Development of a Comprehensive State Monitoring and Assessment Program for Wetlands in Massachusetts

Interim Progress Report
February 19, 2010

Scott Jackson, Kevin McGarigal, Theresa Portante and Brad Compton
Department of Natural Resources Conservation
University of Massachusetts Amherst

INTRODUCTION

This interim progress report covers activities conducted by the University of Massachusetts from March 2009 through February 15, 2010. Included are summaries of sample identification work, data analysis and CAPS modeling. The field data collection that occurred in 2009 is not covered by this report as a summary of field work has already been submitted.

STATUS OF INVERTEBRATE AND DIATOM SAMPLE DATA

Diatoms

Leaf litter samples collected from forested wetlands within the Chicopee Watershed have been analyzed for diatom community composition. Rex R. Lowe analyzed the samples using a 600-valve count.

Taxonomic richness: 23 Families, 50 genera (1 unknown), ~217 species. Common taxa (present at >30 sites): *Eunotia sp., Pinnularia sp., Eunotia exigua (Breb. Ex Kütz.) Rabenh., Eunotia curvata f. bergii Woodhead & Tweed, Eunotia pectinalis (O.F. Müller) Rabenhorst, Fragilariaforma virescens (Ralfs) Williams & Round, Eunotia paludosa v. paludosa Grun., Meridion circulare (Greville) Agardh, Tabellaria floculosa (Roth) Kütz, Gomphonema sp., Eunotia septentrionalis Østrup, Gomphonema parvulum (Kütz.) Kütz.*

Invertebrates

The following Orders were selected for finer taxonomic identification: Diptera, Coleoptera, Hemiptera, Hymenoptera, Orthoptera, Araneae, Collembola.

Diptera specimens were sent to John Tipping at Lotic Inc. Identification will be complete by the end of February 2010. Sean Werle is in the process of identifying the Collembola specimens.

Don Chandler identified Coleoptera specimens. Eric Eaton identified Hemiptera, Hymenoptera, Orthoptera, and Araneae specimens.

<u>Emergence Trap Samples 2008-Chicopee Watershed</u>
Hemiptera: 4 Families, 8 genera. Common genus: *Scaphoideus*

Hymenoptera: 6 Families, 4 genera, Common family*: Diapriidae, Formicidae*

Pitfall Trap Samples 2008-Chicopee Watershed
Coleoptera: 32 Families, 103 Genus, 168 Species (94 morphospecies). Common species/morphospecies (present at >20 sites): *Pterostichus coracinus, Agonum fidele, Platydracus viridianus, Pallodes pallidus, Synuchus impunctatus, Carpelimus #1, Agonum gratiosum.*

Hymenoptera: 20 Families, 12 genera, identified 3 species. Common genera: *Trimorus, Lasius, Aphaenogaster, Myrmica*

Hemiptera: 20 Families, 27 genera, identified 9 species. Common genus: *Scaphoideus*

Orthoptera: 2 Families, 4 genera, identified 2 species. Common genus: *Gryllus*

Araneae: 17 Families, 48 genera, identified 50 species. Common taxa (present at >20 sites): Linyphiidae, Lycosidae, *Wadotes, Neoantistea magna, Pirata insularis, Neoantistea agillis.*

Emergence Trap Samples 2009-SuAsCo and Millers Watershed

All samples (508) sorted to Order.

Order	Count	Order	Count
Diptera	7858	Hymenoptera	75
Coleoptera	54	Thysanoptera	11
Araneae	55	Lepidoptera	9
Acari	107	Plecoptera	37
Hemiptera	71	Trichoptera	25
Psocoptera	36	Ephemeroptera	2
Collembola	167	Neuroptera	2
Mecoptera	1	Odonata	1

Pitfall Trap Samples 2009- SuAsCo and Millers Watershed

Sample identification (to Order) in progress.

DATA ANALYSIS

The overarching goal of the data analysis is to determine whether CAPS IEI and the component ecological integrity metrics (e.g., habitat loss, connectedness, etc.) are related to observed ecological conditions, and to further quantify the magnitude and nature of those relationships. To accomplish this goal, we developed a comprehensive relational database that includes over 40 tables containing the CAPS metrics and ecological settings variables and the field ecological data representing four major ecological communities and 565 sites distributed throughout Massachusetts (Table 1).

Table 1. Field ecological data compiled to date.

Ecological community	Taxonomic group	Number of sites	Number of taxa
Forested uplands	vascular plants	98	404
	lichens	98	51
	earthworms	98	Tbd
Forested wetlands	vascular plants	218	457
	lichens	218	Tbd
	bryophytes	218	Tbd
	algae	221	217*
	earthworms	218	Tbd
	insects	220	283**
Riverine	invertebrates	385	606
Salt marsh	vascular plants	45	Tbd
	invertebrates	45	Tbd

*Taxa identified for 70 sites sampled in 2008; identification for 150 sites sampled in 2009 is incomplete.
**Taxa identified so far; specimens from 2008 still being identified; does not include 150 sites sampled in 2009

Based on this database, our analysis includes three different strategies:

1. *Pseudo-validation.*—Our first strategy is to "pseudo-validate" CAPS IEI by regressing our existing IEI against several published biotic integrity metrics/indices. A significant relationship between CAPS IEI and one or more published metrics will confirm that CAPS IEI is at least consistent with other integrity metrics, although this does not confirm that either represents true ecological integrity. Currently, we have compiled a suite of biotic integrity metrics for riverine systems and are in the process of compiling metrics for the other ecological communities in preparation for the analysis.

