



CENTER FOR EMBEDDED NETWORKED SENSING

Applications of High Resolution Biological Sensing in Aquatic Systems

Graduate Students:

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Faculty:

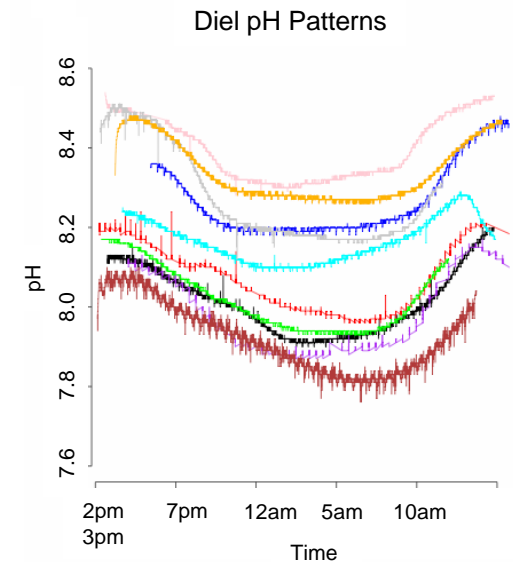
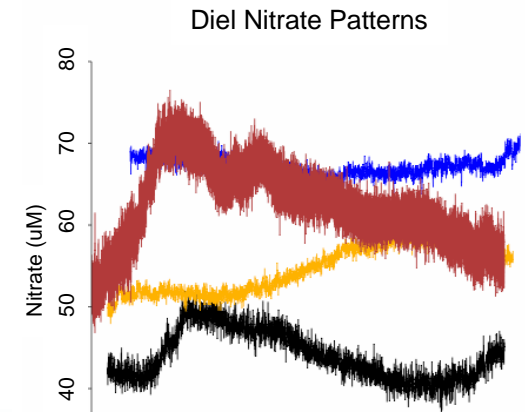
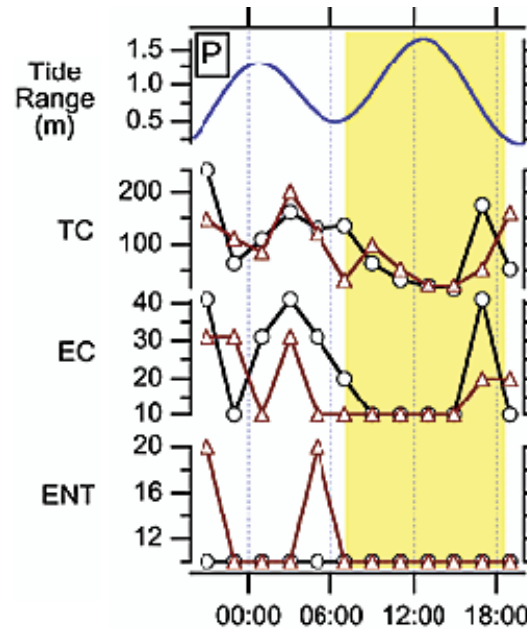
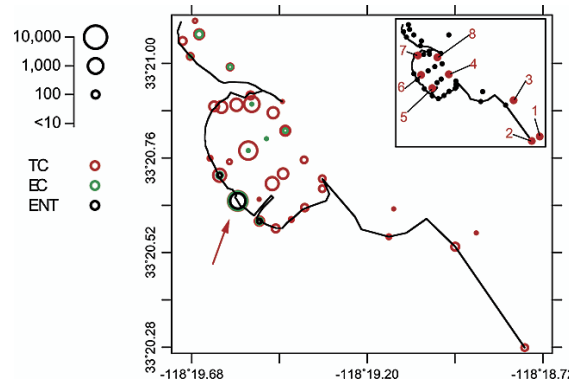
Richard Ambrose, Jenny Jay, & William Kaiser

