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

Progress Report
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INTRODUCTION

This interim progress report covers activities conducted by the University of Massachusetts from March 2010 through February 2011. Included are summaries of sample identification work, data analysis and IBI development for forested wetlands and data summary and preliminary analyses for salt marshes. An update is provided for development of the Conservation Assessment and Prioritization System (CAPS).

DATA FROM 2008 AND 2009 FIELD WORK IN FORESTED WETLANDS

When we began research on forested wetlands we did not know what sampling techniques would be the most appropriate or how many specimens we would likely collect. Multiple techniques were used for diatoms and invertebrates and these yielded an immense collection of specimens. The budget available for specimen analysis, although large, is not nearly large enough to identify all the specimens collected over the two years.

Over the past year, we have been engaged in analysis of the samples from 2008 field work as well as sorting of 2009 samples. The slow process of getting data from taxonomic experts contracted to identify the specimens has hampered our progress. For example, we are still awaiting data for dipterans, a very important group of invertebrates in forested wetlands. The work has been slow because of both the difficultly in identifying dipterans and the large number of dipteran specimens that need to be identified (**Table 1** & **Table 2**).

Analysis of 2008 data will give us some insight into which taxa groups should be the focus for identification of 2009 specimens. We decided to proceed with the analysis of 2008 data without the dipteran data so that we can move forward with identification of 2009 specimens, to develop and test data analysis techniques, and to look for early indications of how successful we are likely to be in developing Indices of Biological (IBIs) for CAPS Index of Ecological Integrity (IEI) and metric scores.

Diatoms 2008

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

Leaf Litter Samples (n=71)

Taxonomic richness: 23 Families, 48 genera, ~ 200 species. Four percent of the valves identified could not be classified beyond genera (Appendix A, **Table 19**). Common taxa: *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.*

Water Samples (n=28)

Taxonomic richness: 19 Families, 37 genera, 158 species. Four percent of the valves identified could not be classified beyond genera (Appendix A, **Table 20**). Common taxa: *Pinnularia, Eunotia, Eunotia paludosa v. paludosa* Grun., *Eunotia exigua* (Beb. Ex Kutz.) Rabenh.

Invertebrates 2008

All invertebrates captured by emergence traps and pitfall traps were sorted and identified to order (**Table 1** and **Table 2**). The following Orders were selected for finer taxonomic identification: Araneae, Coleoptera, Collembola, Diptera, Hemiptera, Hymenoptera, and Orthoptera.

Diptera specimens were sent to John Tipping at Lotic Inc. Data should be received shortly. Sean Werle identified the Collembola specimens. Don Chandler identified Coleoptera specimens and Eric Eaton identified Hemiptera, Hymenoptera, Orthoptera, and Araneae specimens.

***Table 1**. 2008 Emergence Trap Taxa.*

Order	Total Abundance	Order	Total Abundance
Diptera	1659	Coleoptera	13
Isoptera	511	Ephemeroptera	7
Acari	488	Trichoptera	5
Hymenoptera	26	Lepidoptera	3
Hemiptera	24	Psocoptera	1
Araneae	18	Thysanoptera	1
Collembola	14		

Table 2. *2008 Pitfall Trap Taxa.*

Order	Total Abundance	Order	Total Abundance
Collembola	10243	Polydesmida	35
Acari	2292	Opiliones	25
Diptera	1741	Pseudoscorpiones	14
Araneae	1709	Copepoda	11
Hemiptera	1286	Trichoptera	11
Hymenoptera	1273	Bivalvia	4
Coleoptera	1130	Lithobiomorpha	4
Julida	142	Mecoptera	3
Orthoptera	134	Isoptera	2
Pulmonata	84	Amphipoda	1
Psocoptera	47	Chordeumatida	1
Isopoda	46	Geophilomorpha	1
Thysanoptera	43	Plecoptera	1
Lepidoptera	40	Unknown	44

Emergence Trap Samples 2008-Chicopee River Watershed

Hemiptera: Observed at 16 sites; 4 Families, 7 genera, 3 species. Twelve percent were identified to species, 60% to genus, 8% to family, and 12% were left at the order level (Appendix A, **Table 21**). Common genus: *Scaphoideus*.

Hymenoptera: Observed at 16 sites; 5 Families and 4 genera. Thirty-five percent of the specimens were identified to genera and 65% were left at the family level (Appendix A, **Table 21**). Common family*: Diapriidae, Formicidae*.

Pitfall Trap Samples 2008-Chicopee River Watershed

Araneae: Observed at 62 sites; 17 Families, 51 genera, identified 59 species. Fifty-seven percent were identified to species, 16% to genus, 18% to family, and 9.7% were left at the order level (Appendix A, **Table 22**). Common taxa include *Neoantistea magna*, Linyphilidae, *Wadotes*, and Lycosidae.

Coleoptera: Observed at 61 sites; 32 Families, 108 Genus, 163 Species (95 morphospecies). One hundred percent of the specimens were identified to species/morpho-species (Appendix A, **Table 23**). Common species/morphospecies: *Pterostichus coracinus, Agonum fidele, Platydracus viridianus, Pallodes pallidus, Synuchus impunctatus, Carpelimus #1, Agonum gratiosum*.

Collembola: Observed at 62 sites; 6 Families and 30 genera. Identifications were not made beyond the genus level (Appendix A, **Table 24**). 99.6% of specimens were identified to genus. Common genera: *Tomocerus, Dicyrtoma, Sinella, Hypogastrura, Pseudachorutes*.

Hemiptera: Observed at 60 sites; 20 Families, 25 genera, identified 10 species. Three percent were identified to species, 92% to genera, and 5% were left at the family level (Appendix A, **Table 25**). Common genera and species: *Scaphoideus, Ceratocombus vegans*.

Hymenoptera: Observed at 62 sites; 18 Families, 14 genera, and 6 species. Ten percent were identified to species, 82% to genera, and 8% were left at the family level (Appendix A, **Table 26**). Common genera and families: *Trimorus, Aphaenogaster, and Ceraphronidae*.

Orthoptera: Observed at 30 sites; 2 Families, 4 genera, identified 2 species. Three percent were identified to species, 67% to genera, 30% to family and 3% were left at the order level (Appendix A, **Table 27**). Common genus: *Gryllus*.

Invertebrates 2009

Stovepipe Samples - Concord and Miller's River Watersheds

Stovepipe samples were sent to Lotic Inc. for sample identification and to evaluate the effects of fixed count sampling. Twenty samples per watershed were selected from the low and high ends of the IEI gradient. Data should be received shortly.

Emergence Trap Samples - Concord and Miller's River Watersheds

All samples (497 samples from 145 sites) have been sorted to Order (**Table 3**).

***Table 3**. 2009 Emergence Trap Taxa.*

Order	Total Abundance	Order	Total Abundance
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 - Concord and Miller's River Watersheds

All pitfall trap samples have been sorted and identified to order. The total number of specimens is 70,536 (**Table 4**).

***Table 4**. 2009 Pitfall Trap Taxa.*

Taxa	Total Abundance	Taxa	Total Abundance
Collembola	27210	Bivalvia	61
Coleoptera	8648	Pseudoscorpiones	46
Acari	8233	Polyzoniida	44
Hymenoptera	6114	Lithobiomorpha	24
Diptera (adult)	5581	Copepoda	17
Diptera (larvae)	1188	Trichoptera	13
Araneae	5576	Nematoda	13
Gastropoda	3952	Amphipoda	6
Hemiptera	1585	Odonata	6
Isopoda	811	Neuroptera	5
Julida	355	Scutigeromorpha	4
Orthoptera	209	Plecoptera	3
Opiliones	146	Siphonaptera	3
Polydesmida	133	Diplura	2
Lepidoptera	125	Mecoptera	1
Chordeumatida	90	Diplopoda	1
Annelida	81	Geophilomorpha	1
Thysanoptera	80	Unknown	92
Psocoptera	77		

Earthworms 2007-2009 – Deerfield, Chicopee, Concord and Miller's River Watersheds

Earthworms collected in upland forests in the Deerfield River watershed and in forested wetlands in the Chicopee, Concord and Miller's River watersheds were identified by the Great Lakes Earth Worm Watch lab at the University of Minnesota.

