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# Developing a Lake Index of Biotic Integrity

## For use with benthic macroinvertebrates in NYS

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# Outline

- Background on NYS lake assessment
- Project design and methods
- Developing the IBI:
  - Defining lake types
  - Assessing biological component metrics
  - Draft IBI
- Conclusions and Next steps

# NYS Lake Water Quality Assessments

- Two main programs
  - Lake Classification and Inventory (LCI)
  - Citizens Statewide Lake Assessment Program (CSLAP)

- Focused on water chemistry, invasive spp., and recreation etc…

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# NYS Lake Water Quality Assessments

- Lake programs lack a biological assessment component

- NYS has a 43 yr. legacy of stream/river bioassessment

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# Design and Methods

- Establish sampling and processing methods
- Pilot the implementation of these operating procedures
- Develop a multimetric index of biotic integrity (IBI)

- Beginning in 2008:
  - Sampled approximately 10-12 lakes/yr.
  - Stratified by depth, trophic state and disturbance

# Design and Method

- 55 lakes sampled
- 8-12 locations / lake
- Composite benthic sample
  - Single habitat samples
- 300 organism subsample
  - Grided tray sort
  - Lowest taxonomic resolution
- Surface Water Chemistry
  - 1m depth over deep hole

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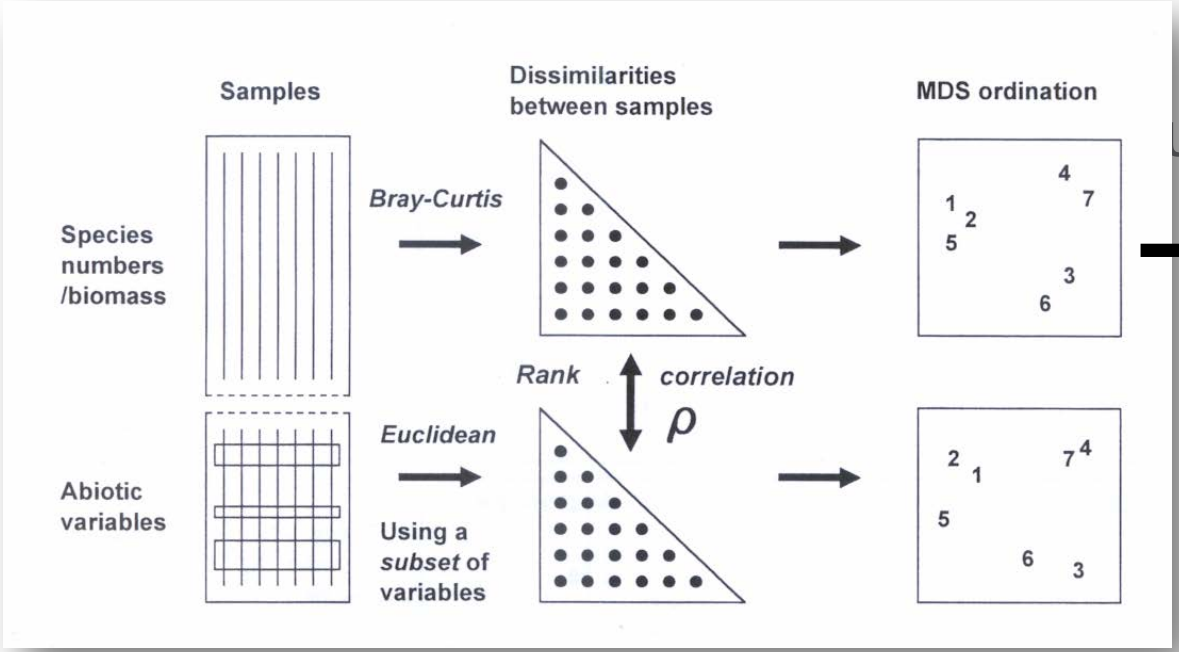
# Lake Classification and Chemical Stressors




| k | Best variable combinations ($\rho_w$) | | | |
|---|---|---|---|---|
| 1 | $H_2S$ (.62) | %Org (.54) | Sal (.53) | … |
| 2 | $H_2S$, Sal (.76) | $H_2S$, MPD (.67) | $H_2S$, %Org (.65) | Sal, |
| 3 | **$H_2S$, Sal, MPD (.80)** | $H_2S$, Sal, %Org (.75) | $H_2S$, | |