Motivation

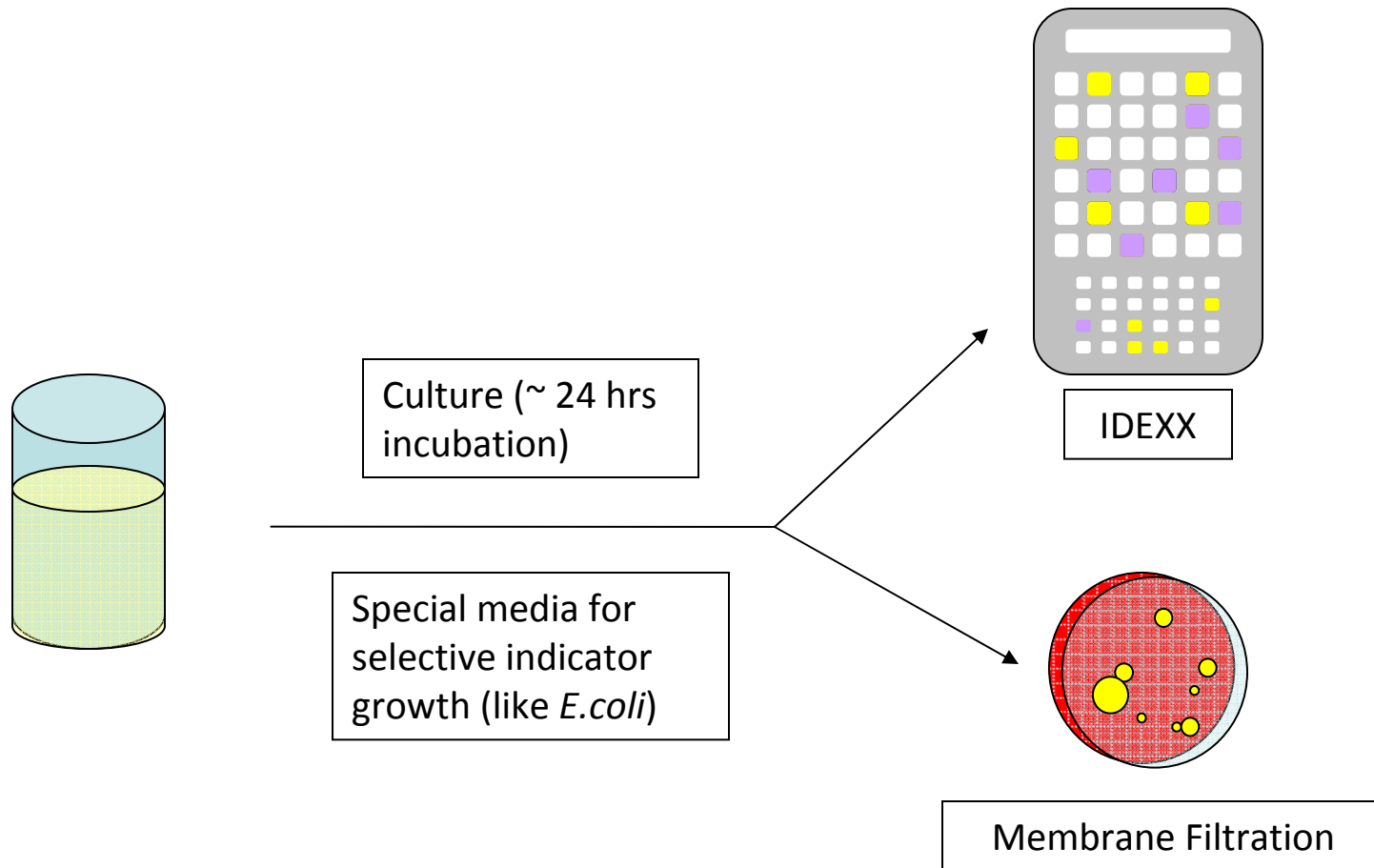
- Public Health and Recreation
 - Does a 24-hr delay in results/postings protect swimmers from being exposed to poor water quality?
 - What standards should be set to prevent algal impairment in streams
- Research and environmental monitoring
 - How can these data be combined with physiochemical measurements to understand the spatial and temporal changes occurring in aquatic environments?



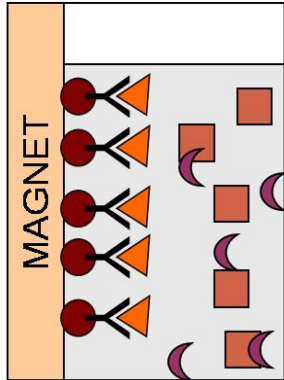
- Many physicochemical conditions vary on small spatial and temporal scales
- Microorganisms spatiotemporal distributions result from an integration of physicochemical conditions
- High resolution biological sensing may be better than physicochemical sampling alone



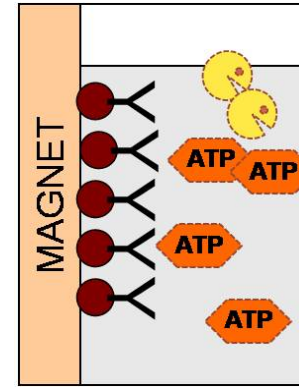
How do we currently measure water quality?



Proposed Method: Immunomagnetic Separation/ATP quantification



Isolate target using antibody-magnetic bead complex

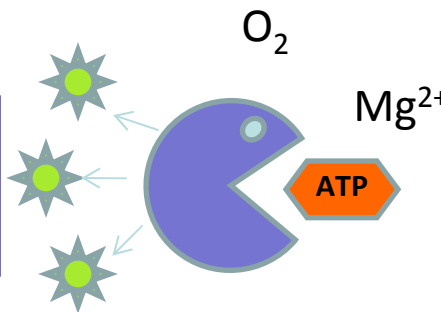
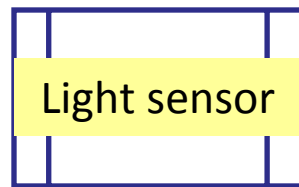


Extract target ATP and add enzymes



Enzymes degrade ATP, light is a byproduct

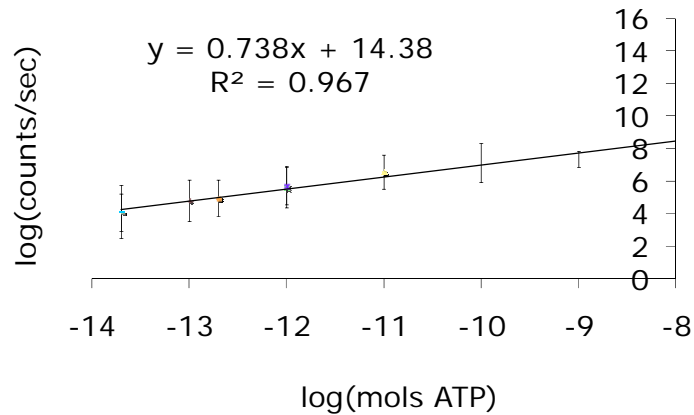
Measure light emission, sends data to computer