A total of 476 earthworms were identified in the upland forest samples: 2 families, 7 genera, and 13 species. Common taxa include: Lumbricidae and *Dendrobaena octaedra* (Appendix A, **Table 28**).

A total of 127 earthworms were identified from forested wetland samples: 2 families, 5 genera and 7 species. Common taxa include: *Dendrobaena octaedra, Lumbricus,* and *Aporrectodea* (Appendix A, **Table 29**).

Bryophytes 2008 – Chicopee River Watershed

Bryophytes were collected in 68 forested wetlands in the Chicopee River watershed: 68 genera and 100 species were identified. Common species include: *Sphagnum palustre, Aulacomnium palustre, and Thuidium deliatulum* (Appendix A, **Table 30**). The specimens collected in 2009 have not been identified.

Comparison of Diatoms from Water Column and Leaf Litter Samples

Diatom samples were collected from forested wetland sites in the Chicopee River watershed from May 22 to July 11, 2008. Three microhabitats were sampled: leaf litter, substrate-surface sediment, and standing water. Multiple habitats were sampled to evaluate which method should be used to collect diatoms in forested wetlands for a Site Level Assessment Method (SLAM).

Forested wetlands have variable hydrologic regimes (e.g. seasonally saturated, temporarily flooded) that makes the selection of a sampling method complex. It is expected that forested wetlands will support both subaerial and aquatic diatoms (e.g. benthic, planktonic). As a result of the variation in hydrology microhabitats within forested wetlands some sites had substantial amounts of standing water. Other sites were relatively dry and many sites fell between these two conditions. Water column samples are only available from sites and plots that contained standing water at the time of sampling. Leaf litter samples are available from all sites and all plots within sites. This makes the leaf litter samples the preferred candidates for data analysis.

The cost of identifying diatoms for one sample from each site sampled in the Chicopee, Concord and Miller's River watersheds would be approximately $36,000. To identify diatoms separately for leaf litter and water column samples would cost about $72,000. At this point we can't afford to analyze more than one sample per site. However, we have questions about using leaf litter samples alone. Leaf litter samples from sites that lacked standing water at the time of sampling would be expected to contain both benthic and planktonic species of diatoms. At sites/plots with standing water it is unclear to what degree the leaf litter samples will contain planktonic diatoms, many of which would be expected to be suspended in the water column. Further complicating the situation is the expectation that diatom communities may differ as a result of differing hydrological characteristics of the site (percent inundation, water depth and hydroperiod).

A comparison between water and leaf litter samples collected in the Chicopee River watershed was conducted to evaluate the differences in the diatom communities collected from the two microhabitats. Twenty-eight sites with paired leaf litter and water samples were selected for analysis. Subsamples (4 aliquots per site) were combined before identification. Fixed counts of 600 valves were identified per sample. In addition, taxa collected from leaf litter at 5 sites with no standing water were compared to samples collected from sites with standing water.

For the comparison between paired water and leaf litter samples, taxa counts were aggregated to the lowest common classification level. For example, if some individuals within the genus *Caloneis* were identified to species, but others left at the genera level, all would be classified as *Caloneis sp*.

Twenty taxa were collected only in leaf litter samples; all occurred at low frequencies (1 to 3 sites). Fifteen taxa were collected only in water samples; all occurred at low frequencies (1 to 3 sites).

A Wilcoxon rank sum test was conducted to compare taxa frequency of occurrence, total abundance, richness, and Simpson's diversity between paired leaf litter and water samples. There were no significant differences between the two sample types ($p>0.10$) for any of the variables tested.

Analysis of variance was conducted for each taxon to test for differences in relative abundance between leaf and water samples. Only 2 taxa were significantly different ($p<0.10$) between groups: Cocconeis (F-value=3.23, p-value=0.08), Stenopterobia (F-value=3.2, p-value=0.08).

In addition, a Mantel test was conducted to determine the correlation between the dissimilarity of sites in leaf litter and water diatom taxa multivariate space. Counts were converted to relative abundance and Bray-Curtis dissimilarity measurement was applied. The matrices were strongly correlated (Mantel $R=0.76$, $p<0.01$) indicating the diatom community composition and relative abundance between the sample types are similar.

Lastly, the taxa collected from leaf litter at the five dry sites had taxa present in similar abundance and frequency as the leaf litter samples taken from wet sites. Forty-two of the taxa collected from leaf litter at sites with no water (n=5) were also found in water samples from wet sites. There were 8 taxa collected from dry leaf litter samples that were not present in the leaf litter samples collected from wet sites. Seven of those taxa were collected from one location. Three of those taxa were collected in the water samples. The 3 taxa (*Diadesmis contenta, D. biceps,* and *Fragilaria acidobiontica*) were all low in abundance and occurrence in both the dry leaf litter and water samples.

In conclusion, we found no significant differences between the diatom taxa collected from the paired leaf litter and water samples. This would indicate that in the presence of a water column, collecting diatoms either from the leaf litter or in water samples may be appropriate. In regards to dry site sampling, this cursory evaluation indicates that surface water may have been present prior to sampling since we collected many of the same taxa found in the water samples. One possible follow up to this analysis would be to categorize the diatoms according to habitat to determine the proportion of aquatic taxa to subaerial taxa.

Table 5. *Comparison of diatom taxa abundance and occurrence between leaf litter and water samples.*

Taxon	Water Sample Occurrance	Leaf Sample Occurrance	Water sample Total Abundance	Leaf Sample Total Abundance
ACHAcf.PSEO	1	0	43	0
ACHAcf.ROSE	1	0	13	0
ACHABIAS	0	1	0	2
ACHAcf.CHLI	0	1	0	4
ACHANODO	0	1	0	4
Achnanthidium	6	9	53	48
ASTEFORM	2	0	12	0
Aulacoseira	5	9	568	485
BRACBREB	0	1	0	1
BRACMICRO	0	1	0	2
Caloneis	4	2	12	4
Chamaepinnularia	6	5	44	24
Cocconeis	0	3	0	3
Cyclotella	0	2	0	20
Cymbella	2	7	33	53
DECUPLAC	7	9	20	28
DIADBICE	1	0	2	0
DIADCONT	1	0	1	0
DENTKUET	0	1	0	2
DIADPARA	0	2	0	2
DIADPERP	1	2	1	3
DIATANCE	1	2	1	9
DIATANCEli	1	0	12	0
DIPLOELLI	1	2	3	2
ENCYMINU	11	6	62	14
ENCYNORVla	0	1	0	2
ENCYSILE	2	1	5	2
Eunotia	28	28	7378	8166
FRAGcf.ACID	1	0	2	0
FRAGcfTENE	1	0	134	0
Fragilariaforma	12	13	1594	1326
FRAGNEOP	0	1	0	2
FRAGVAUC	2	4	25	313
Frustulia	14	13	246	355
Gomphonema	15	15	598	595
Hantzschia	0	2	0	6
Kobayasiella	0	1	0	2

LEMNHUNG	1	0	4	0
Luticola	1	3	2	0
Meridion	13	13	716	969
MIRCKRAS	0	1	0	1
Navicula	11	11	498	387
Neidium	12	12	117	121
Nitzschia	11	13	460	445
Nupela	3	2	16	8
Pinnularia	27	26	1710	1779
Placoneis	6	5	27	19
Planothidium	6	5	114	283
PSAMSUBA	1	0	5	0
PSEUBREV	1	1	1	2
PSEUPARA	1	0	5	0
RHOPGIBB	1	0	3	0
SELLcf.SEMI	2	1	8	1
SELLPUPU	3	3	17	24
STAUCONS	0	2	0	9
STAUCONSve	1	3	38	21
STAULEPT	0	1	0	2
Stauroneis	12	12	194	149
STENDELI	0	2	0	9
STENsp.	0	1	0	2
Stenopterobia	3	0	14	0
Surirella	3	0	9	0
Synedra	3	6	232	222
TABEFENE	1	0	6	0
TABEBINA	0	1	0	1
TABEFLOC	16	15	456	528
TABEQUAD	1	1	1	1
TETRRUPE	0	1	0	2
ULNAULNA	1	2	1	5

FORESTED WETLAND DATA ANALYSIS AND IBI DEVELOPMENT

Introduction

These are the objectives for data analysis.