PRIMER-E

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# BEST

- 22 possible chemistry variables
  - Big 4, Nutrients, Color/Transparency, Solutes
  - Screened for redundancy (Ca, Cl, Mg, Na, $SO_4$, Silica)

**Lake Shoreline Disturbance……habitat?!?!**

- 5 variable subsets
  - *r* = 0.324 Cond., **Alkalinity**, Color, Secchi, Ammonium
  - *r* = 0.321 **Alkalinity**, Color, Secchi, Ammonium, Potassium
  - *r* = 0.317 **Alkalinity**, Color, Secchi, Ammonium

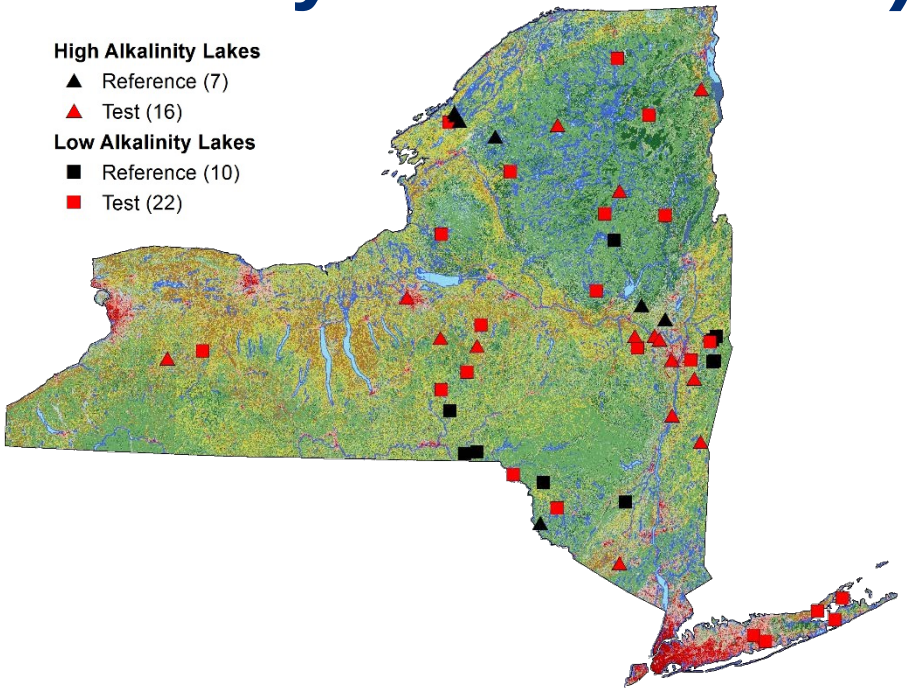
# TITAN

- **T**hreshold **I**ndicator **T**axa **AN**alysis (TITAN)
  - Detect changes in taxa distributions along env. Gradients
  - Uses taxonomic data to report stressor changepoint

- TITAN Results:
  - 40 mg/L (Alkalinity as $CaCO_3$)
  - 180 µmhos/cm (Conductance)

# Lake Classification (Alkalinity and Landuse)

- High and Low Alkalinity
  - ≥ 40 mg/L $CaCo_3$
- Landuse - % Natural Cover
  - 80% for High Alkalinity
  - 90% for Low Alkalinity
- Specific Conductance
  - ≤ 180 µmhos/cm

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# Evaluating Metrics by Lake Type

- Literature review of previous lake IBI projects
  - Tested 32 benthic community metrics
  - Tolerance, Functional, Diversity, Abundance etc…..

- Evaluation of metrics followed Barbour et al. (1996)
  - Removed redundant metrics (correlation and scatter plots)
  - Sensitivity based on interquartile range (IQR) overlap

# Evaluating Metrics

- Metrics assigned sensitivity values:
  - 0 pts. – Extensive overlap of IQR
  - 1 pt. – One median outside IQR
  - 2 pts. – Both medians outside IQR
  - 3 pts. – No overlap of IQRs

