NH’s Progress in the Development of Biocriteria to Assess Wetland Condition

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Overview

- How we started...
- This project.
- Results.
- Considerations for next steps.
The Progression
Biological Condition Gradient (BCG) and Maine's Tiered Aquatic Life Use (TALU)

1. Native or natural condition
   - Minimal loss of species; some density changes may occur

2. Some replacement of sensitive species; functions fully maintained
   - Some sensitive species maintained but notable replacement by more tolerant taxa; altered distributions; functions largely maintained

3. Tolerant species show increasing dominance; sensitive species are rare; functions altered
   - Severe alteration of structure and function
Maine DEP's Linear Discriminant Model
(12-variable version)

- Quantitative ecological attributes of the macroinvertebrate community to determine the strength of the association of a test community to any of Maine’s legislatively assigned water quality classes (Class A, B, or C).
- Where a class-specific probability value is greater than 0.4 but less than 0.6, an Indeterminate (I) status is assigned.
- Model minimum criteria:
  - Generic richness: 15
  - Total abundance: 50

Variables:
- Total mean abundance
- Ephemeroptera abundance
- Odonata relative abundance
- Trichoptera relative abundance
- Shredder taxa relative abundance
- Non-insect taxa relative richness
- MTI sensitive taxa abundance
- MTI sensitive taxa relative abundance
- MTI sensitive taxa richness
- MTI intermediate taxa relative abundance
- MTI intermediate taxa richness
- Ratio of MTI sensitive to eurytopic taxa abundance
Selected Maine Protocols for Wetland Assessment

- Maine DEP’s wetland biomonitoring protocols and predictive model.
  - Sampling macroinvertebrates.
  - Rapid assessment (Wetland Human Disturbance Assessment).
  - Water quality sampling.

- To which we added
  - Second rapid assessment -- Ecological Integrity Assessment (EIA).
  - Sampling vegetation.
  - Floristic Quality Assessment (FQA).
Floristic Quality Assessment - Identified weighted mean C thresholds (reference values) for 14 wetland system types.

Nichols, 2018. Reevaluating Exemplary Wetland Systems and Developing Thresholds for Interpreting Floristic Quality Assessment Scores. NHNHB.
Rapid Assessments: WHDA and EIA

- Desktop landscape analyses (GIS) followed by...
- Field-based observations of landscape features, hydrology, vegetation and soils.
Target wetland: Open-water lacustrine and palustrine wetlands and low gradient riverine backwater areas.

Contiguous wetland types.
Ecological Integrity Assessment (EIA)

Within the AA, unless noted:

- Hydrology.
- Vegetation.
- Landscape context (GIS).
  - Land Use Index.
  - Buffer zone within 100m, 250m and 500m.
  - Percent of Perimeter Having Buffer.
    - Intactness of 10m perimeter.
  - Average Buffer Width (up to 100m).
- Soil.
Wetland Human Disturbance Assessment (WHDA)

- Watershed characteristics and potential NPS pollution impacts.
- Vegetative modifications to wetland.
- Hydrologic modifications to wetland.
- Evidence of chemical pollutants in wetland and adjacent/upstream sources (GIS/imagery).

- Evaluates:
  - Watershed (land use).
  - 100-foot buffer around wetland.
  - Within wetland (AA).
Macroinvertebrate Sampling

- Water depth ≤ 1 meter.
- Three locations in each wetland.
- One-meter measured sweep technique with dip net; sieve the sample, then preserve.
- Contract taxonomist processed, identified and counted specimens.
- Taxonomic (and other data) provided to Maine DEP biomonitoring program for input to model to determine predicted attainment class.
Water Sampling

- Field meters at three macroinvertebrate sampling locations.
  - Dissolved oxygen.
  - pH.
  - Temperature.
  - Conductivity/ Specific conductance.

- One grab sample
  - Alkalinity, chloride, chlorophyll-\(a\), dissolved organic carbon (DOC) and nutrients \([\text{NO}_2+\text{NO}_3\), DOP, TP, TKN]\).
Vegetation Sampling

- Shrub rake.
- Retrieved aquatic vegetation with measured-sweep method at three macroinvertebrate sample locations.
- Also recorded vegetation observed but not part of retrieve.
- Developed species list.
- Applied floristic quality assessment.
Predictive Model

Results

A : 6
B: 14
C: 12
I: 10
Buffer rings are 100m, 250m, and 500m beyond assessment area.
Predicted Attainment Class B

Buffer rings are 100m, 250m, and 500m beyond assessment area.
Predicted Attainment Class C

Buffer rings are 100m, 250m, and 500m beyond assessment area.
Indeterminant Status

Buffer rings are 100m, 250m, and 500m beyond assessment area.
Rapid Assessments

**EIA**

- Predicted attainment class: A, B, C, I
- Better and worse categories

**WHDA**

- Predicted attainment class: A, B, C, I
- Better and worse categories
Floristic Quality Assessment

Mean C

Percent spp. w/ C = 0
(nonnative species)

Percent spp. w/ C ≥7-10
EIA - Average Buffer Width by Attainment Class
Alkalinity

ALKALINITY_MGL by Attainment Class

Environmental Services

24
Spearman Rank Correlations

Between chloride* and:

- EIA -0.83
  - Land Use Index -0.78
  - Avg. buffer width -0.68
- WHDA 0.77
- Percent Nonnative Species 0.72
- Mean C -0.52

* Similar correlation between specific conductance and the above parameters.
Macroinvertebrates: Functional Feeding Group by Predicated Attainment Class

- Other
- Scraper
- Shredder
- Piercer
- Predator
- Collector-gatherer
- Collector-filterer
Additional Observations

Documented:

- Plant species not yet documented in NH.
- Rare species.
- New locations of invasive species.
- Algal blooms (incl. cyanobacteria).
- Other wildlife.

Pectinatella sp.  Nostoc sp.  Spirogyra sp.  Potamogeton crispus  Lemna trisulca  Wolffia brasiliensis  Potamogeton zosteriformis
Challenges

- Sharing protocols is challenging.
  - Difficult to translate years of experience to detailed protocols.
  - Sampling in very organic substrate.
  - Occasional need for guidance when others are also in the field.
  - Lack the "evolutionary" process that leads to protocol and model development.
Considerations for next steps

Rapid Assessment/ FQA
- Continue application of EIA and FQA (and increase dataset for FQA thresholds).
- Collect additional data in non-exemplary wetlands.

Water Quality.
- Gather additional data on chloride or specific conductance and buffer width in open water wetlands.

Macroinvertebrates.
- Target wetland type to better define/refine target wetland population for model.
- Examine any temporal effects of macroinvertebrate sampling timeframe.
- Analyze macroinvertebrates by specific location where sampled (finer scale of analysis), especially in wetlands that have multiple open water areas.
In Summary

- We're not there yet (in terms of identifying biocriteria).
- We have information about NH’s wetlands that didn’t exist previously.
  - For wetlands that represent a range of human disturbance.
  - Documented new occurrences of rare and previously undocumented plant species (and additional invasive species locations).
- We have continued to build on prior work, which brings NH closer to being able to select a method and establish biocriteria and thresholds to characterize wetland condition.
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The health of our waters is the principal measure of how we live on the land.

- Luna Leopold