1. Determine whether we can detect a dose-dependent relationship between IEI scores and biotic community composition.

2. Create an IBI for assessing wetland condition using the full range of IEI scores to approximate a continuious Generalized Stressor Gradient (GSG).

3. Determine whether we can detect dose-dependent relationships between various metrics and biotic community composition.

4. Create IBIs for assessing wetland condition relative to individual stressors as characterized by CAPS metrics.

We used CAPS IEI and individual metric grids to look for relationships between IEI/metric scores and biotic communities in forested wetlands and create preliminary IBIs from data. Because we are looking for relationships across entire stressor gradients (rather than simply using reference and test sites) the analysis requires data from a large numbers of sites. We do not yet have data for all taxa at all sites. As a result the analyses presented below are preliminary in nature and the results are likely to change as more specimens are identified and larger numbers of taxa and sites are included in future analyses.

The analyses conducted for this report were selected to balance the desire to include a large number of taxa with an equally important need to include a large number of sites. Because some taxa groups have not yet been identified for the Miller's and Concord River watersheds (and may not be available for all sites in the Chicopee River watershed) as more taxa that are included in the analysis fewer sites will be included (see **Table 6**).

Field based-ecological settings variables were only assessed in the Miller's and Concord River watersheds. The three ecological settings variables included in analyses were 1) water pH, 2) depth of soil organic layer and 3) an integrated hydrology variable. Because of the limited number of sites available for analysis ecological settings variables could only be considered individually, not in combination.

***Table 6**. Number of sites and number of taxa available for analysis as of February 28. 2011. "With settings" means taxa are available from sites in the Miller's and Concord River watersheds where field-based ecological settings data were collected. "No settings" means that settings variables cannot be used inorder to include data from the Chicopee River watershed where ecological settings data were not collected.*

Analysis	Number of Sites Available for Analysis	Number of Taxa Available*
Plants, worms, lichens (no settings)	213	357
Plants (no settings)	213	327
Lichens (no settings)	213	23
Worms (no settings)	213	7
Plants, worms, lichens (with settings)	139	321
Plants (with settings)	139	294
Lichens (with settings)	139	20
Worms (with settings)	139	7
Diatoms	67	81
Bryophytes	67	28
All taxa (except inverts)	62	345
Invertebrates†	61	133
All taxa (no settings)†	56	458

* Number of taxa that met our threshold for inclusion in the analysis (present at 10 or more sites)
† Invertebrates includes only those taxa collected via pitfall traps

Methods

At each taxonomic level we created counts of each taxon's abundance including all individuals in each sample that were in that taxon regardless of the level to which it was identified. This means that a sample, if it was identified to species, was counted at five levels (species, genus, family, order, and class). Then we dropped all taxa that were observed at less than ten sites. The number of taxa and number of sites included in each analysis varied.

We created an IBI (Index of Biological Integrity) by fitting models that predict the CAPS metrics or IEI scores from taxa abundances. The steps in this process were: 1) fit individual responses for each taxon, 2) use models from step 1 to predict the likelihood of different IEI values at each site based on the abundance of taxa, and 3) select the group of taxa that produce the most accurate predictions. There were two additional techniques woven through this process with the goal of optimizing reproducibility and reducing over fitting: 1) cross validation and 2) testing the significance of each taxon's fit against pseudospecies.

We modeled the relationship between each species and IEI with two or four functional forms and eight error models. In the absence of settings variables we used two functional forms. The three parameter logistic function (Equation 1; Crawley 2007) allowed for threshold responses of taxa to the gradient while the constrained exponential quadratic (Equation 2) allowed for Gaussian and exponential responses to the gradient.

(1) $$y = \frac{a}{1 + b \times e^{-cx}}$$

(2) $$y = e^{(a+bx+cx^2)}$$

where c is constrained to always be negative.

In fits with settings (as covariates) we used four functional forms to model the relationship between species, IEI, and a settings variable. The functional forms allowed the response to IEI (x) and the settings variable (s) to each take either of the forms in equations (1) and (2).

(3) $$y = \frac{a}{1 + b \times e^{-cx}} + \frac{d}{1 + f \times e^{-gs}}$$

(4) $$y = e^{(a+bx+cx^2)} + e^{(d+fs+gs^2)}$$

where c and g are constrained to always be negative.

(5) $$y = e^{(a+bx+cx^2)} + \frac{d}{1 + f \times e^{-gs}}$$

where c is constrained to always be negative.

(6) $$y = \frac{a}{1 + b \times e^{-cx}} + e^{(d+fs+gs^2)}$$

where g is constrained to always be negative.

With runs that included settings variables each taxon was modeled without any settings variable and with each possible settings variable. Whichever settings variable option yielded the fit with the best AIC value was used with that taxon for the remainder of the analysis.

We modeled error with the Binomial, Beta Binomial, Poisson, and Negative Binomial distributions along with zero inflated (Zuur 2009) versions of those distributions. We included all these models to make sure that we had an error model in the mix that approximated the true error distribution for each taxon. The zero inflated models added a parameter to each model that allowed zeros to be modeled separately, helping to model taxa that occur infrequently and consequently have more zeros than otherwise expected by the distributions. With eight error models and two (no setting) or four (with a settings variable) functional forms we had either 16 or 32 models for each taxon. We used AIC weights to estimate the relative quality of each of the models based on how many parameters they had and how well they fit the data.

In model calibration, the second step, we predicted the log likelihood of every IEI (or metric) at each site from the error distribution and fit of each model given the abundance of the taxon at the sites. The predictions from the 16 (no settings) or 32 (with a settings variable) different models were then averaged (based on the AIC weights) to make a single IEI log likelihood profile for each site and taxon.

Finally, in step three, we added together the log likelihood profiles of individual taxa to make a prediction for the site based on multiple taxa; the IEI with the greatest log likelihood was the predicted IEI. We used a stepwise procedure to select the taxa in which we started with the taxon that, by itself, produced the most accurate IEI prediction (highest concordance) and then incrementally added the taxon that increased the concordance correlation coefficient (Lin 1989, 2000) of the prediction the most.

We used concordance because it reflects both the correlation and the agreement of the metric and the IBI.

To reduce the potential to over fit the data we performed steps one through three (above) on 20 cross validation groups; in each group a different 5% of the sites was omitted and thus withheld from the model fitting process. The IEI of each site was then predicted (step 2) for each taxon based on the models from which the site was omitted. And in step 3 the taxa were selected based on how well they improved the cross validated prediction of IEI.

As an additional hedge against over fitting we created 1000 pseudospecies by randomly permuting the data from the original species. For each pseudospecies we performed the same model fitting (step 1) and calibration (step 2) as the real species. Then during taxon selection (step 3) we compared each selected taxon's improvement in fit to the improvement in fit garnered by each of the 1000 pseudospecies to estimate the significance of the improvement in fit of each taxon. We used this significance test to decide how many taxa to include in the final prediction set; we included all taxa up until the first taxon that didn't produce a significant increase in prediction accuracy.

The following analyses were completed.