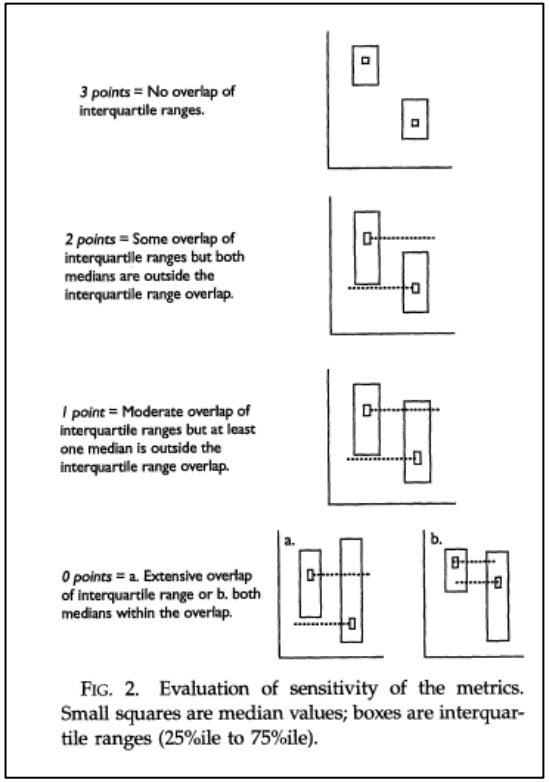
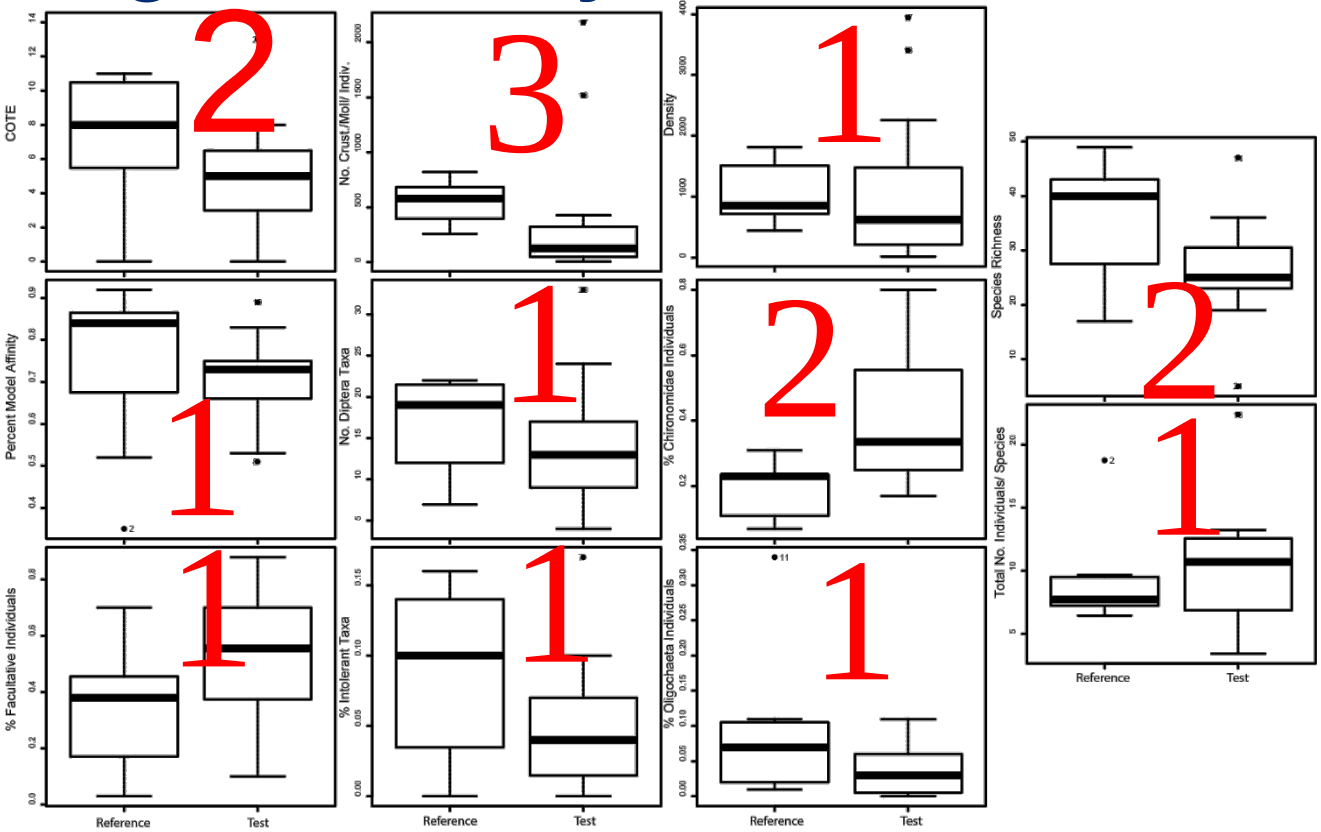



FIG. 2. Evaluation of sensitivity of the metrics. Small squares are median values; boxes are interquartile ranges (25%ile to 75%ile).