2. *Verification.*—Our second strategy is to "verify" that CAPS IEI (and each component metric) does in fact reflect a real gradient in the biotic community by constructing an index of ecological integrity from the field biotic data (predicted IEI) that is maximally related to our GIS-based IEI and confirming a strong relationship. Specifically, we will use likelihood-based statistical models to predict CAPS IEI from the field biotic data. Briefly, this procedure

involves first fitting non-linear statistical models to predict each species' abundance based on CAPS IEI, and subsequently using these fitted models to predict CAPS IEI for each site based on each species recorded abundance at each site (a procedure known as statistical "calibration"). The final predictions are based on a parsimonious suite of species selected to optimize the relationship. Currently, we have developed the software for conducting the statistical analysis and have applied it to the upland forest data and the riverine invertebrate data with moderate success. Figure 1 depicts the relationship between CAPS IEI (x-axis) and the predicted IEI (y-axis) based on the field data for vascular plants in upland forests. We are in the process of refining the statistical method to optimize performance and will shortly be ready to apply the method to each of the field data sets (Table 1).

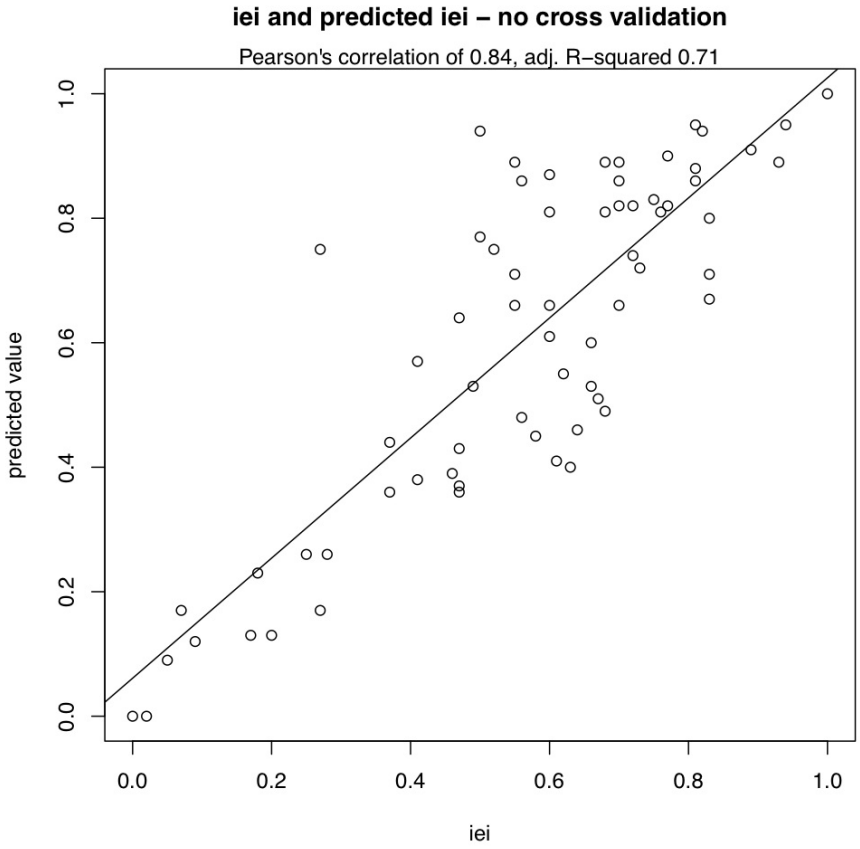

Figure 1. Linear regression of CAPS IEI against predicted IEI derived from field data on vacular plants from 98 forested uplands in the Deerfield watershed.

Calibration.—Our third strategy is to "calibrate" CAPS IEI by adjusting the parameterization of each component metric to optimize the relationship between CAPS IEI and the predicted IEI (from the verification method above). Briefly, this computer intensive procedure will involve adjusting the parameters of a component metric to improve the "verification" fit of that metric, and adjusting the weights of each component metric in the composite IEI to improve the "verification" fit for IEI. In this manner, we aim to optimize CAPS IEI to the

CAPS MODELING

Completed work

- New landcover using 2005 land use & complete statewide data
- Preliminary statewide run (June 2009)
- Rewrite post-processing module
- New scenario analysis module
- Many software improvements
- Redesign watershed metrics (implementation is in progress)
- New coastal metrics: salt marsh ditches, beach hardened structures
- New settings variables: terrestrial barriers, soil moisture, soil pH, soil depth, soil texture, $CaCO_3$, wind exposure, slope steepness, substrate mobility, stream gradient, flow volume

Work in progress

- Remaining settings variables: tidal depth, tidal hydroperiod, tidal frequency, growing season degree-days, minimum winter temperature, relative humidity, solar radiation, water salinity, wave exposure
- Additional new coastal metrics: tidal restrictions, beach pedestrians, boat traffic