1. All taxa in the Chicopee River watershed without settings variables for IEI (56 sites)
2. Plants only in the Chicopee River watershed without settings variables for IEI (68 sites)
3. Diatoms only in the Chicopee River watershed without settings variables for IEI (71 sites)
4. Plants, lichens and earthworms in the Chicopee River watershed without settings variables for IEI (68 sites)
5. Plants, lichens and earthworms in the Miller's, Concord and Chicopee River watersheds without settings variables for IEI (213 sites)
6. Plants, lichens and earthworms in the Miller's and Concord River watersheds without settings variables for IEI (145 sites)
7. Plants, lichens and earthworms in the Miller's and Concord River watersheds with settings variables for IEI (139 sites)
8. All taxa in the Chicopee River watershed without settings variables for the "Wetlands Buffer Insults" metric (56 sites)
9. Plants, lichens and earthworms in the Miller's, Concord and Chicopee River watersheds without settings variables for the "Wetlands Buffer Insults" metric (213 sites)
10. Plants, lichens and earthworms in the Miller's, Concord and Chicopee River watersheds without settings variables for the "Wetlands Buffer Insults" metric, log transformed (213 sites)

Results

For each of the analyses we created two figures and one table to summarize the results.

The first figure is a plot of the change in concordance as taxa are added in a stepwise fashion; at each step the taxa that yields the highest concordance when combined with the previously added taxa was selected. The blue lines indicate different criterion that could be used to choose a subset of taxa. We included taxa that were added prior to the first taxa that had a P-value greater than 0.05 (alpha = 0.05).

The table lists the taxa included in the model (in the order in which they were added) and the associated P-value.

The second figure is a plot of the response as predicted from species abundance (IBI score) against the "observed" response (CAPS model output).

1. <u>All taxa in the Chicopee River watershed without settings variables for IEI (56 sites)</u>

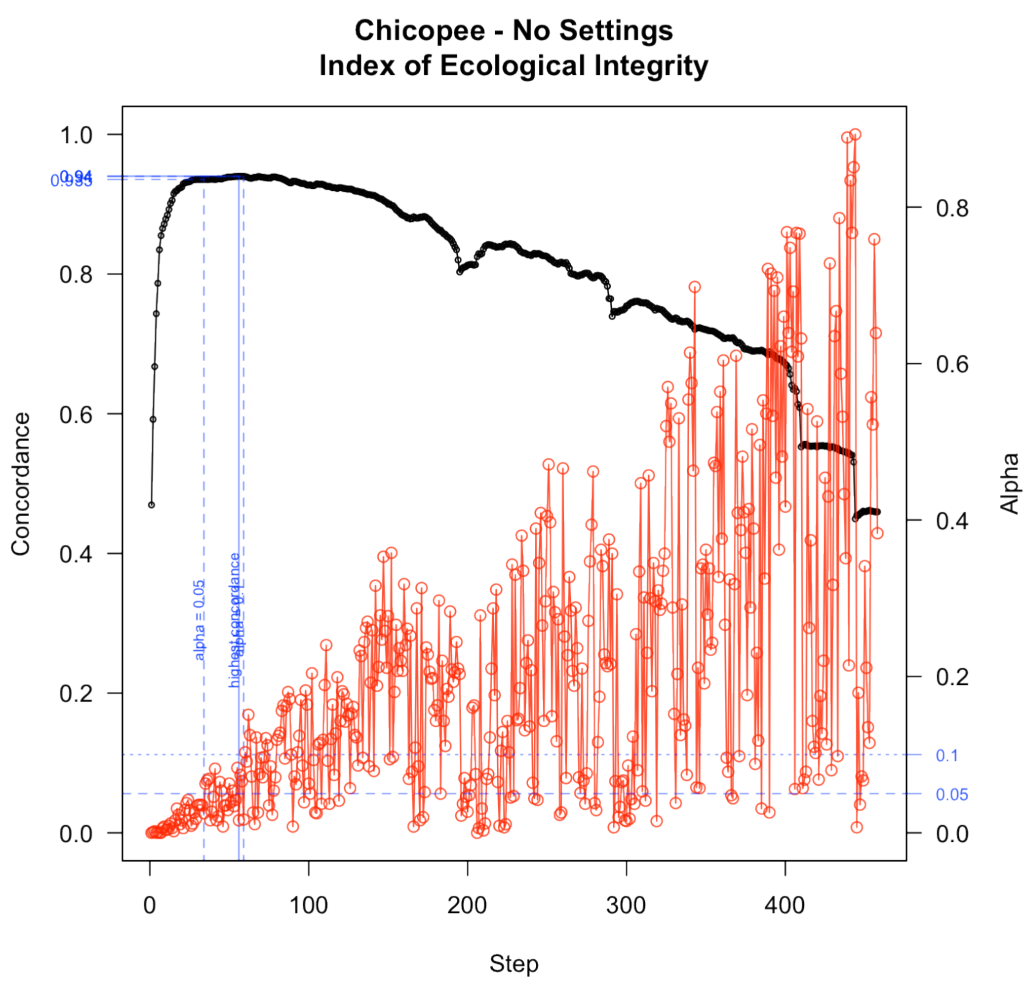

***Figure 1**. Plot of the change in concordance for IEI as taxa are added in a stepwise fashion for all taxa in the Chicopee River watershed analyzed without ecological settings variables.*

Table 7. *Taxa included in the model (in the order in which they were added) for IEI and the associated P-value for all taxa in the Chicopee River watershed analyzed without ecological settings variables.*

Taxa	p.value	Group	Taxonomic.level
Solidago rugosa var. rugosa	0	vascular.plants	species
Hemiptera	0.001	invertebrates	order
Encyonema minutum (Hilse in Rabenhorst) D.G. Mann	0.002	diatoms	species
Eubaeocera (Coleoptera)	0	invertebrates	genus
Brachyelytrum	0.001	vascular.plants	genus
Eunotia paludosa v. paludosa Grun.	0	diatoms	species
Onoclea sensibilis	0	vascular.plants	species
Eunotia pectinalis (O.F. Muller) Rabenhorst	0.006	diatoms	species
Pterostichus coracinus (Coleoptera)	0.008	invertebrates	species
Neidium bisucatum (Lagerst.) Cl.	0.004	diatoms	species
Poaceae.1	0.004	vascular.plants	family
Rosaceae	0.009	vascular.plants	family
Rhododendron	0.012	vascular.plants	genus
Ceraphronidae (Hymenoptera)	0.006	invertebrates	family
Kalmia latifolia	0.002	vascular.plants	species
Synuchus impunctatus (Coleoptera)	0.016	invertebrates	species
Carabidlarva (Coleoptera)	0.031	invertebrates	genus
Acer	0.023	vascular.plants	genus
Leucobryum glaucum	0.011	bryophytes	Species
Betula lenta	0.016	vascular.plants	species
Pinnularia	0.006	diatoms	genus
Lasius niger gr. (Hymenoptera)	0.029	invertebrates	species
Teleasini (Hymenoptera)	0.038	invertebrates	tribe
Pinnularia rupestris Hantzsch	0.042	diatoms	species
Osmunda regalis var. spectabilis	0.029	vascular.plants	species
Carya	0.009	vascular.plants	genus
Iris	0.012	vascular.plants	genus
Betula populifolia	0.026	vascular.plants	species
Bazzania trilobata	0.018	bryophytes	Species
Polytrichum commune	0.035	bryophytes	Species
Calypogeia muelleriana	0.036	bryophytes	Species
Nitzschia	0.036	diatoms	genus
Maianthemum canadense	0.035	vascular.plants	species
Pinnularia termitina (Ehr.) Patr.	0.025	diatoms	species