Barbour, M.T., Gerritsen, J., Griffith, G.E., Frydenborg, R., McCarron, E., White, J.S., and Basitan, M.L. 1996. A Framework for Biological Criteria for Florida Streams Using Benthic Macroinvertebrates. JNABS 15(2):185-211

# High Alkalinity Metrics




**Sensitive Metrics**

- COTE
- No. Crust./Moll. Indiv.
- Density
- Percent Model Affinity (FFG)
- No. Diptera Taxa
- % Chironomidae Indiv.
- % Facultative Indiv.
- % Intolerant Taxa
- % Oligochaeta Indiv.
- Species Richness
- Total No. Indiv. / Species

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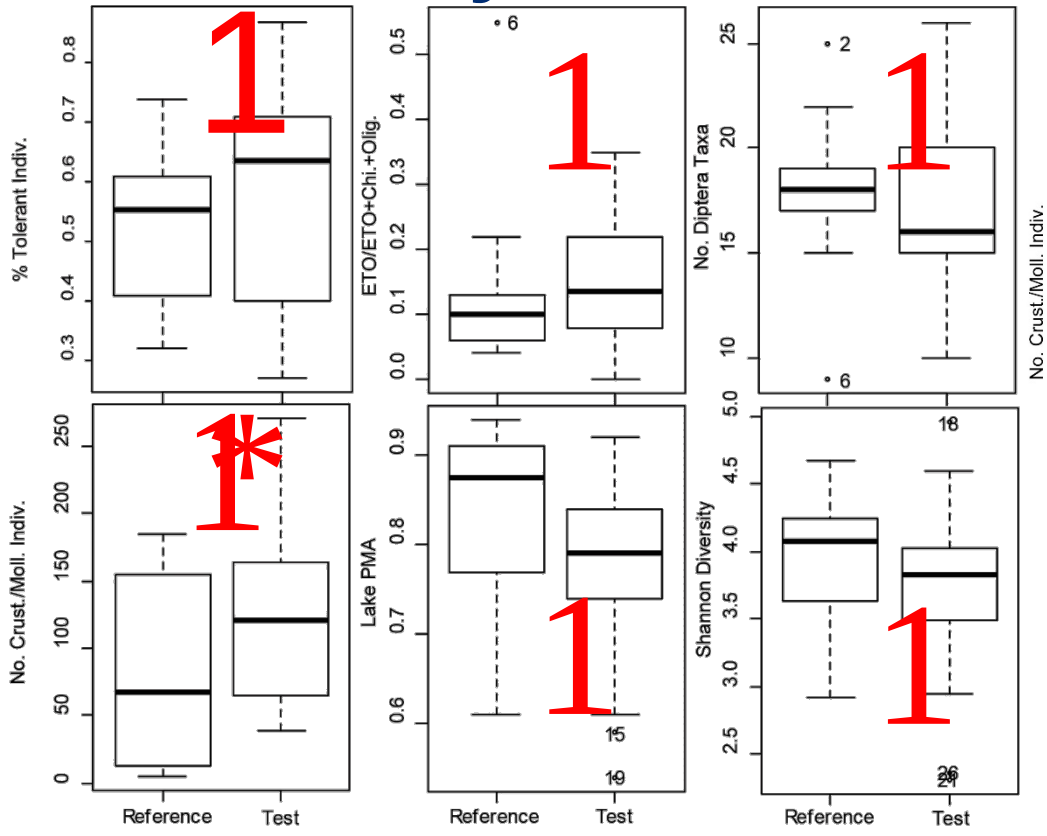
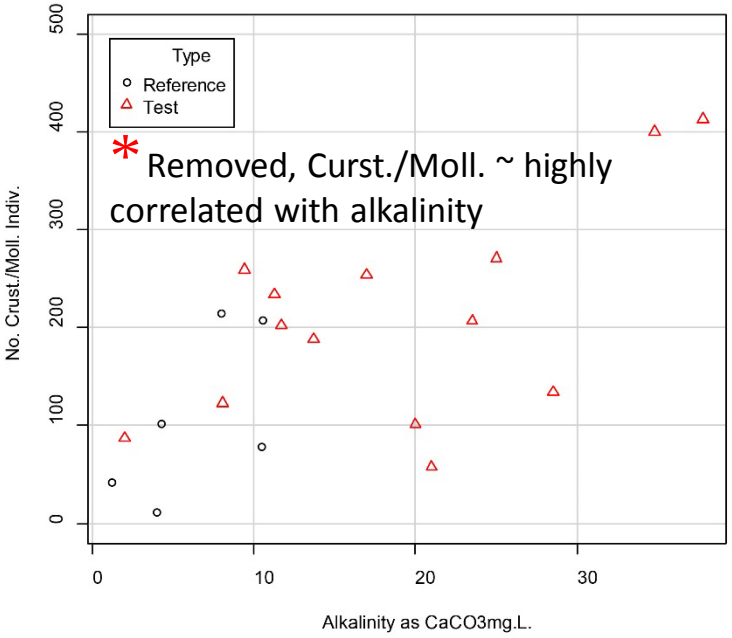
# Low Alkalinity Metrics




