Title
Applications for High Resolution Biological Sensing in Aquatic Systems

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Applications of High Resolution Biological Sensing in Aquatic Systems

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Introduction: Water quality assessment through use of microbiological indicators

Algae and microbial organisms in freshwater

- **Algal response integrates stream conditions over the period of exposure**
  - Studying in situ algal communities poses difficulties because it is hard to account for conditions before the study period. In addition, loss of algal cells due to primary consumers, shedding are hard to take into account.
  - Characterizing physicochemical conditions is also difficult because stream conditions vary on small temporal (hours) and spatial (meters) scales
- **Using algal monocultures enclosed in a semi-permeable membranes, it is possible to look at algal response while controlling for site conditions prior to study and loss of cells**

Pathogen indicator organisms in fresh/marine waters

- **Fecal indicator bacteria (pathogen indicators) are used to determine whether recreational waters are safe to swim in or not**
  - Current methods are culture-based, requiring up to 24 or more hours of incubation prior to obtaining a cell concentration
  - All postings arising for samples analyzed by culture methods experience a delay which makes them potentially inaccurate
- **One technique that can be used to rapidly measure bacteria is immunomagnetic separation and ATP quantification**

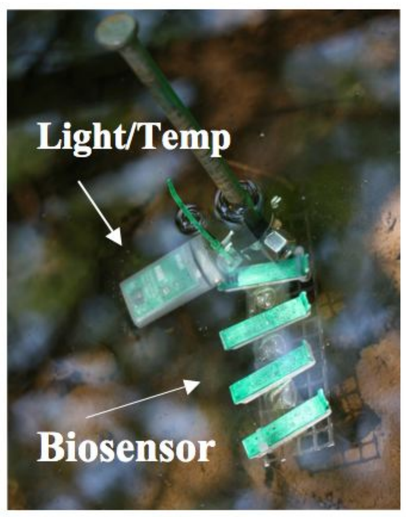
Problem Description: Bioindicators are critical in understanding aquatic ecosystem health

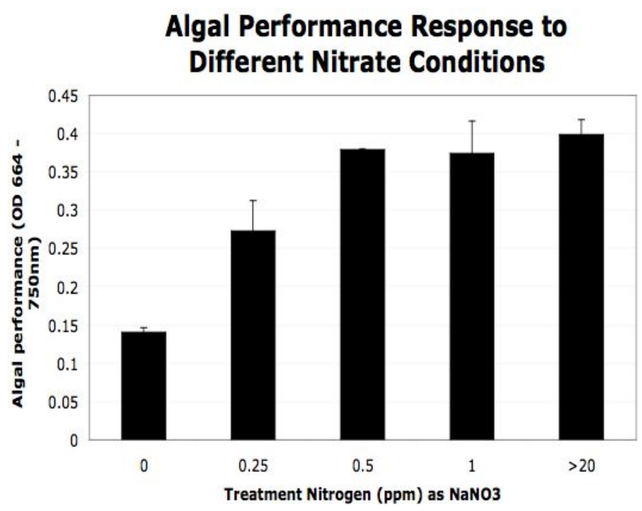
Physical and chemical sensors are often proxies in environmental health studies but do not always provide a comprehensive picture. Microorganism dynamics are complex and often result from many different spatiotemporally dynamic factors. Furthermore, stream quality impairments and health-related illnesses commonly result from microorganisms. Due to the complexity of microorganisms and their environmental and public health importance, it is critical to be able to measure biotic response in addition to physicochemical conditions.

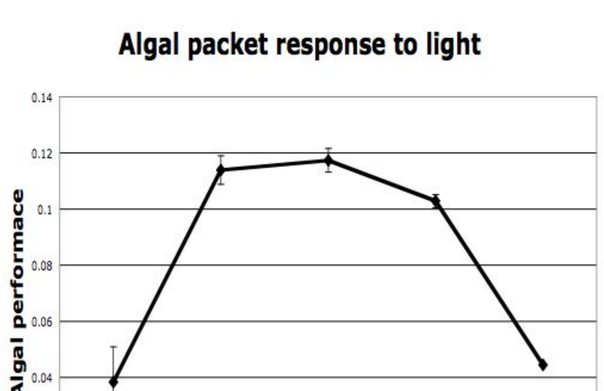
Current Research: Increase sampling density/frequency and measure

Field Testing of Algal Biosensor

- Algal biosensor array (15 sensors) distributed in stream reach for 72h
- Light, temp, NO_3, PO_4, and cond spatial and temporal patterns measured in reach
- In-stream algal conditions determined