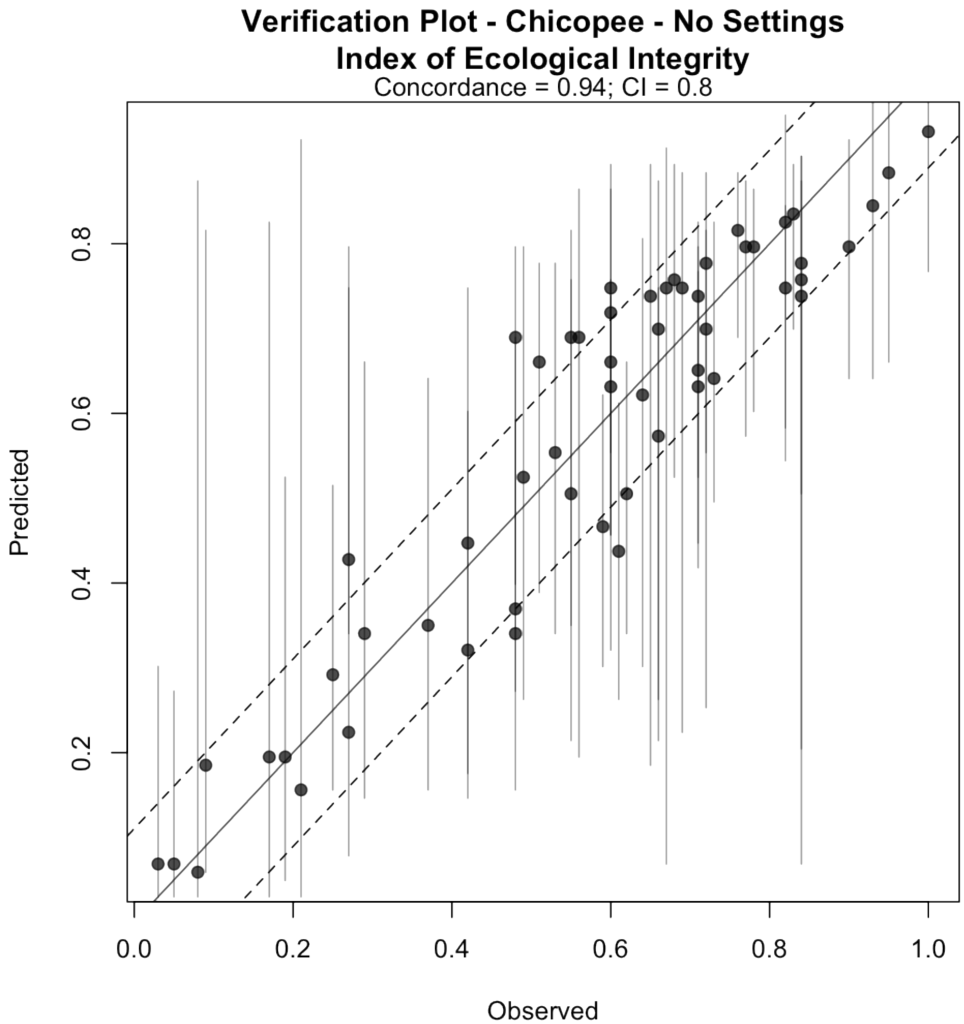

***Figure 2**. Verification plot of IEI vs. IBI concordance for all taxa in the Chicopee River watershed analyzed without ecological settings variables (concordance = 0.94). Dotted lines are set to contain 80 percent of sites (40% above and 40% below the solid line).*

2. <u>Plants only in the Chicopee River watershed without settings variables for IEI (68 sites)</u>

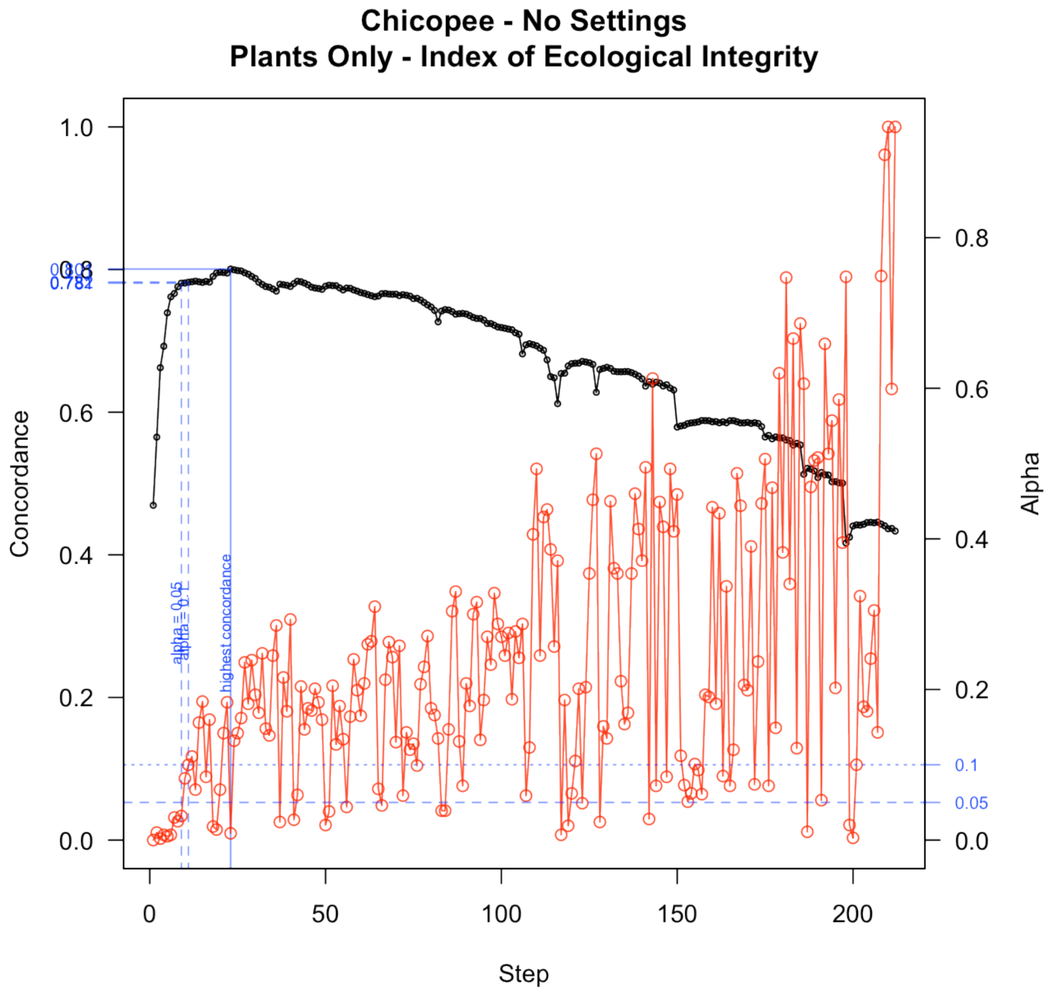

Figure 3*. Plot of the change in concordance for IEI as taxa are added in a stepwise fashion for vascular plants in the Chicopee River watershed analyzed without ecological settings variables.*

Table 8*. Taxa included in the model (in the order in which they were added) for IEI and the associated P-value for vascular plants in the Chicopee River watershed analyzed without ecological settings variables.*

Taxa	p.value	Group	Taxonomic.level
Solidago rugosa var. rugosa	0	vascular.plants	species
Bidens	0.010	vascular.plants	genus
Onoclea sensibilis	0.002	vascular.plants	species
Medeola virginiana	0.007	vascular.plants	species
Lyonia ligustrina	0.005	vascular.plants	species
Hamamelis virginiana	0.007	vascular.plants	species
Celastraceae	0.030	vascular.plants	family
Carex trisperma var. trisperma	0.025	vascular.plants	species
Cyperaceae	0.032	vascular.plants	family