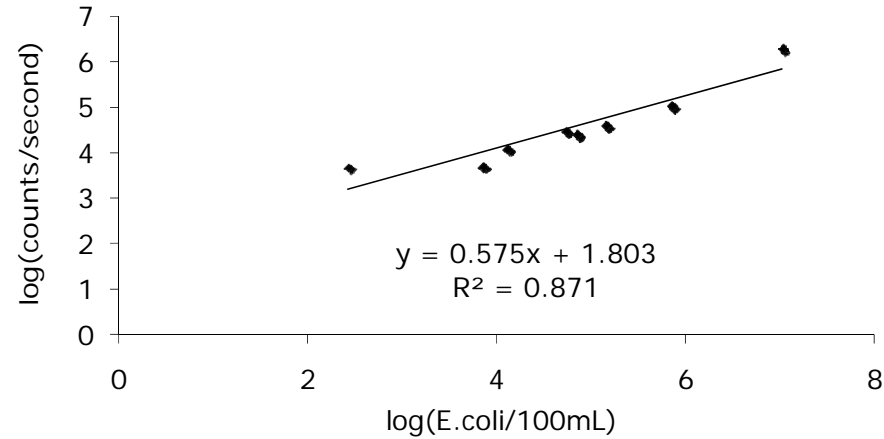


Calibrating photomultiplier tube

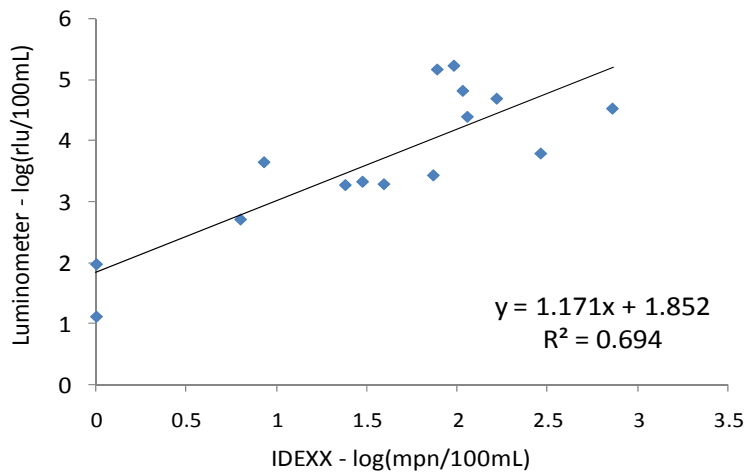
ATP Standard Calibration Curve



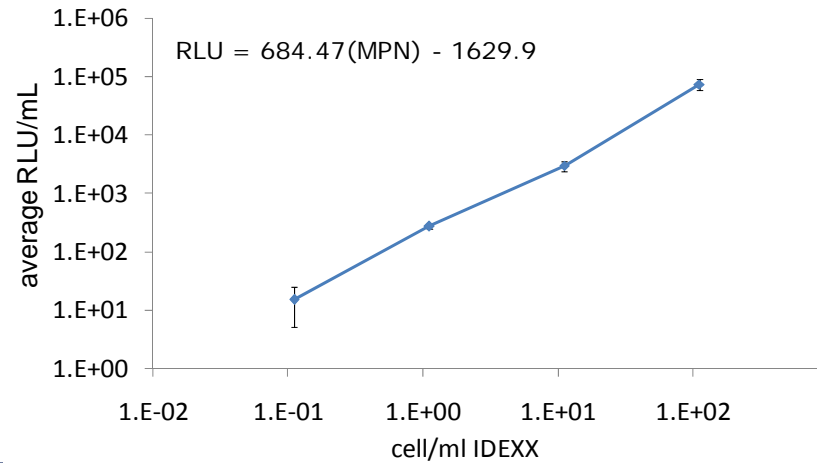
