Phosphorus Loading: A Bioavailability Approach

**Nature of the Problem**
- Great Lakes phosphorus (P) loading regulated under the International Joint Commission’s (IJC) Great Lakes Water Quality Agreement (GLWQA).
- Total phosphorus (TP) and soluble reactive phosphorus (SRP) have been main focus in phosphorus loading.
- GLWQA amended in 2012; bioavailability of the various phosphorus fractions must be taken into account.
- Algal bioassays key in assessing bioavailability of phosphorus fractions and focusing of source reduction efforts.

**Study Site – Cayuga Lake**
- Located in central New York as part of the Finger Lakes system.
- Second largest by volume and surface area.
- Several lake source cooling systems in operation and WWTP discharges.
- Samples collected from mouths of four tributaries: 1) Salmon Creek 2) Fall Creek 3) Six Mile Creek 4) Cayuga Inlet.
- Samples collected from Ithaca Area WWTP effluent.
- Ithaca Area WWTP uses ACTIFLO©.

**Methods**
- Starved green algae added to both assays.
- Sample filtrate → soluble assay.
- Particulate sample → particulate assay dark side.
- Incubated at constant temperature and light.
- Assays run until asymptotic uptake observed.

**Phosphorus Loading Comparison**
- Representative of phosphorus fraction bioavailability approach using algal bioassay analysis.
- **Bioavailability Not Accounted For**
  - Representative of phosphorus loadings not accounting for bioavailability of various P fractions.
  - **Cayuga Inlet** shown as highest concern using only TP and SRP loadings with bioavailability not accounted for.

**Phosphorus Fractions**
- TDP
- TP
- PP
- SRP
- DOP
- Fe-Al
- Organic
- Ca-mineral
- Residual

**Conclusions**
- Using only total phosphorus (TP) and soluble reactive phosphorus (SRP) to assess phosphorus loading does not give complete picture.
- Algal bioassays are key in assessing bioavailability of phosphorus fractions.
- Bioavailability of various phosphorus fractions must be accounted for in determining best use of reduction efforts to target source and phosphorus fraction.

**Acknowledgements**
- Funding provided by Upstate Freshwater Institute
- Dr. Martin Auer for advising and unconditional support.
- Upstate Freshwater Institute for sample collection:
  - Dr. Steve Effler
  - Dr. Dave Mathews
  - Anthony Prestigiacomo
- Anika Kuczynski for soluble assay data collection and laboratory assistance.
- Terrianna Bradley for laboratory assistance.

**Percent Bioavailability**
- Percentage of phosphorus fraction available for algae to use as food.
- Starved green algae (*Selenastrum capricornutum*) used in assays.

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