Research Needs for the Upper James River Estuary

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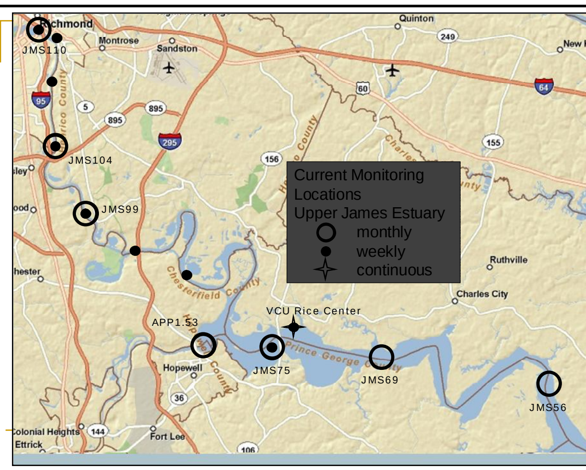
Questions to be Answered

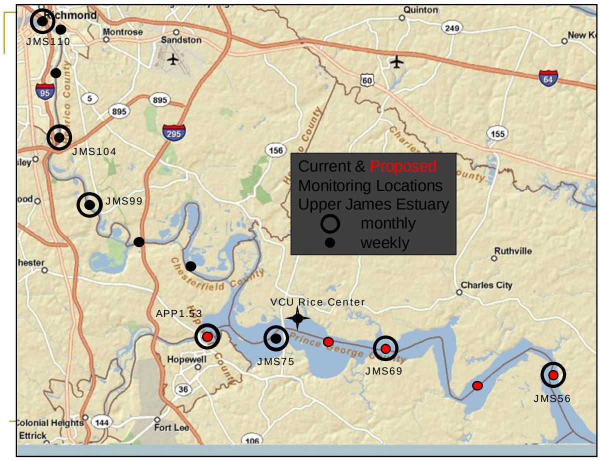
Objective 1. Characterizing algal blooms in the Upper James River.

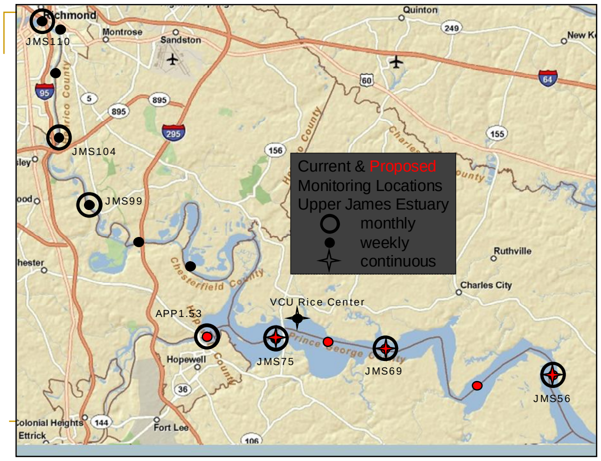
- What are the spatial and temporal dynamics of algal blooms in the tidal freshwater James River? (Task A1)
- What nutrients limit the growth of phytoplankton in the tidal freshwater James River? (Task A2)
- Who are the important grazers on algal biomass and what is their contribution to controlling algal blooms in the tidal freshwater James River? (Task A3)

Task A1. Characterizing the Spatial and Temporal Dynamics of Algal Blooms

- Proposed expansion of weekly and continuous monitoring in the region where chronic algal blooms occur (rm 55-75).
  - 5 additional sites for weekly sampling
  - 3 additional sites for continuous monitoring







Task A1. Characterizing the Spatial and Temporal Dynamics of Algal Blooms

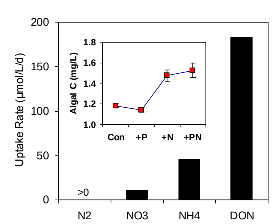
- Weekly data for CHLa and nutrients. Weekly phytoplankton enumeration for JMS75, 69 and 56 (May-Oct).
- Expanding the network of weekly sampling locations will improve spatial and temporal resolution of blooms. Data used to determine whether long-term, monthly monitoring sites are representative.
- Data from continuous monitoring locations (May-October) will be used to characterize the occurrence of transient algal blooms that are unlikely to be detected by weekly-monthly sampling. These data will also contribute to assessment of impairments by detecting transient (night-time) oxygen depletion.

Task A2. Identifying nutrient forms supporting algal blooms.

- N vs. P limitation, utilization of DON, importance of N_2 fixation.