* Removed, Curst./Moll. ~ highly correlated with alkalinity

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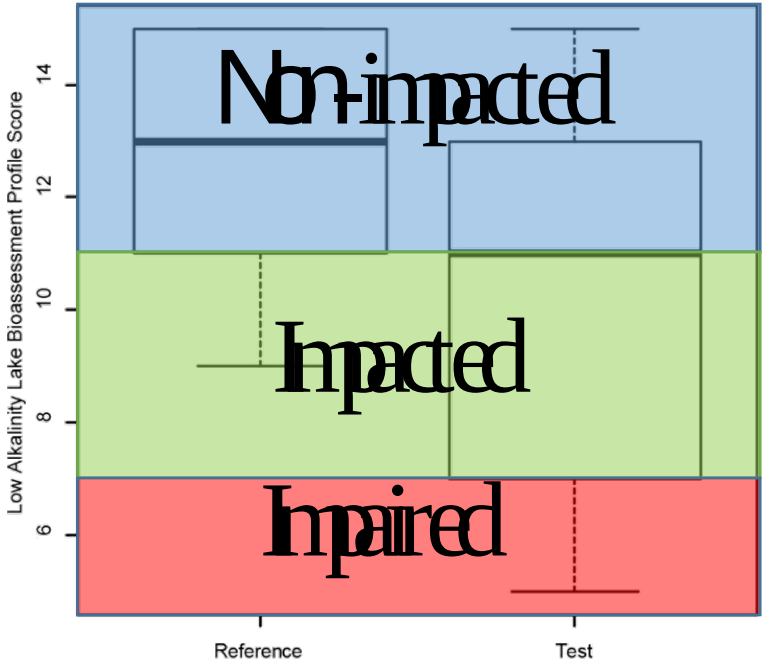
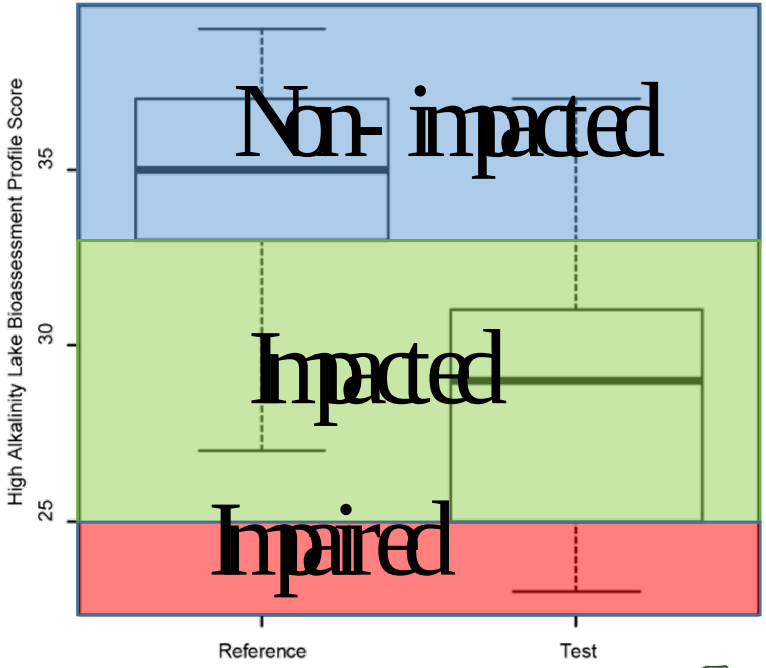
# Final Lake Multimetrics

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# Some new data!