lab culture E.coli calibration



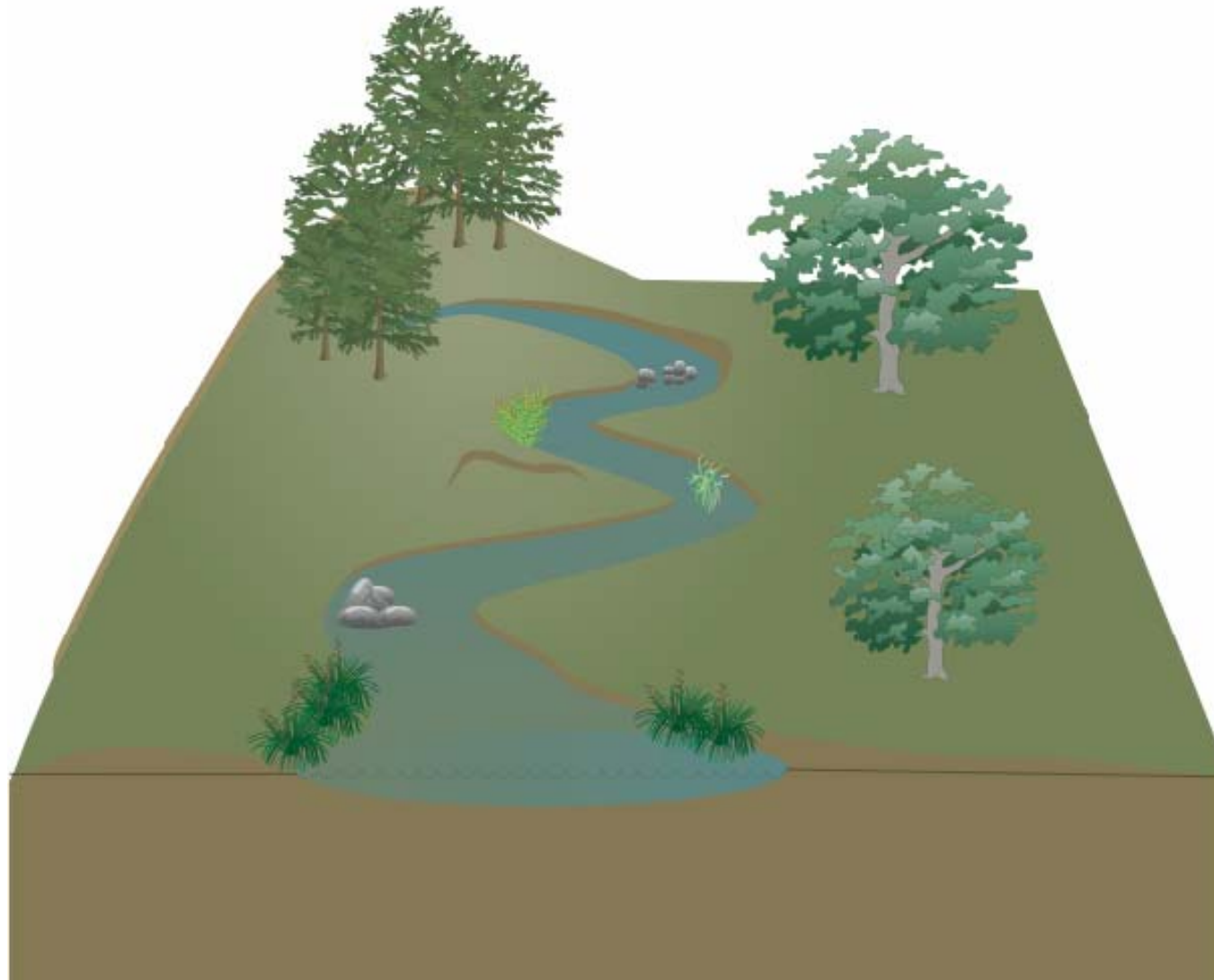
SCCWPR eval & Prev Data



Correlating 2 methods of measuring E.coli: ATP (RLU) with

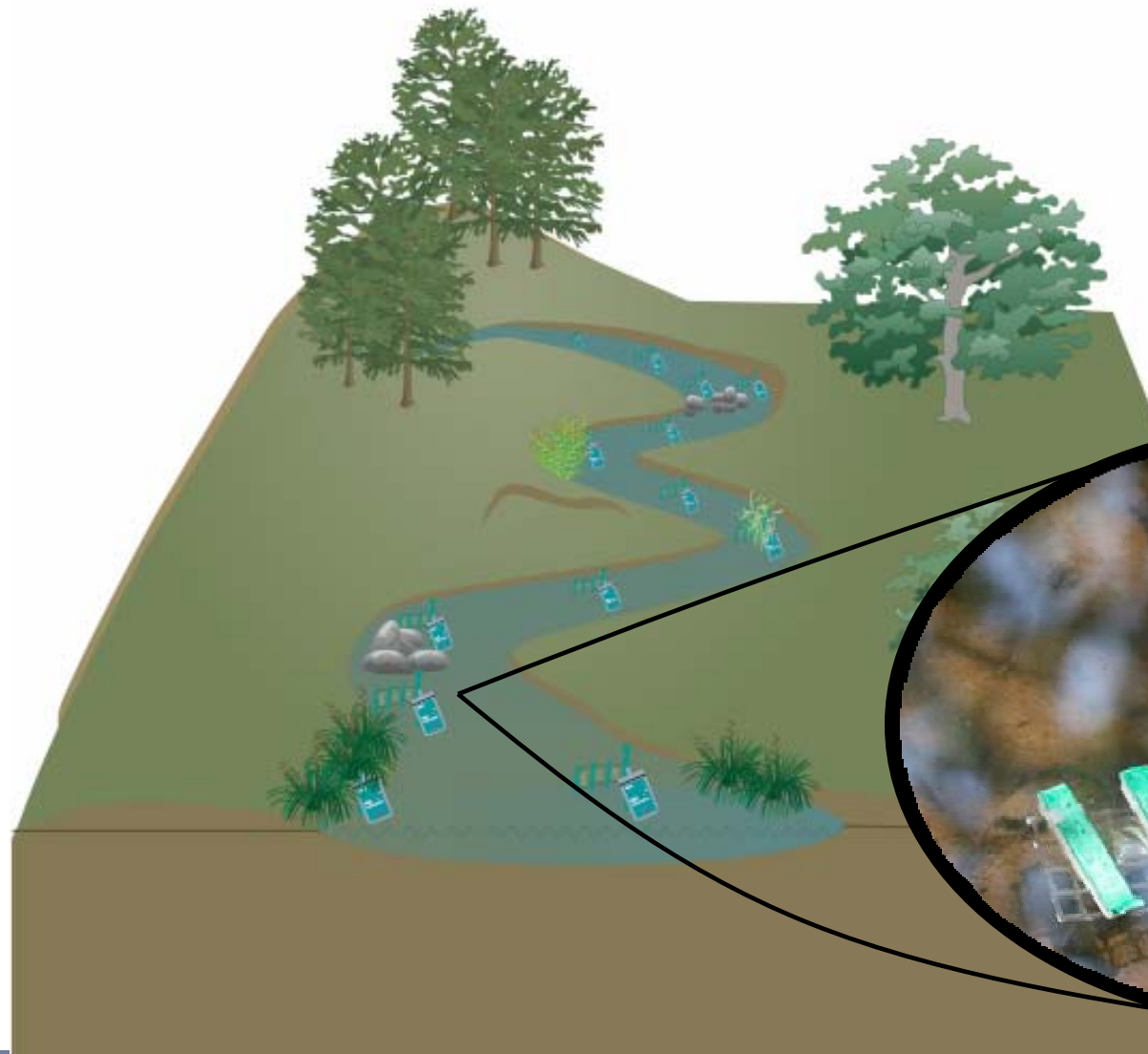


