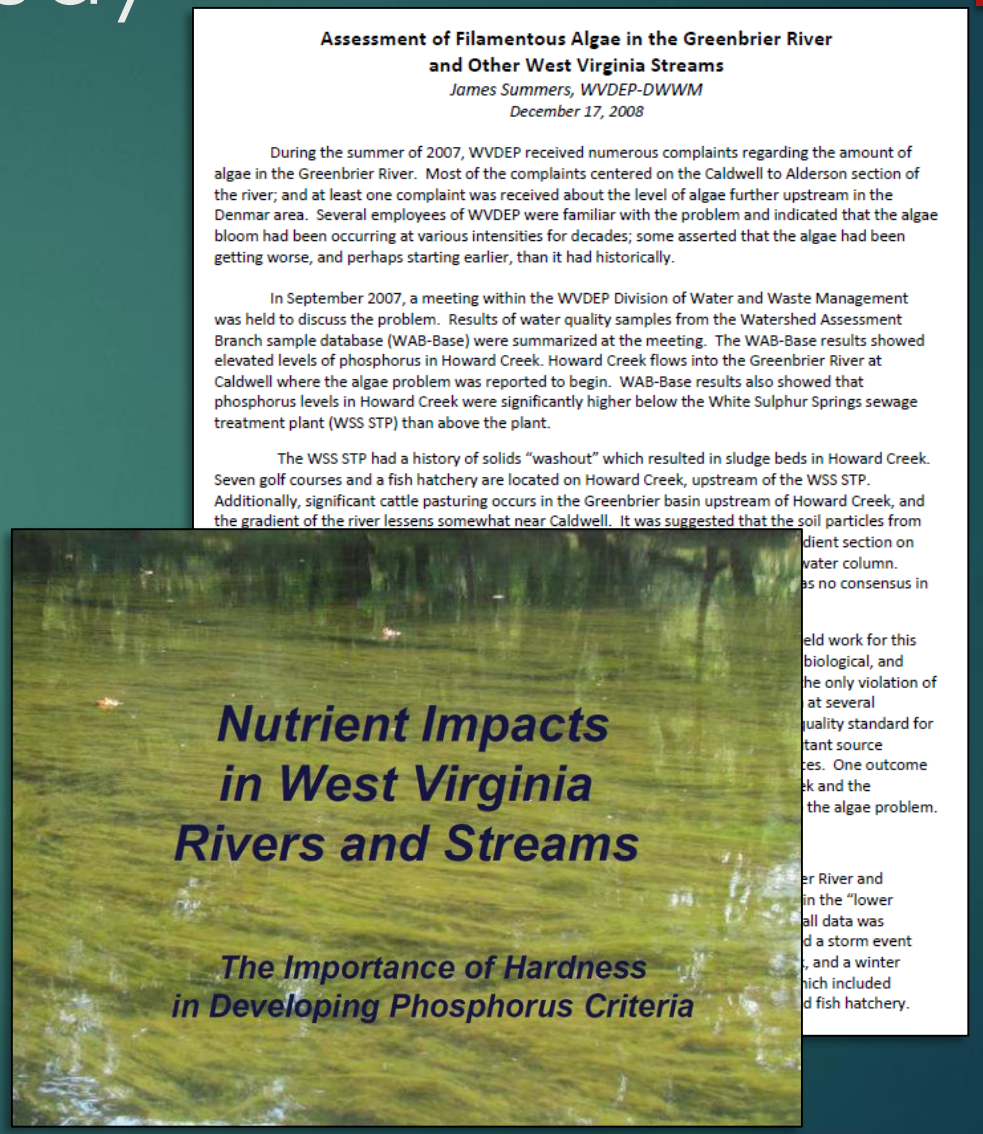
WVDEP 2008 Greenbrier River Study

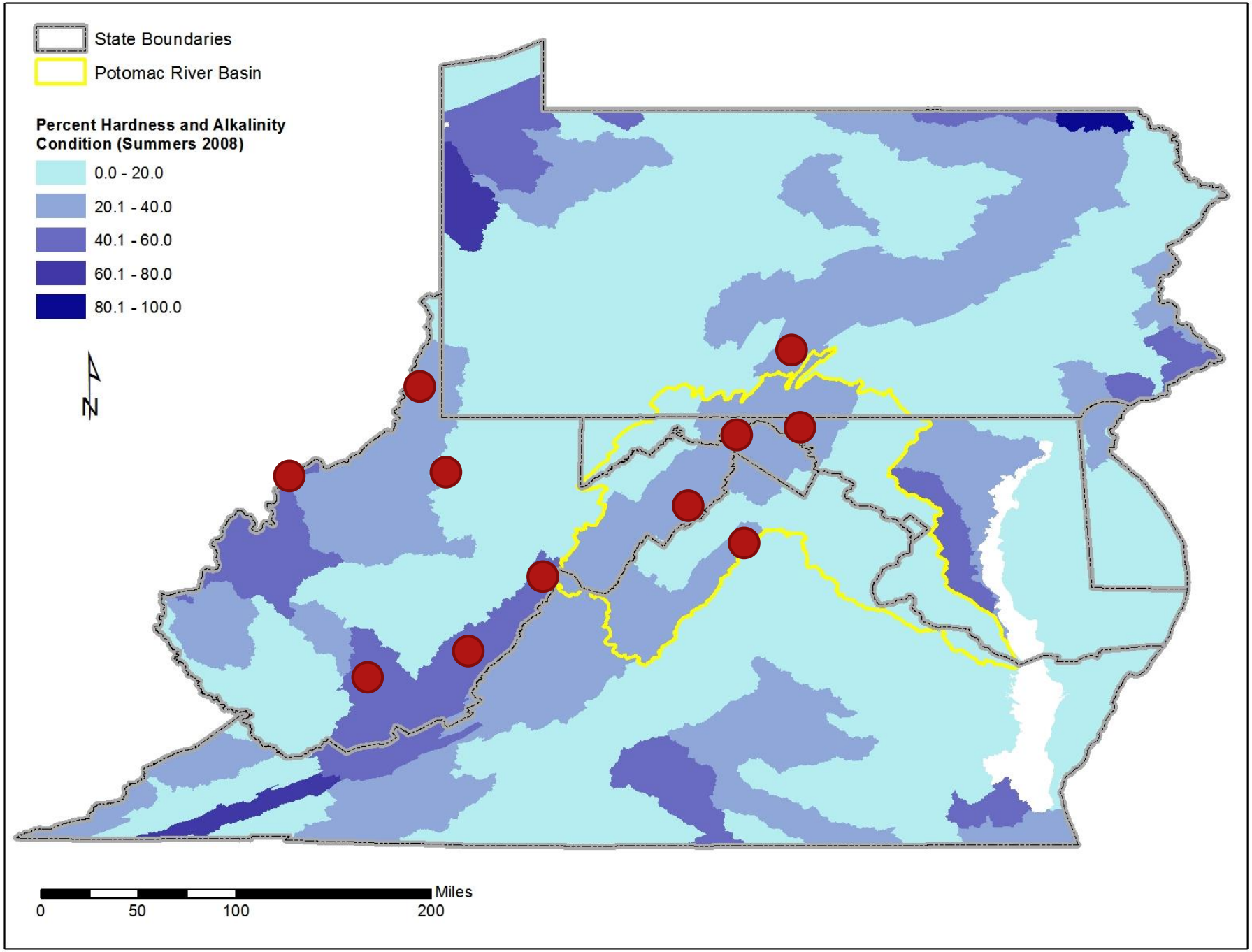
Monitoring data showed

- 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^{2+}, Mg^{2+}
- ***Clear Water***
- ***Low Flow***
- ***Warm Temperature***




State Boundaries
Potomac River Basin
Percent Hardness and Alkalinity Condition (Summers 2008)
0.0 - 20.0
20.1 - 40.0
40.1 - 60.0
60.1 - 80.0
80.1 - 100.0
N
Miles
0
50
100
200

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Field Methods

- 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

Field Methods

- 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

Field Methods

- 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?

Field Methods

- 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

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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)