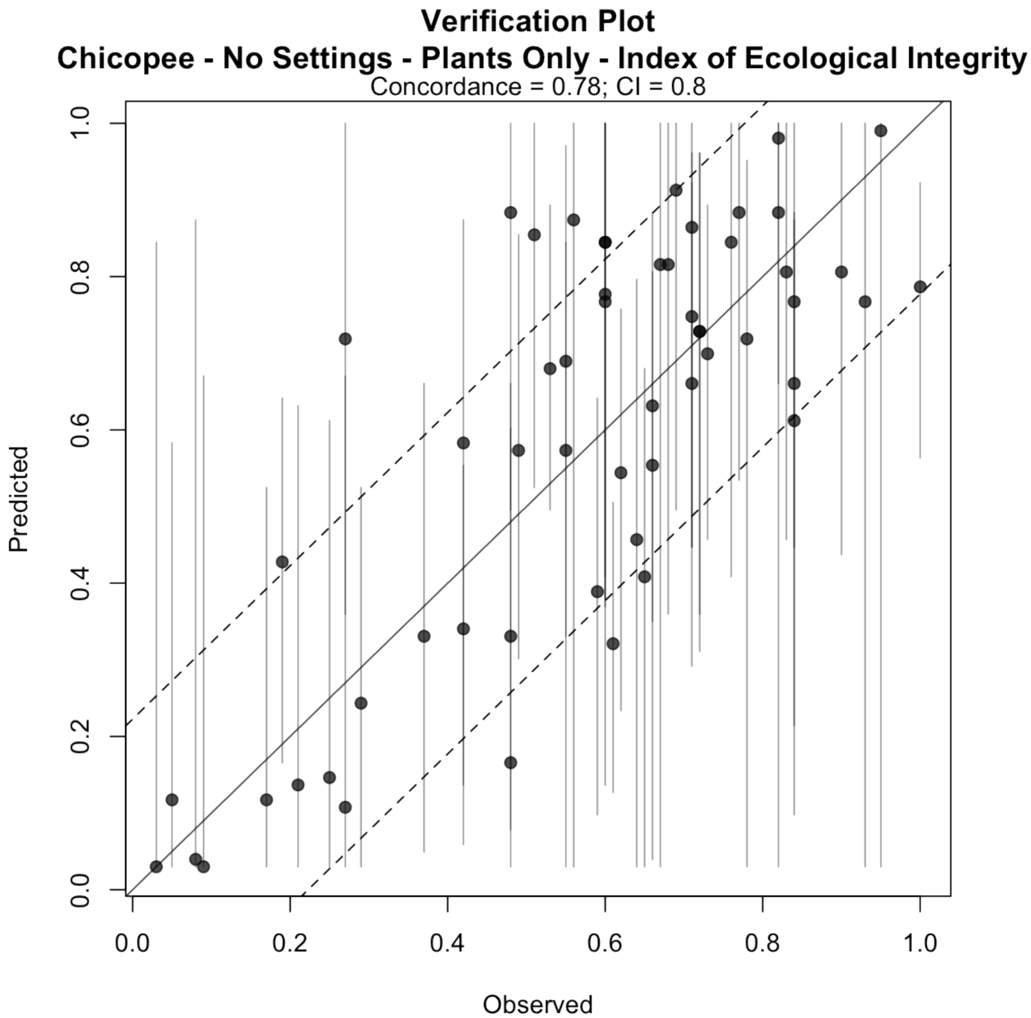

***Figure 4**. Verification plot of IEI vs. IBI concordance for vascular plants in the Chicopee River watershed analyzed without ecological settings variables (concordance = 0.78). Dotted lines are set to contain 80 percent of sites (40% above and 40% below the solid line).*

3. <u>Diatoms only in the Chicopee River watershed without settings variables for IEI (71 sites)</u>

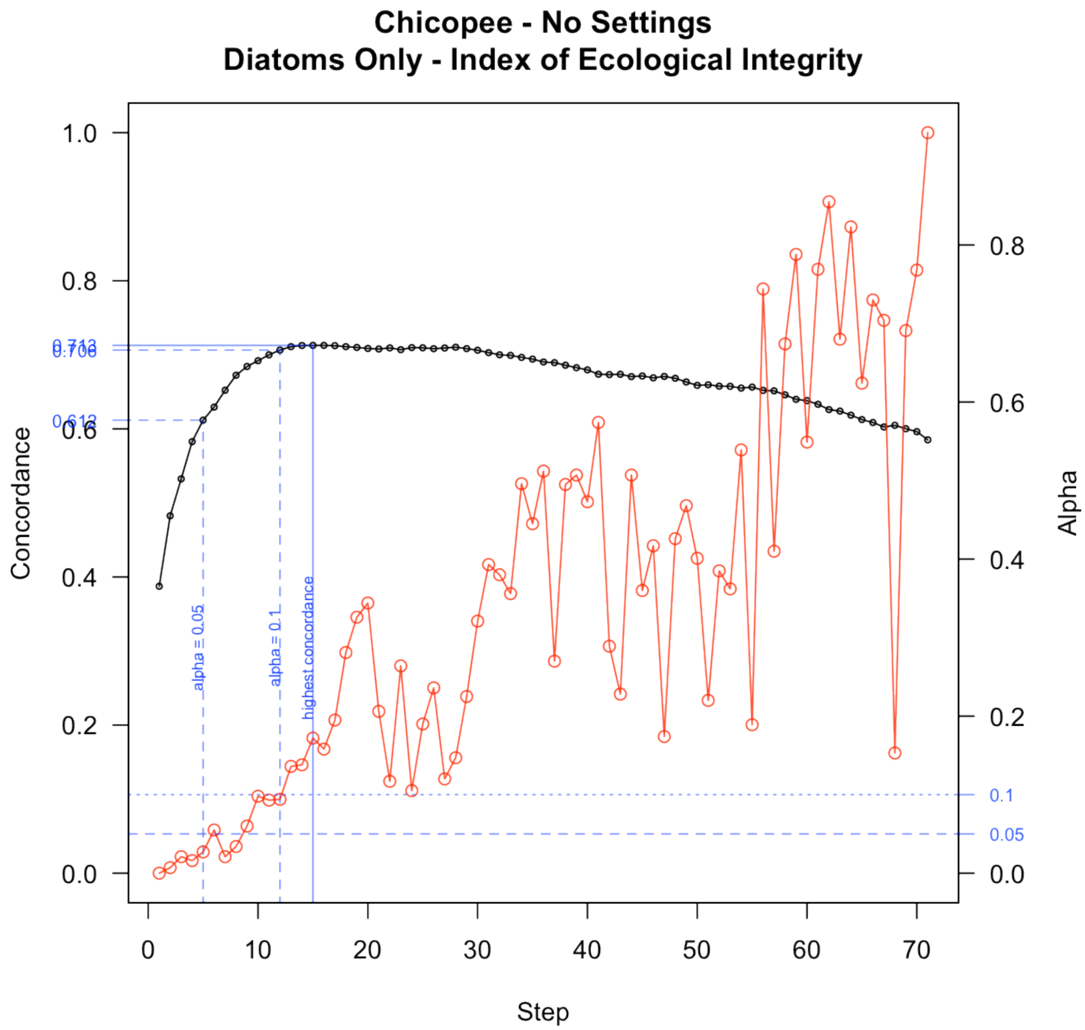

***Figure 5**. Plot of the change in concordance for IEI as taxa are added in a stepwise fashion for diatoms in the Chicopee River watershed analyzed without ecological settings variables.*

***Table 9**. Taxa included in the model (in the order in which they were added) for IEI and the associated P-value for diatoms in the Chicopee River watershed analyzed without ecological settings variables.*

Taxa	p.value	Group	Taxonomic.level
Eunotia	0	diatoms	genus
Pinnularia	0.007	diatoms	genus
Frustulia saxonica Rabh	0.021	diatoms	species
Synedra	0.016	diatoms	genus
Encyonema minutum (Hilse in Rabenhorst) D.G. Mann	0.027	diatoms	species