Stream Characterization



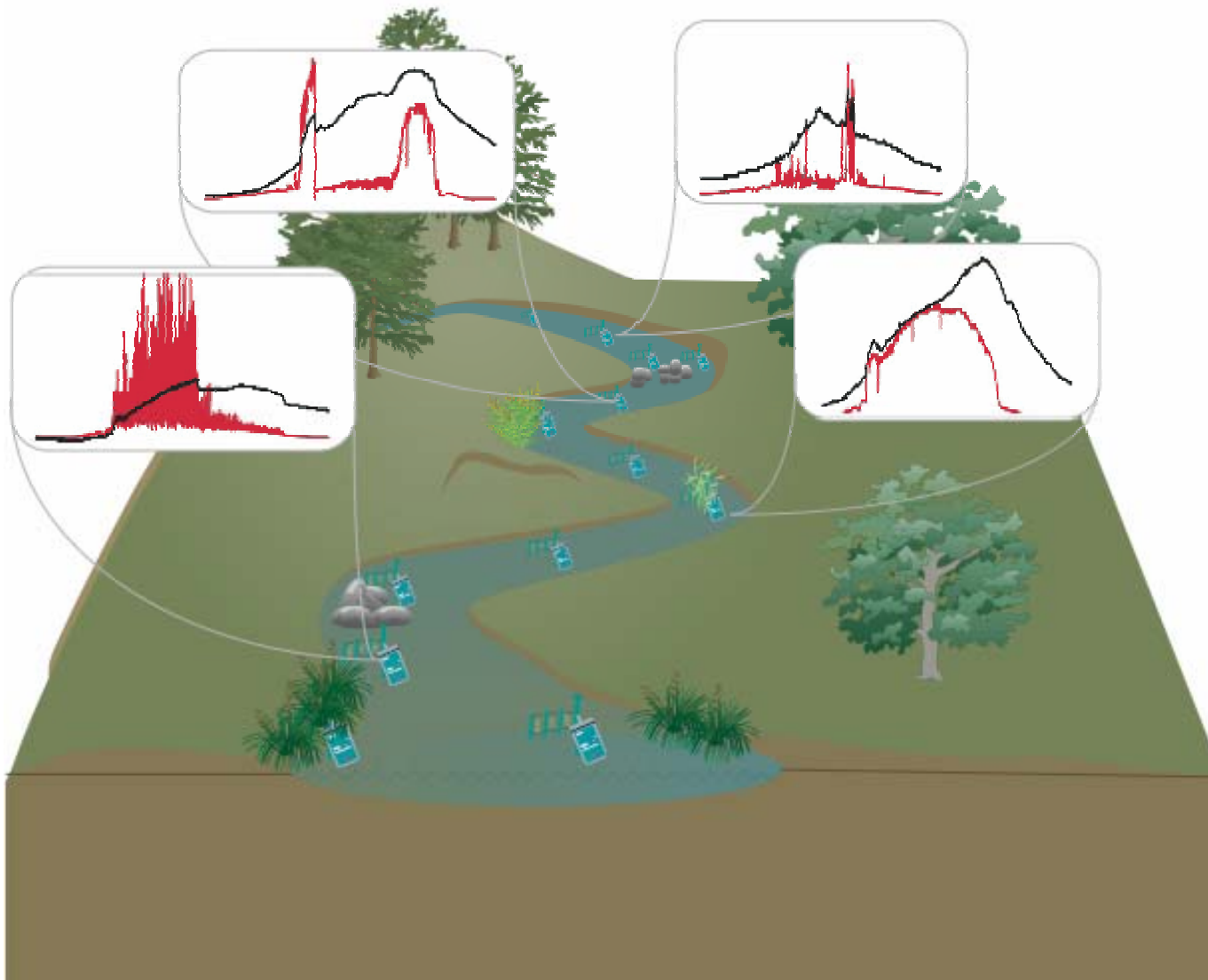
- 20m of stream
- 15 locations selected
- Water samples
- Manual sensing
 - PAR, Velocity, algal cover, pH
- Sediment cores