Rapid Field ID: Common FGA

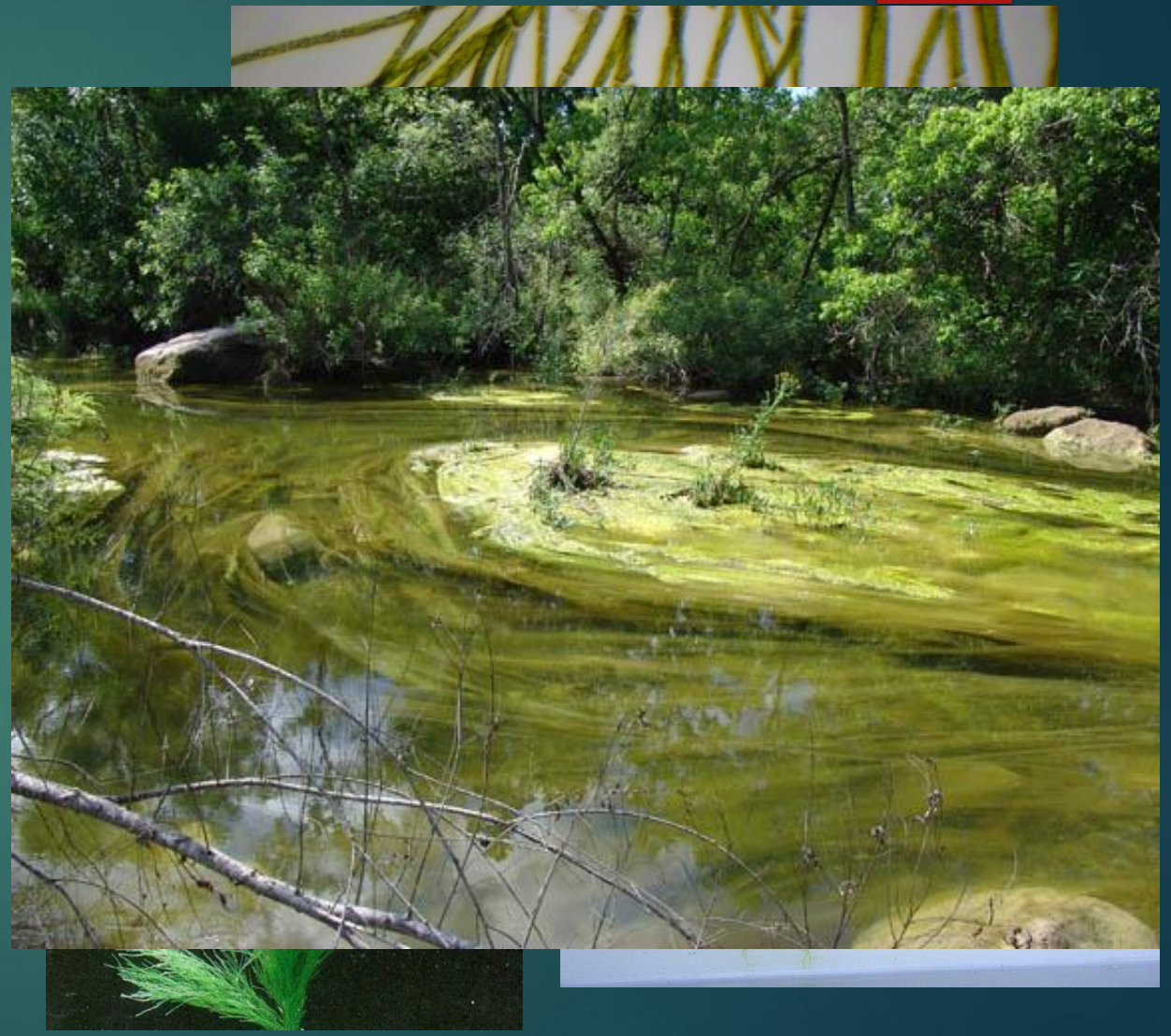
Hydrodictyon sp.

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

Rapid Field ID: Common FGA

Cladophora sp.

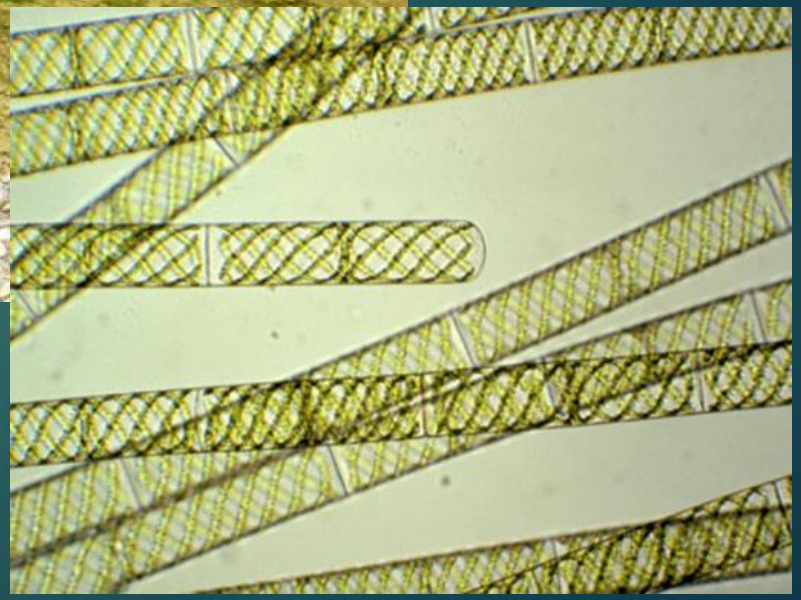
- Found in all flow environments
  - Low: appears feathery (branching)
  - High: appears long and loses branching
- Does attach well to substrate



Rapid Field ID: Common FGA

Spirogyra sp.