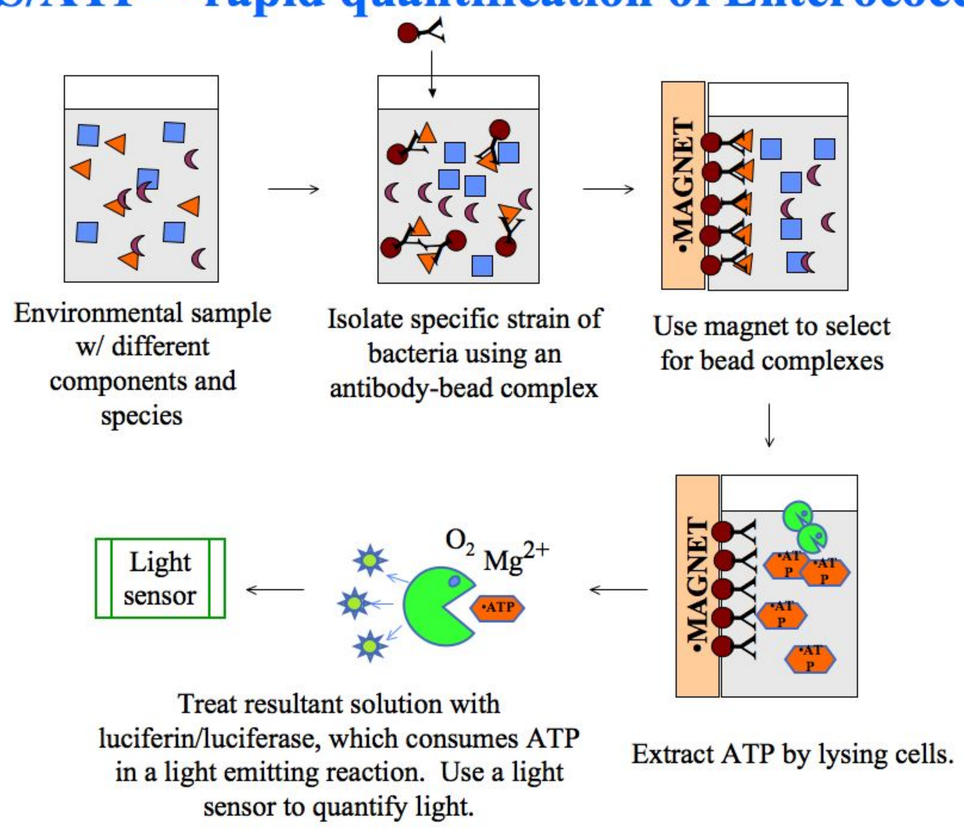


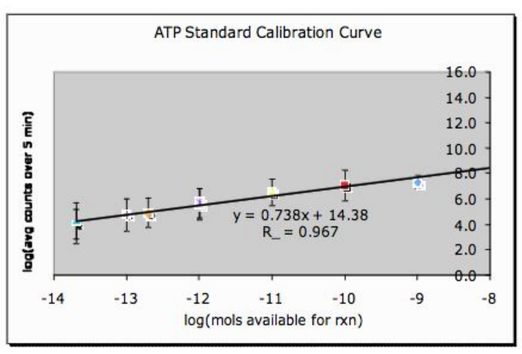




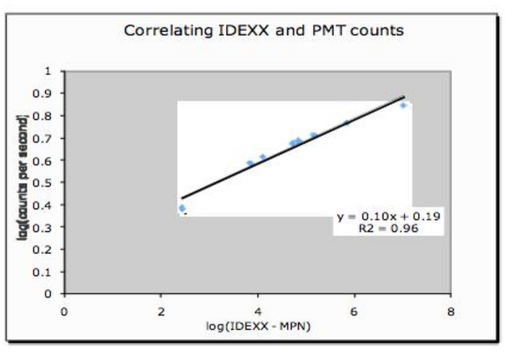
- **The monoculture responds to several stream conditions**
  - **Light, Temp, Nitrate, etc**
- **The monoculture response is an integration of all conditions**
- **Comparing algal responses to stream constituents allows determination of factors controlling in-stream algal**

IMS/ATP*– rapid quantification of Enterococcus





Developing a calibration curve between ATP (standard) and light emission.



Developing a correlation curve between cell count using substrate-defined technology (IDEXX) and light emission.

*Method developed from Lee and Deininger's work with *E.coli* in freshwater, *Luminescence* 2004