Biosensors and Pendent Loggers



- Place algal biosensors and pendent loggers
- Begin logging for 72 hours

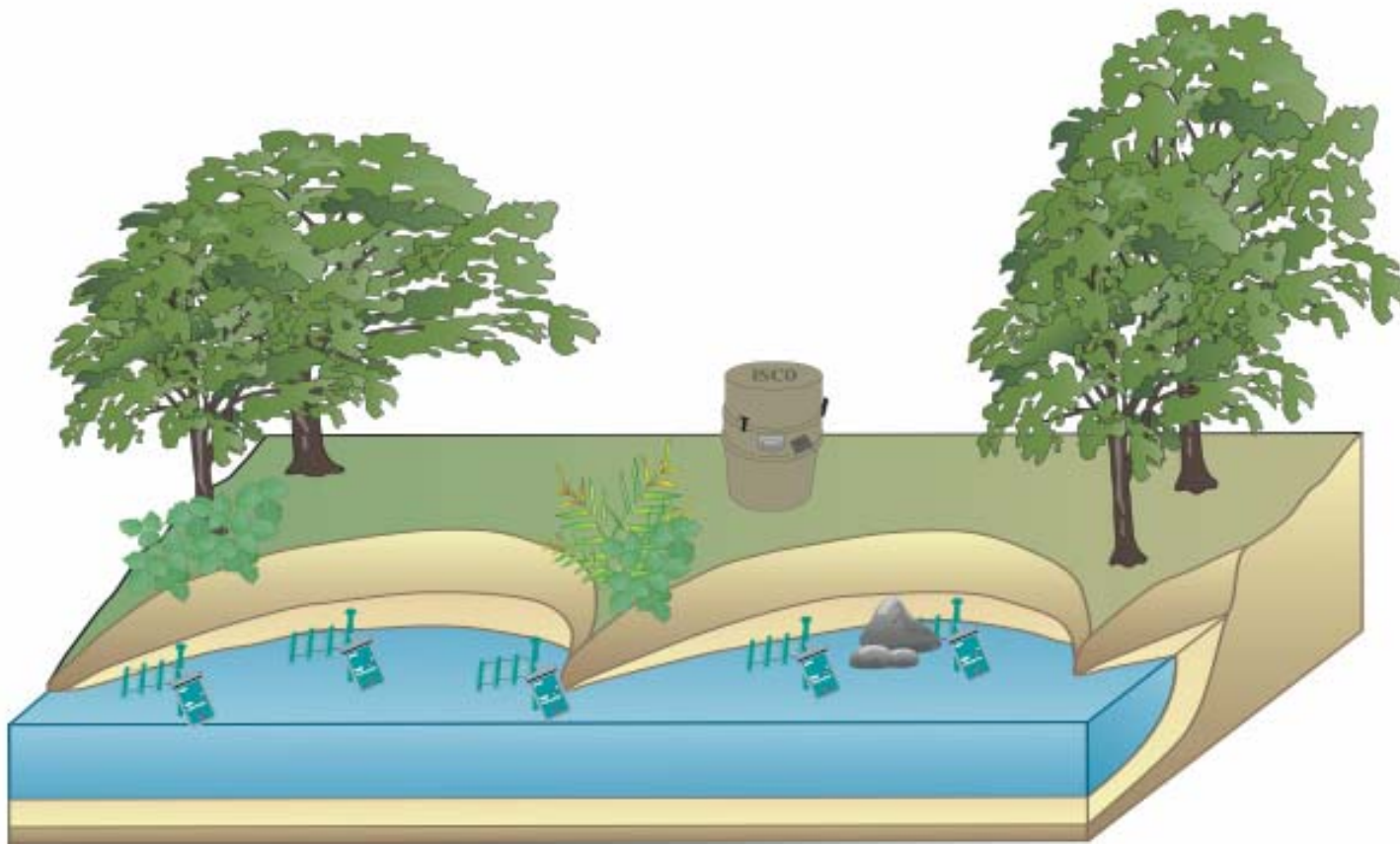
Determining Autosampling Locations



- 8 locations selected for water sampling every 2-3 hours
- Selection based on pendent logger data
- Temperature vs. light is proxy for water residence time