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



Rapid Field ID: Common FGA

Rhizoclonium sp.

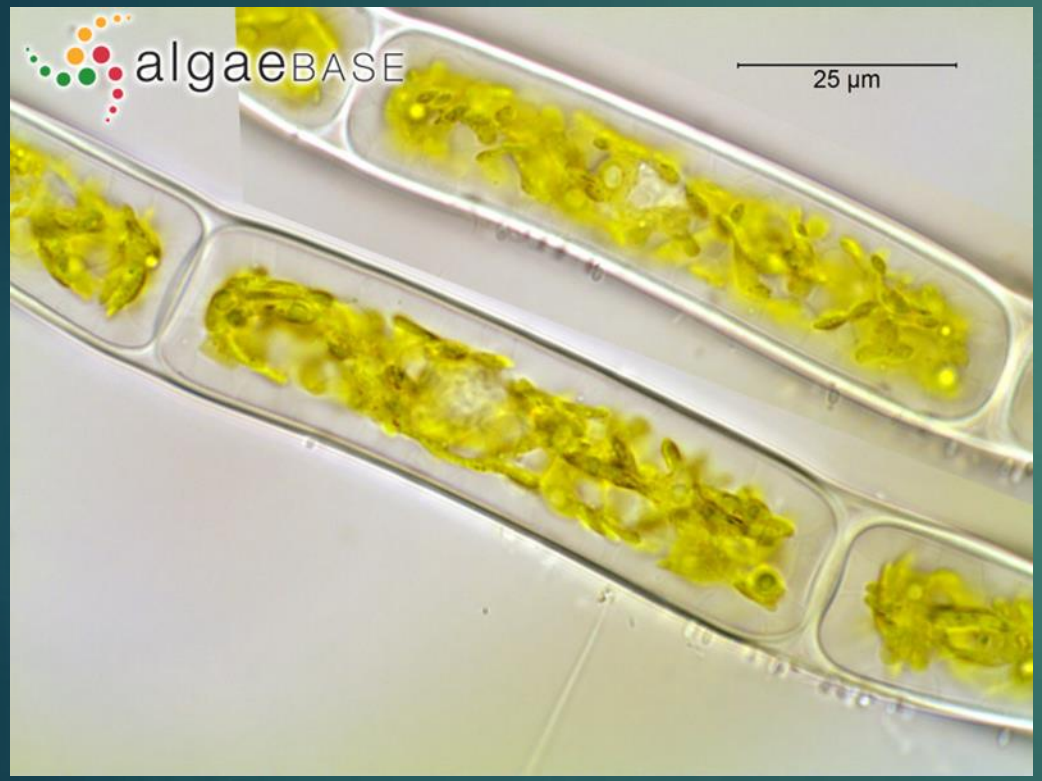
And

Oedogonium sp.

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

Rapid Field ID: Common FGA

Rhizoclonium sp.