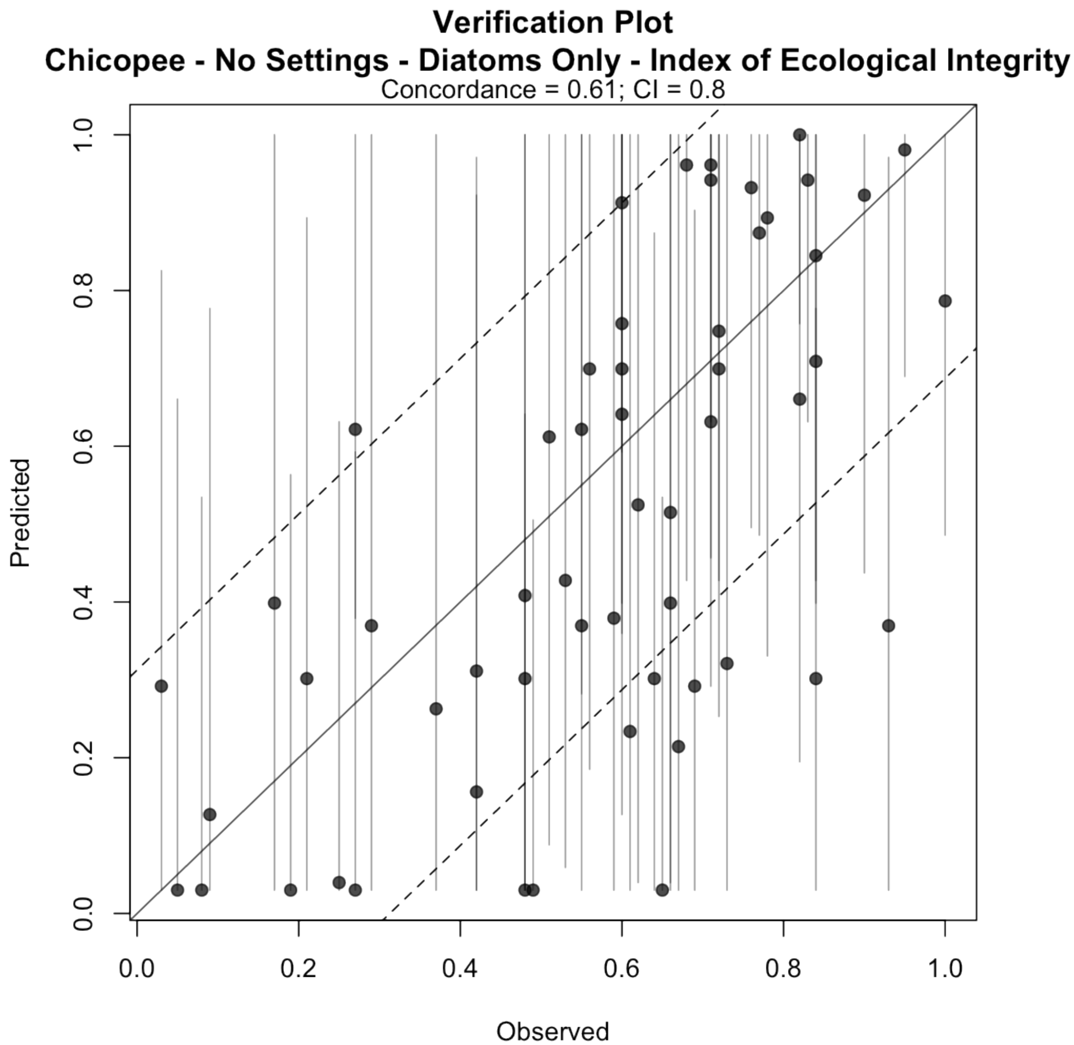

***Figure 6**. Verification plot of IEI vs. IBI concordance for diatoms in the Chicopee River watershed analyzed without ecological settings variables (concordance = 0.61). Dotted lines are set to contain 80 percent of sites (40% above and 40% below the solid line).*

4. Plants, lichens and earthworms in the Chicopee River watershed without settings variables for IEI (68 sites)

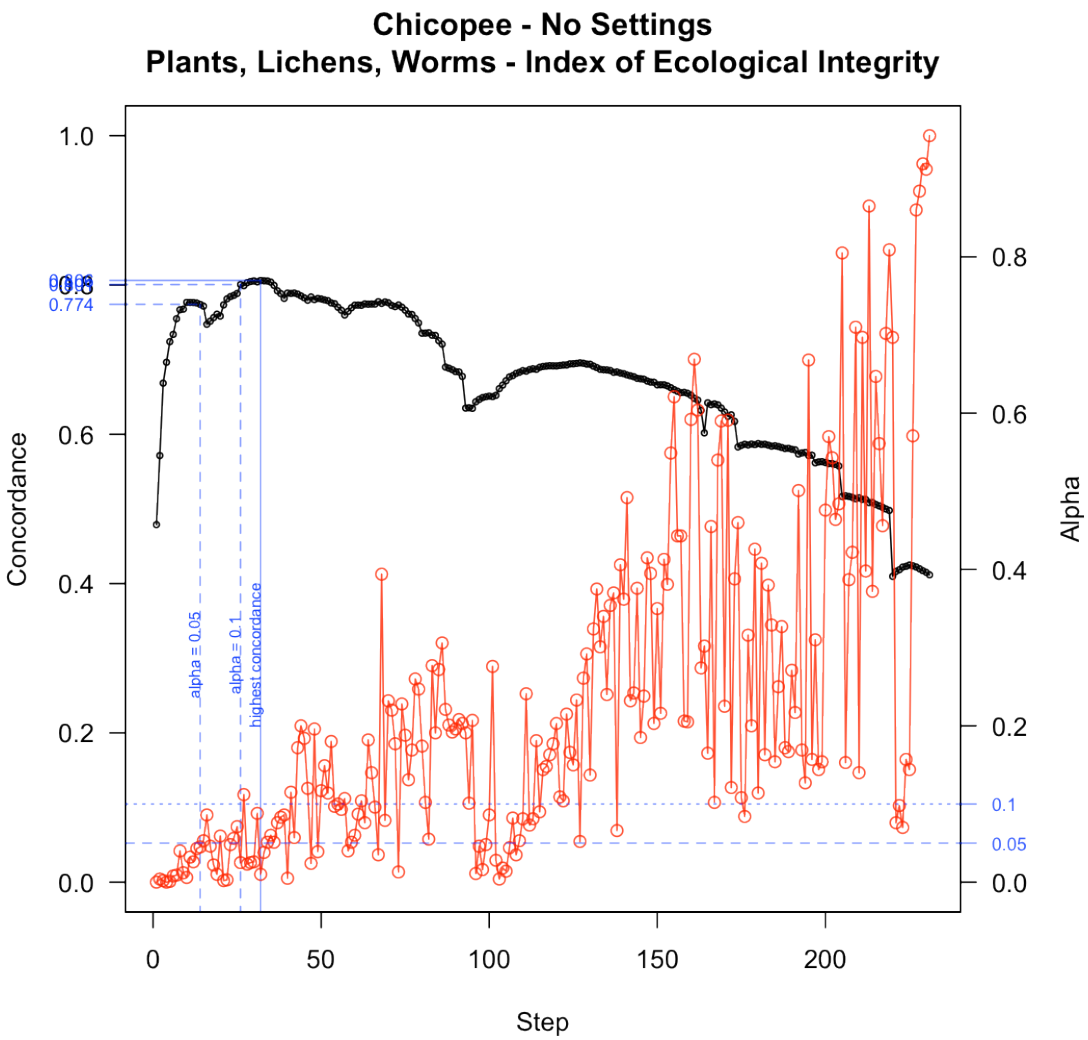

Figure 7. *Plot of the change in concordance for IEI as taxa are added in a stepwise fashion for vascular plants, lichens and earthworms in the Chicopee River watershed analyzed without ecological settings variables.*

Table 10. *Taxa included in the model (in the order in which they were added) for IEI and the associated P-value for vascular plants, lichens and earthworms in the Chicopee River watershed analyzed without ecological settings variables.*

Taxa	p.value	Group	Taxonomic.level
Solidago rugosa var. rugosa	0	vascular.plants	species
Bidens	0.004	vascular.plants	genus
Pinus strobus	0.002	vascular.plants	species
Liliaceae	0	vascular.plants	family
Onoclea sensibilis	0.001	vascular.plants	species
Rubiaceae	0.008	vascular.plants	family
Prunus	0.009	vascular.plants	genus
Viburnum	0.04	vascular.plants	genus
Maianthemum	0.012	vascular.plants	genus
Lysimachia terrestris	0.006	vascular.plants	species
Maianthemum canadense	0.032	vascular.plants	species
Betula populifolia	0.026	vascular.plants	species
Rhododendron viscosum	0.043	vascular.plants	species
Polygonum	0.045	vascular.plants	genus

