Development of an index of Chemical and Physical Integrity

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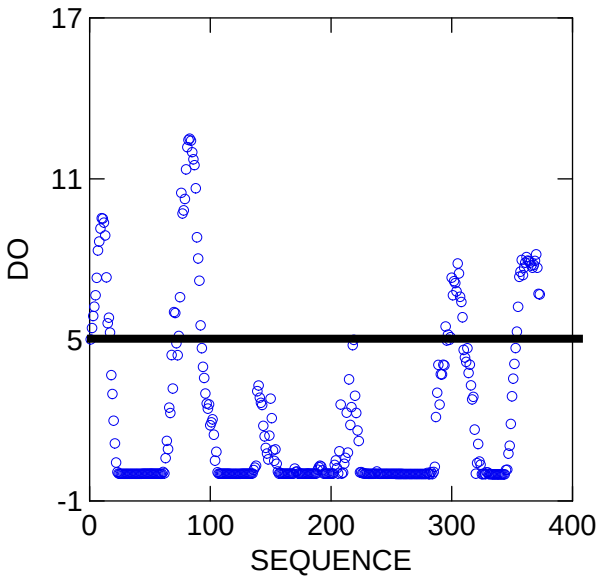
What is a Water Quality Index (WQI) ?

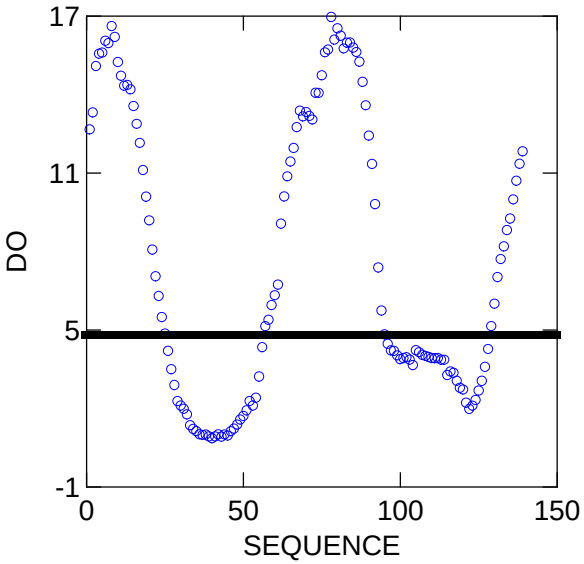
- A WQI takes individual measures of water chemistry and summarizing them with an index that provides an **overall indicator of water quality**.

- Such indices are used to broadly summarize conditions in both state and federal water quality programs.

- The concept is that water quality grab samples are an abstraction of the actual conditions, yet we can combine measures to provide a single water quality gradient.

Grab Samples are an Abstraction of Reality





- Yet, practically speaking these are the measures that we have to work with.
- So how do we best take these measures and make them meaningful?
- We need to be creative with regard to how we analyze and interpret these data.

Why develop a Water Quality Index (WQI)?

- Provides an overall measure of water quality, which can be used as a disturbance gradient.
- Provides a relatively easy screening tool for wetlands that have not had more intensive surveys.
- Helps stakeholders easily interpret water quality data.

How are WQIs developed?

1. Determine key water quality indicators, often using the "delphi" method.

2. Normalize variables so that measures on different scales can be easily combined.

3. Weight each measure based on confidence in each measure as an indicator of overall water quality conditions.

What data are available?

- Mostly grab samples
- Mostly related to nutrient concerns due to the goals of the study.
- Other data, especially metals, can be added as we obtain the data. There is some preliminary data that suggest that toxic metals are a real problem at some of these wetlands.

What data are available?

pH: Diurnal variation; high fluctuations can be toxic to some organisms; can affect toxicity of some contaminants

DO: Diurnal variation; prolonged periods of [DO]<2 can lead to “dead zones”

N: Consists of Nitrate/Nitrite; Ammonia; Organic Nitrogen

P: Consists of dissolved and total phosphorous

Chlorophyll-a: Can provide a measure of water column primary production vs. SAV

Sulfate: Important in discussions of Hg; can be toxic to some organisms at high concentrations.

Temperature: Physiological tolerances; rates of biogeochemical processes.

Numerous Ways to Summarize Each Parameter

Measures of Central Tendency: Geometric Mean, Median, Arithmetic Average (Mean)

Measures or Variance: Standard Deviation, Standard Error

Percentiles: 10th; 25th, 75th, and 90th

Measures of Extremes: Maximum and Minimum

A First Pass at Data Summarization

Normalize parameters as follows:

Measurement at Each Site/Geomean Across Sites

- Provides a description of average condition among the wetlands involved in the study
- Allows parameters measured on different scales to be combined\
- Values greater than 1 indicate that the score was, on average, higher at a given site than among all sites

A First Pass at a Chemical Gradient

A **Sum** of the Following Concentrations:

Relative Nutrients

Relative DO Swing (maximum – minimum)

Relative Maximum Chlorophyll-a

Relative pH swing (maximum – minimum)

Others???

Discussion

How can we select the best measures to include in the gradients?

- Empirical Relations to Measures of Use
- Best Professional Judgment

What are the best ways to combine these data into a single gradient?

- Multivariate methods (e.g., factor analysis)
- Relative Values
- Others?