Algae/Macrophytes/Invasives

Breakout session,
MORNING Aug 21, 2007

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Slides presented by Tom after the Breakout:

Slide 1
What are the most important unknowns about nutrient effects on spring biota?

1. Relative influence of factors related to algal growth: nutrients, flow regime, recreation, disturbance, light, grazers, etc… What is the most influential factor/which will have the most management benefit?
2. Coupling between water column and sediments; internal vs external loads, rates and timescales.
3. Is there displacement of natives by exotics, irrespective of nutrient changes? What conditions allow native species to competitively exclude others/become dominant?
4. Will the management interactions/nutrient declines bring back "original states"
5. How resistant/resilient are algae and macrophytes to disturbance events (change stable states?)
6. What are functional relationships between fauna and flora?
7. Sediment loads – erosion and stormwater effects: nearfield vs farfield loadings more important for macrophytes/algae?
8. What are the effects of recreational activities on macrophytes/algae?

Slide 2
What are the most important management issues related to nutrients & springs?

1. DEP: if N is implicated in algal growth, then managers need to establish scientifically defensible target values for N reduction.
2. Establish nutrient limiting status. Absolute nutrient content vs stoichiometric ratios?
3. Develop standard criteria for assessing/evaluating baseline conditions (multiple trophic levels) in springs for permitting withdrawals/thresholds
4. Master-model for thresholds for permitting, since can't do as much manipulation as you want.
5. Effects of management actions: are they compromising the ecological functions of the systems? Clarify management objectives.

Slide 3
How might these management issues be addressed?

1. Experimental work:
    - Re-aeration? Associations between flow and low DO? Model community metabolism and trophic interactions. Look at additivity of interactions downstream

2. MONEY!!! 2.4 mill/year – not enough, need more.
3. Monitor expected responses to perturbations and management interventions
4. Need upfront research before sink $ into management; need holistic view, baseline.
5. Concentrate research on a few 1st magnitude springs, then supplement with coarser-scale temporal sampling.
6. Design study to provide DEP with scientifically defensibly defined impairment threshold

Slide 4

What are the most important springs research initiatives?

1. Relative influence of factors (nutrients, flow regime, recreation, disturbance, light, grazers, etc) /interactive effects on plants and algae: manipulative experiments. Ex:
    - Macrophyte/flow relationships
    - Redox potential and nutrient effects
2. Focus on core study systems
3. Holistic understanding of system
4. Determination of nutrient thresholds necessary to restore systems to functional state?

Notes taken by Kanika Inglett and Dina Liebowitz in the session

- Algae are nutrient limited
    - Historically
    - Currently
- Sickman's report, trying to figure out at what concentrations nutrients are limiting
- Upwelling of nutrients from sediments
    - P shows better correlations for nutrient limitation than N
- Threshold concentrations for Lyngbya and Vaucheria
- Greenhouse studies
- In Tampa Bay: seagrass limited by P, algae limited by N.
    - Limiting nutrient can depend on species of interest
    - High N leads to direct and indirect effects on C in temperate seagrasses: N toxicity can lead to carbon starvation.
    - Native aquatic plants (Sagittaria, Valis.) closely related to seagrasses, which exhibit N toxicity
- Oligotrophic-adapted plants
- Linkages needed between fields
- Pay attention to timeframes: For example, in 1957 there was high nitrates yet springs were unchanged/little algae
- Oxygen/redox issues
- Subtle changes in sediments, water column, etc. may be able to change the system, species changes
- Need to articulate mechanisms for nutrient limitation hypothesis

- Lack of grazers can lead to algal build-up
    - Lack of DO could lead to limnia disappearing
    - Need to understand the palatability of algae and what's feeding on it?
- Why is biomass up but productivity down?
- Light limited in silver springs?
- Timescales: records show elevated N sometimes 20-30 years before algal problems become apparent
    - High flushing rates associated with response time-lag?
- Lack of good data on algae
- Need to characterize existing systems, both structure and function
- Descriptive mechanisms don't support N-limitation: N levels are not correlated with algae levels in springs along N gradients
    - Ex: Silver Glenn Springs – low N, high Lyngbya. Recreational impacts may be implicated and needs attention.
- Once established, algae may be able to persist at reduced nutrient levels
    - Reducing nutrients won't necessarily lead to reduced algae
- Groundwater change will be slow
- N is still an important element of focus since it's anthropogenically elevated and can be controlled through management.
    - Precautionary principle.
- Also need to look to recreation management.
    - Wekiva – people trampling the area, documented vegetation change from Odum's map.
- System may change/fluctuate temporarily, but also has an element of stability.
- Have seen positive effects of N control in estuaries, not ready to abandon control in springsheds…
- N will be important somewhere down the line, but need to understand specifics of this particular system and why it's changing.
- N Events: Magnitude and duration of N events on biota may be important
    - Return interval of events also important: effects population and community
    - Frequency of events greatly increasing
    - Systems do change, not necessarily a steady-state
- Hydrilla management strategies – which interventions will be the most cost effective; also need to think about public support for actions and effects of actions on public support.
- Return system to historic state?
    - Question of spring function vs priorities? What society wants the area to look like…
- Thick algal mats have fewer inverts ("crappier bugs") than areas that are shaded/more plants and less algae. Areas with less algae have more mayflies, etc. – historic community composition.
    - Maintaining historic species assemblages - federal regulations
- Nutrients, recreation, and aquatic plant management may be priorities
- In trying to keep system looking right, may be destroying the system

    - Allow invasives to maintain the system in a new way…? Don't manage for a while and see what it does…?
- Impact of nutrients downstream
- Management options
    - Reduce NO3
    - Modify recreational uses
    - Control invasives
    - Macrophyte/flow relationship
- Limit footprint – nutrient input
- Personal commitment – public
- Work with what's known
- P lowered from storm H2O loads [unclean notes]

Unknowns

- Relative influence of factors including: nutrients, flow regime, macroalgae, disturbance, lack of grazers… Which one is most amenable to effective change and management?
- Sediment conditions in general (nitrates, S toxicity)
    - Effects on algal mats
- Water column nutrients
- Internal cycling/transformations: rates, timescales
- Interactions of invasives
- Displacement of native populations by exotics (effected by nutrient levels?)
    - Will natives come back?
- How disturbance affects resilience, time to recovery
- Will management affect hydrilla?
- Functional responses between flora and fauna
- Erosion
- What conditions encourage Lyngbya to have competitive edge over other exotics?
- Effects of recreation, water chemistry

Management Issues

- DEP: Threshold of nitrate needed to set target/ to prevent further decline and restore springs
- Baseline assessment criteria
- Model – flexible to change variables: to assess/predict changes and responses. Ecosystem model since can't always manipulate the natural system
- Removing hydrilla – good approach?
- Metabolism, productivity – model min levels DO etc to sustain springs.
- Velocity/flow – DO levels
- Reduce flow: older water issues

How are we addressing management issues?

- 2.4 million $$$ per year; 50% for monitoring
- Get University to adopt springs to study

- Quantify linkages/systems
- Study normal variability between springs
- Have focal springs to study thoroughly – descriptive work. Synoptically sample other springs
- Lab scale – extend to field
- Study impairment factors, management