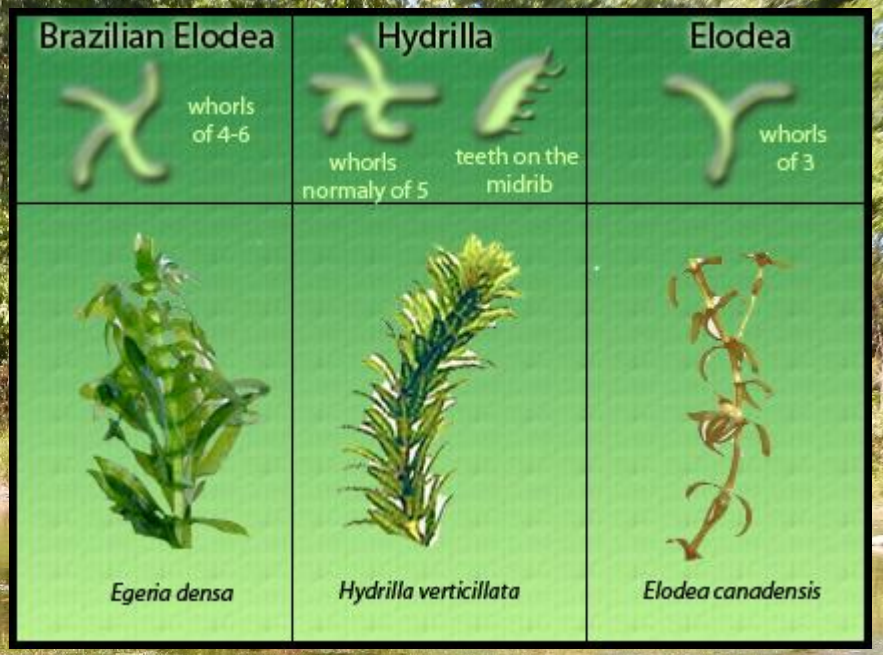


Oedogonium sp.

Rapid Field ID: Vascular plants

- SAV

- Emergent



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Cacapon River

Invasive *Hydrilla*

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

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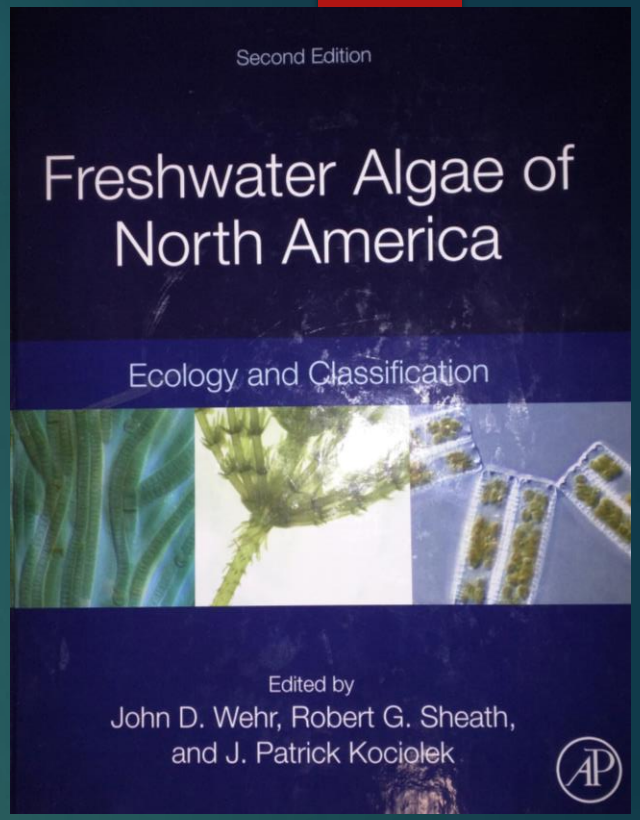
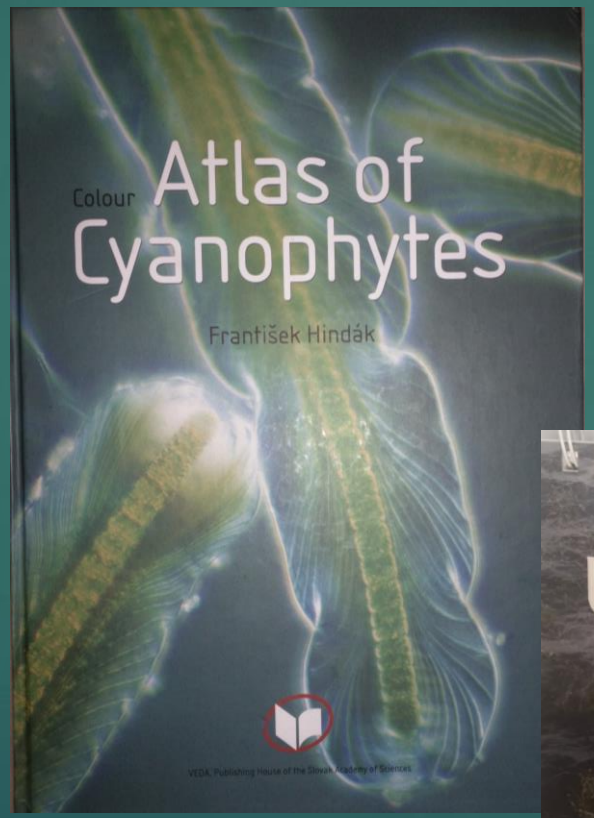
Field Biologist Resources