Preliminary experiments performed Summer 2011 by P. Bukaveckas and M. Mulholland.

Proposed monthly experiments in 2012 (June – October) at JMS75, 69 and 56.



Task A3. Grazer Controls on Algal Blooms

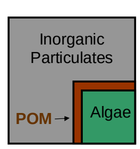
- Identify main consumers of algal biomass in the James food web.
- Target species based on known feeding habits and numerical abundance: Atlantic Menhaden, gizzard shad and juvenile blue catfish.
  - Results of gut contents analyses used to assess algal contributions to diet and also aid in the interpretation of toxin accumulation data (Task B2).

Objective 2. Assessing impairments associated with algal blooms.

- Do algal blooms limit SAV habitat in the tidal freshwater James River? (Task B1)
- What is the occurrence of cyanotoxins (Microcystin) in water, sediments and the food web of the tidal freshwater James River? (Task B2)
- Can genetic tools (detection of Microcystis gene) be used to assess the risk of impairment? (Task B3)
- Does the presence of Microcystin diminish the growth and reproduction of high value or numerically dominant fishes in the tidal freshwater James River? (Task B4)

Task B1: Algal Blooms & SAV

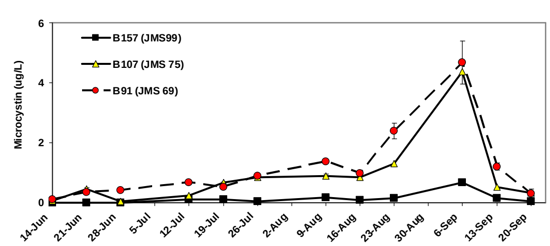
- The relationship between phytoplankton and light conditions is central to both modeling algal blooms and assessing impairments.
- Empirical relationships could be used to forecast changes in water clarity associated with anticipated declines in CHLa following nutrient reductions.
- Improvements in water clarity, coupled with bathymetry data for the Upper James, could be used to assess increases in SAV habitat.



JMS75 Suspended Particulate Matter (summer)

Task B2. Occurrence of cyanotoxins in water and living resources.

- Proposed weekly monitoring of cyanotoxins (Microcystin) in water during June – October at JMS99, 75, 69 and 56.



Task B2. Occurrence of cyanotoxins in water and living resources.

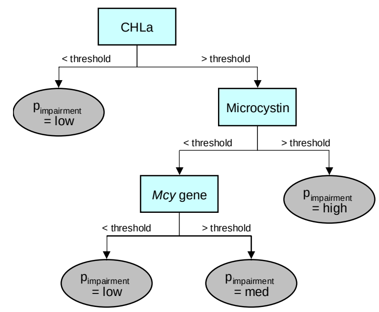
- Monitoring of MC accumulation in target species that are important components of the food web: Atlantic menhaden, gizzard shad, juvenile and adult catfish, and juvenile osprey.
  - Fish samples pre- to post- bloom (May-Oct) to assess accumulation and carry-over.
  - Feather samples from nestling osprey available May to mid-August.

Task B3. Application of Genetic Tools to assess HAB Risk

qPCR used to measure gene copies for:

(a) cyanobacteria,
(b) Microcystis, and
(c) Microcystis capable of producing MC.

Weekly monitoring at JMS75 during June-Oct.



Task B4. Effects of Microcystin on Living Resources

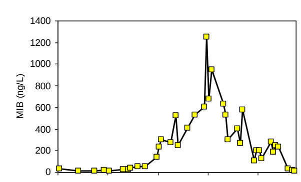
- The focus on algal toxins provides a direct basis for linking algal blooms with diminishment of resources and therefore supports efforts to define the numeric CHLa criteria.
- Experimental data are needed to link toxin exposure with diminishment of growth and reproduction in taxa that are important components of the James food web (e.g., juvenile shad, Atlantic Menhaden and blue catfish).

Algal Blooms & Human Health (B5)

- Modes of exposure
  - Drinking water (Microcystin, MIB/Geosmin)
  - Fish consumption (Microcystin)

2010 intake data from Virginia American Water Treatment Plant located at confluence of Appomattox and James River.

MIB taste detection = 10 ng/L



Year 1 (2012) Priorities

- Task A1. Characterizing algal blooms
  - Expansion of weekly & continuous monitoring.
- Task A2. Assessing nutrient limitation
  - Continuation & Expansion of Algal Bioassays
- Task B2. Cyanotoxin (MC) Monitoring
  - Weekly water monitoring; monthly fin & feather
- Task B3. Application of genetic tools
  - qPCR monitoring of Mcy gene copy number.