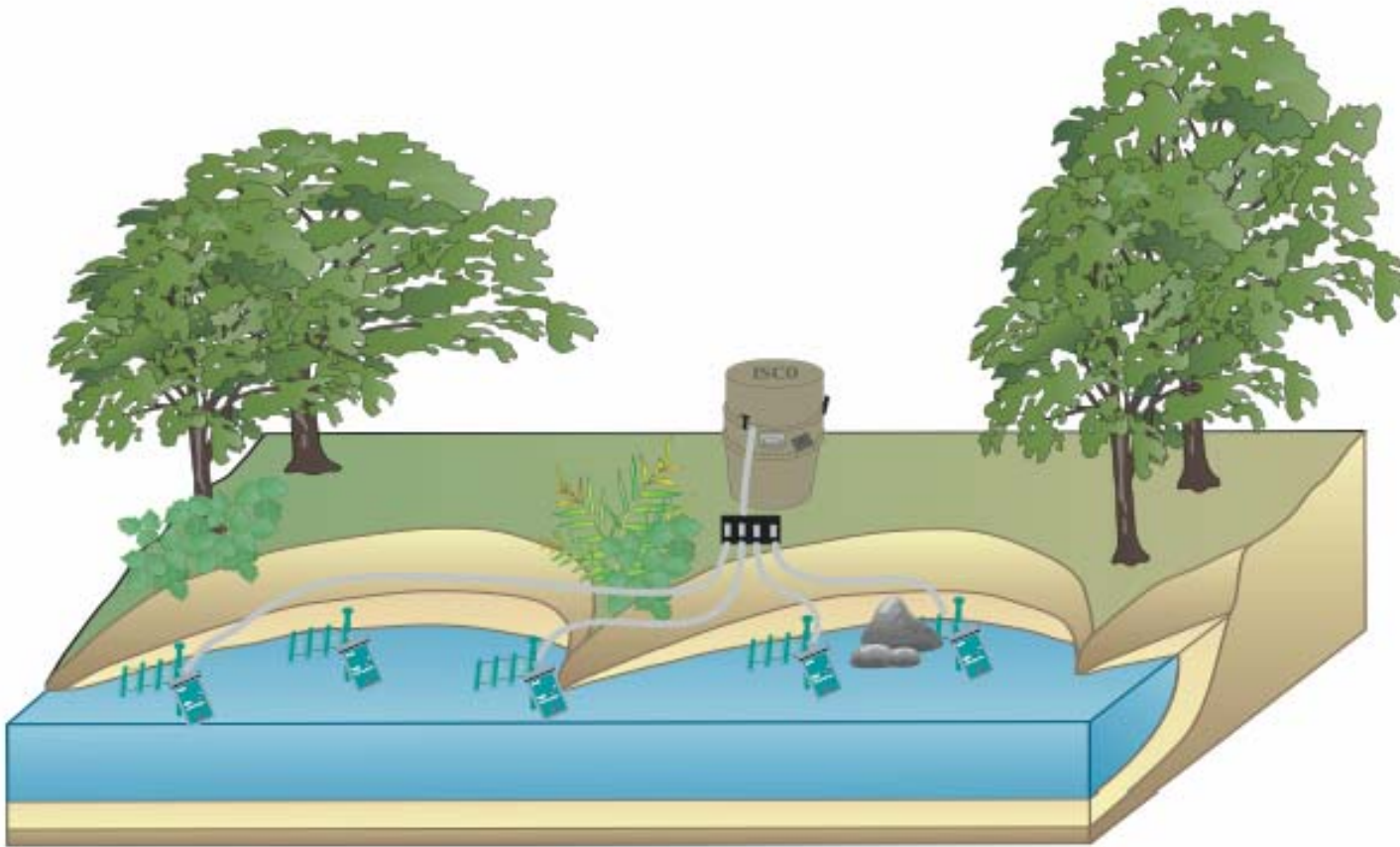
24 Hour Autosampling

- 2 ISCO samplers used to sample 8 locations



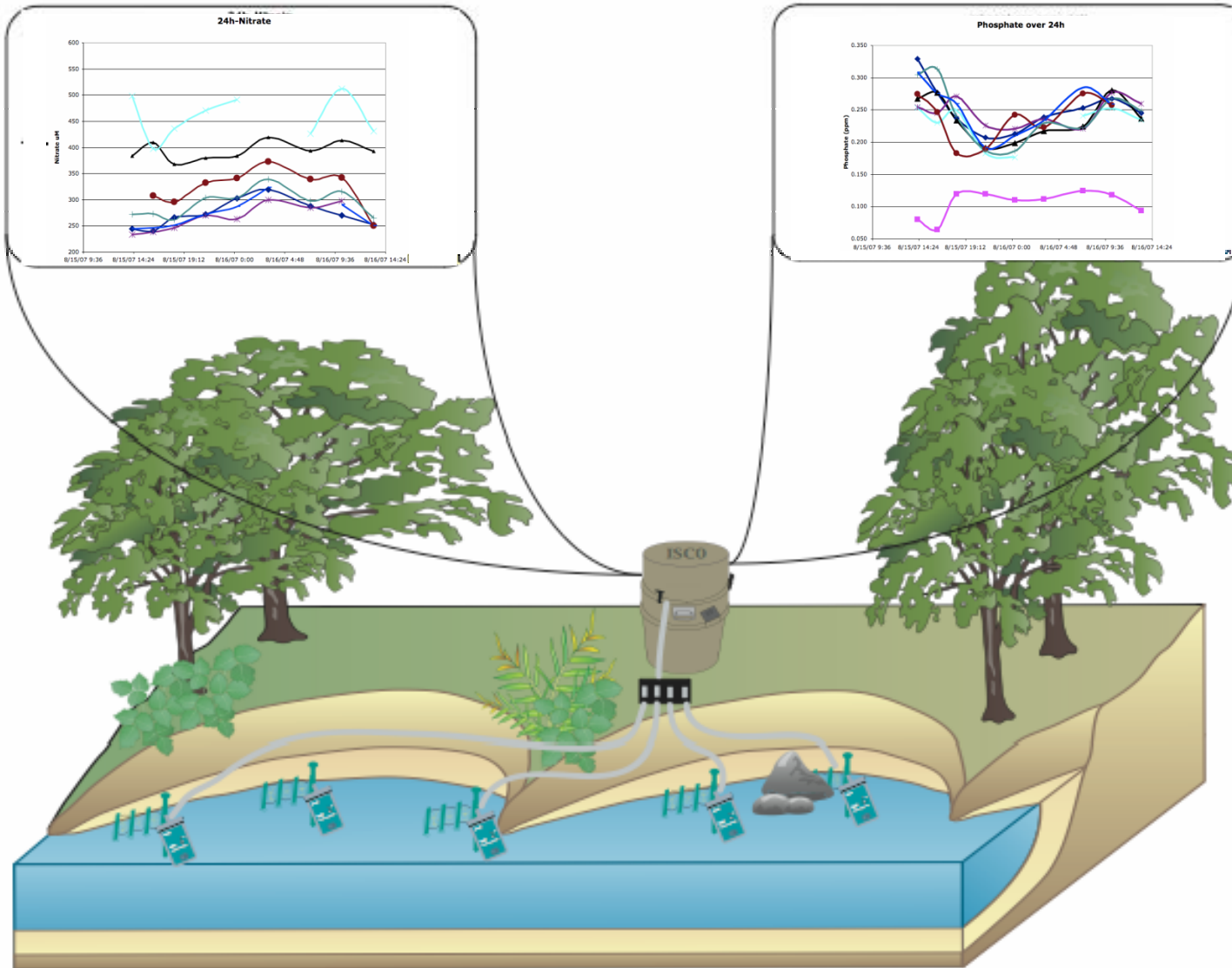
24 Hour Autosampling

- 2 ISCO samplers used to sample 8 locations
- Sampler tube is split using manifold and solenoids





24 Hour Autosampling

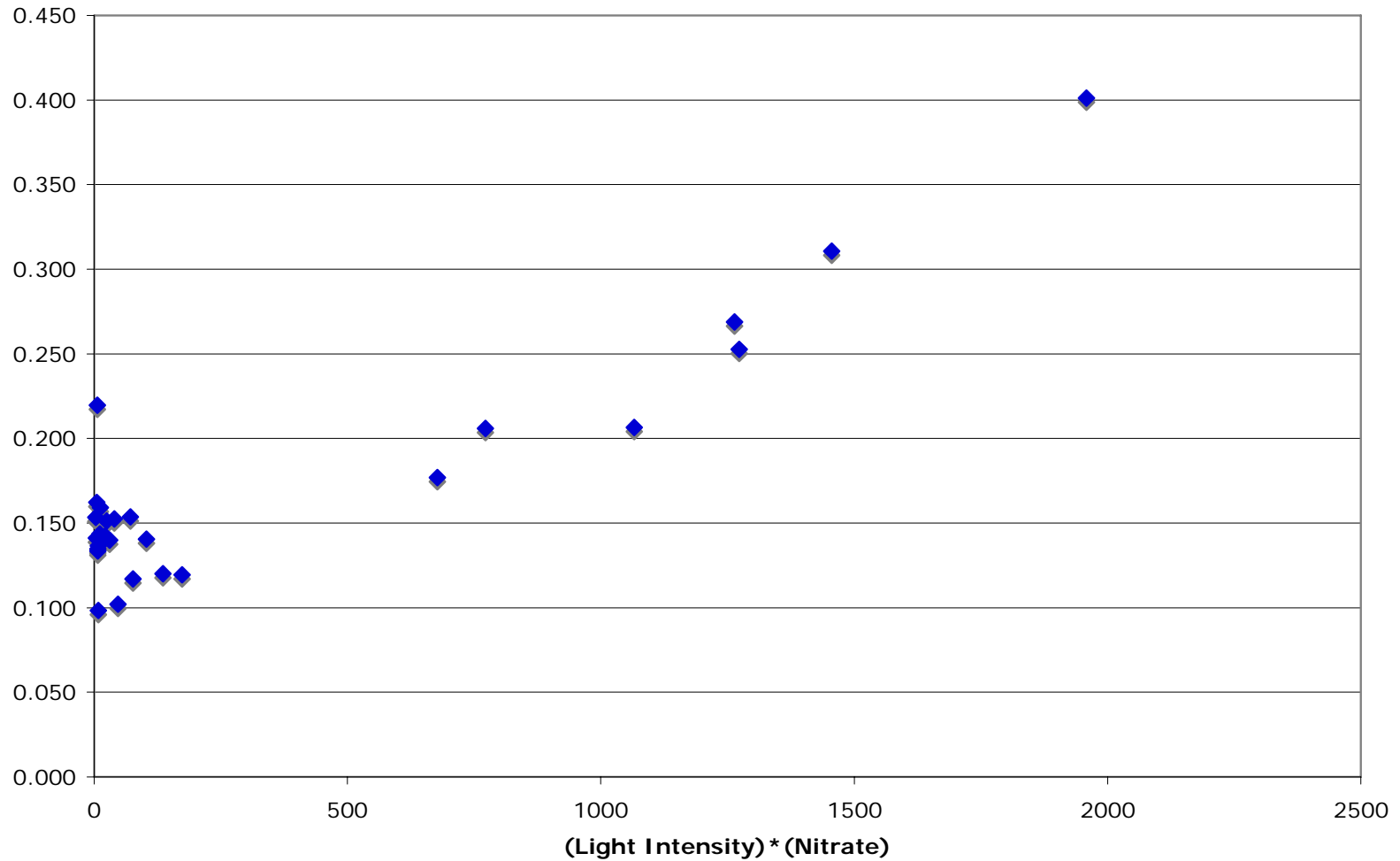


- 2 ISCO samplers used to sample 8 locations
- Sampler tube is split using manifold and solenoids
- Water samples used to determine **diurnal and spatial** variation of NO₃ and PO₄



Algal Biosensor Response

Algal Bioassay Response to Light and Nitrate





Conclusions

- New biological sensing methods can enable integrative and high resolution ways to study small scale biological variations.
- Physical or chemical proxies are often very useful, but don't always provide enough information
- Biological sensing methods that can measure on the same scales as physical and chemical sensors are important for future high-resolution studies