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

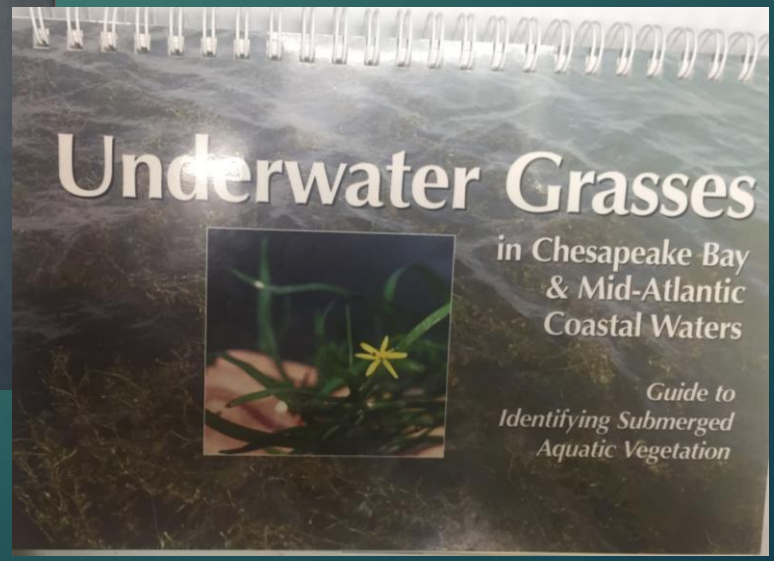
Digital handout available outlining all methods and traits reviewed in this powerpoint.



John Wehr, Robert Sheath & Patrick Kociolek



František Hindák



Bergstrom et al.

Topics of discussion

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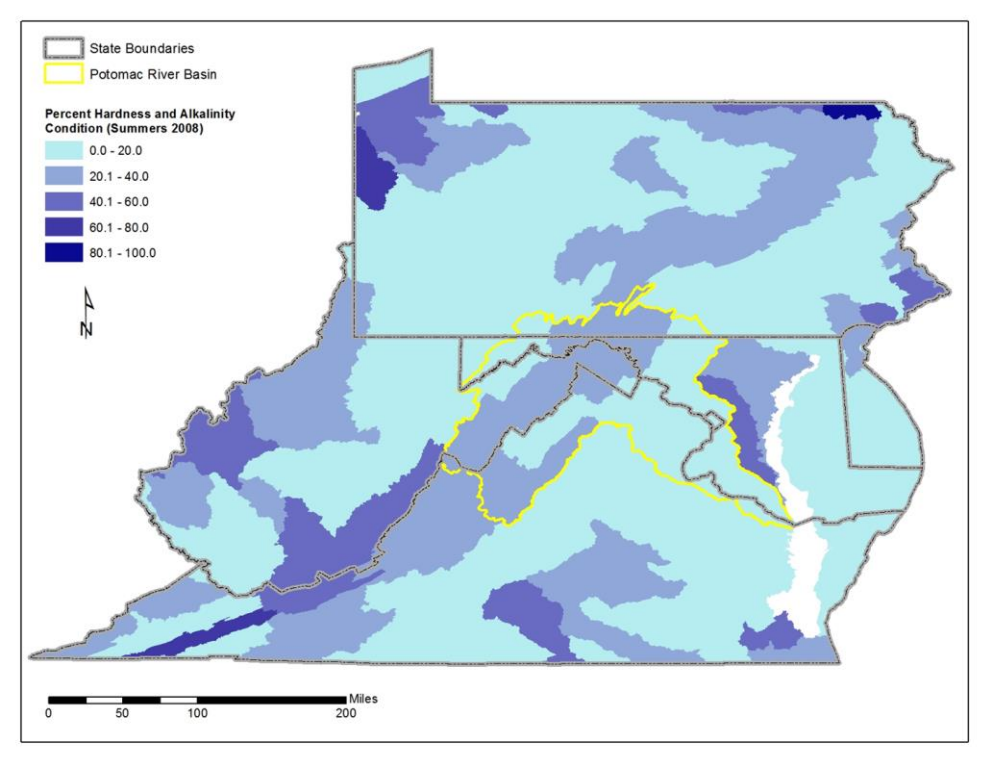
5. Future Work: Course-resolution macrophyte reporting

Future Work: Course-resolution 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
- Use the hashtag: #ICPRBalgae
- 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 broad-brush identification of algae and plants:

  “blue-green”

  “green”

  “vascular plant”