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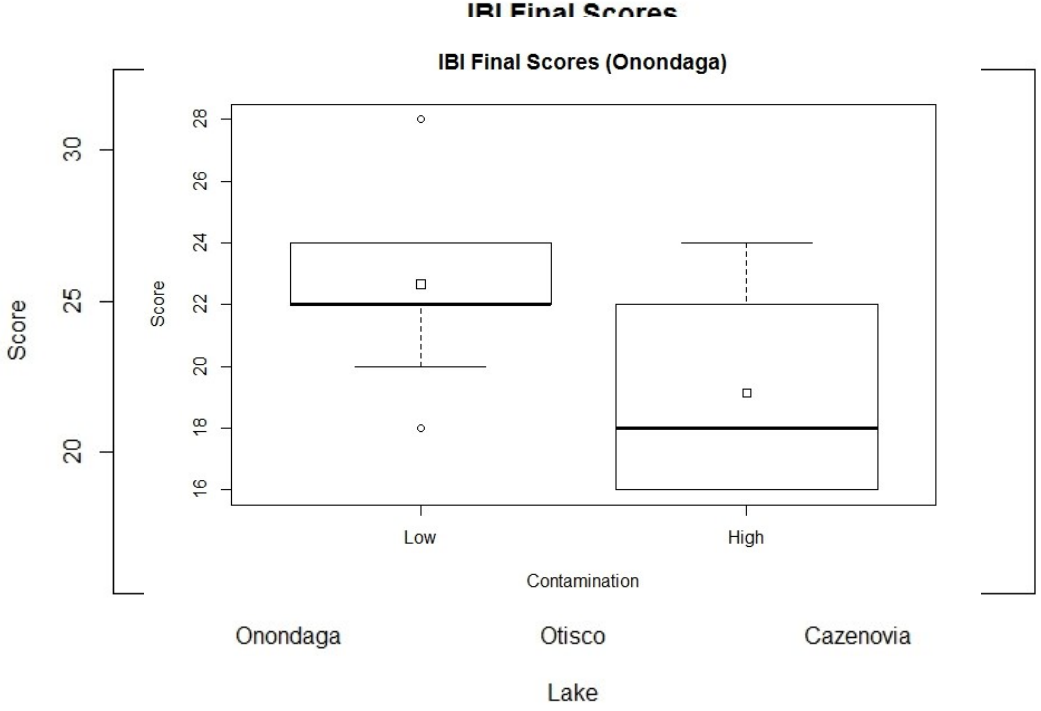


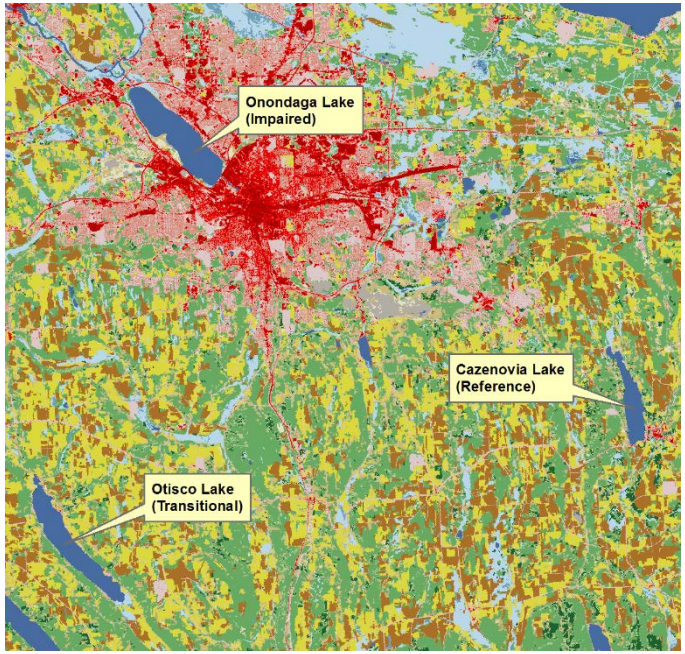


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# Next Steps

- Develop an extensive independent lake dataset for evaluation and adjustment of IBI's ~

  *Focus on shoreline disturbance and habitat*

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- Begin integration of field, lab, and assessment methods into RIBS cycle and reporting??

- Working with TITAN to develop tolerance value metrics for lake specific macroinvertebrate taxa

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# Thank You

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