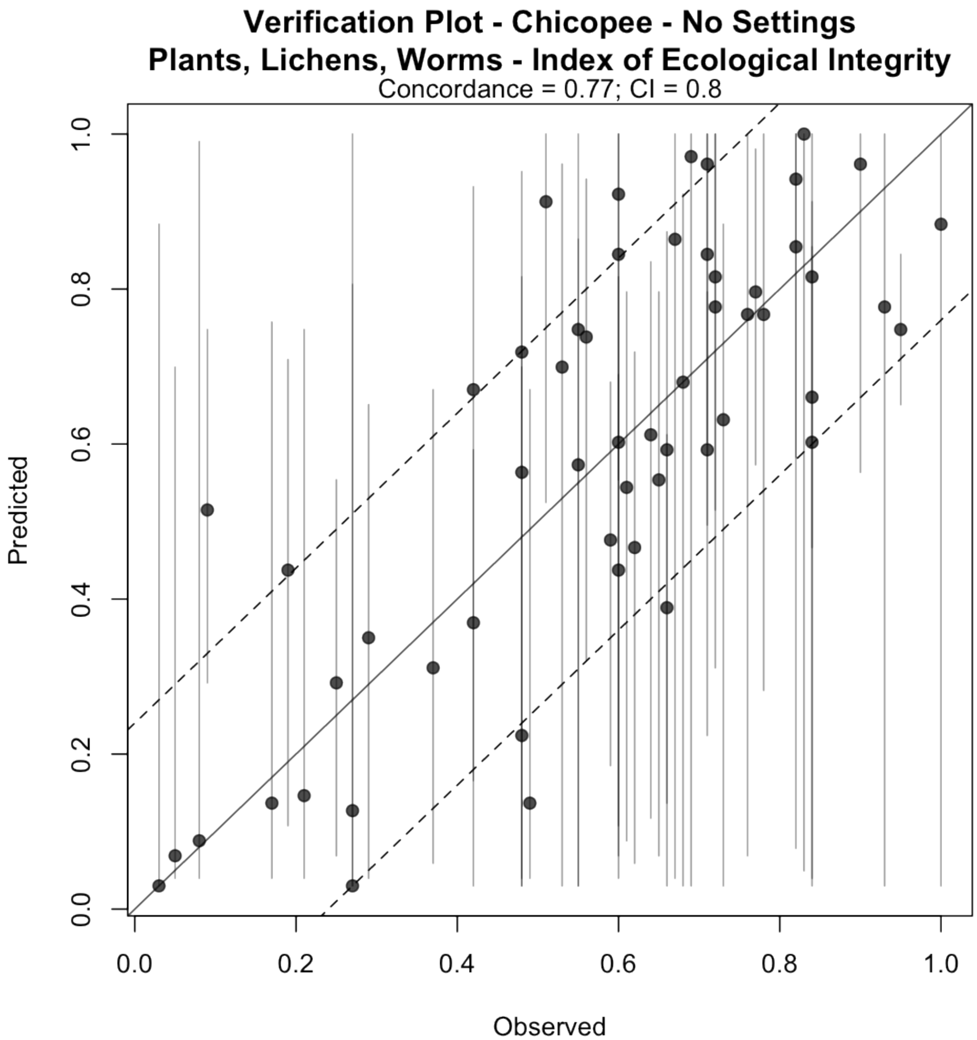

Figure 8*. Verification plot of IEI vs. IBI concordance for vascular plants, lichens and earthworms in the Chicopee River watershed analyzed without ecological settings variables (concordance = 0.77). Dotted lines are set to contain 80 percent of sites (40% above and 40% below the solid line).*

5. Plants, lichens and earthworms in the Miller's, Concord and Chicopee River watersheds without settings variables for IEI (213 sites)

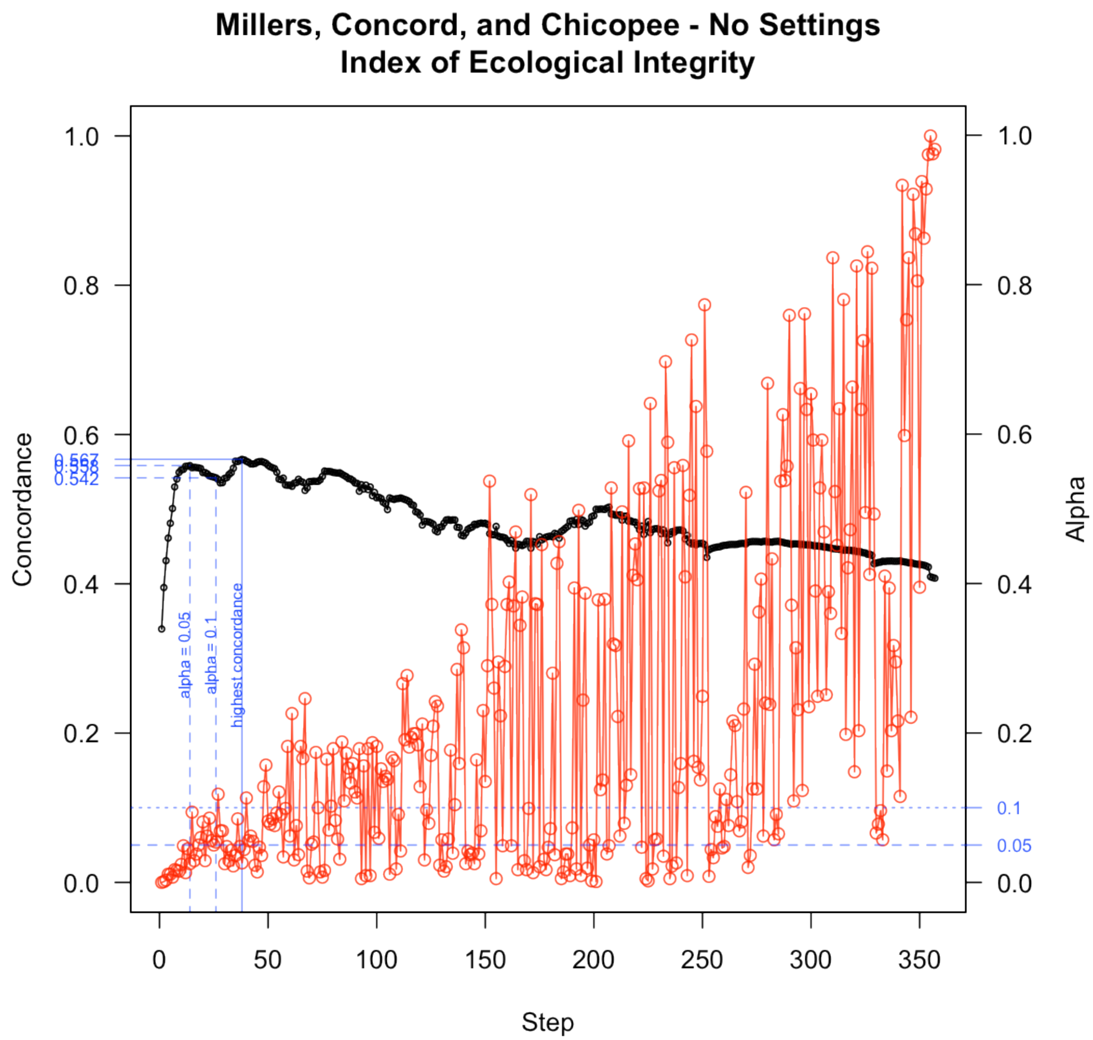

Figure 9*. Plot of the change in concordance for IEI as taxa are added in a stepwise fashion for vascular plants, lichens and earthworms in the Miller's, Concord and Chicopee River watersheds analyzed without ecological settings variables.*

Table 11. *Taxa included in the model (in the order in which they were added) for IEI and the associated P-value for vascular plants, lichens and earthworms in the Miller's, Concord and Chicopee River watersheds analyzed without ecological settings variables.*

Taxa	p.value	Group	Taxonomic.level
Impatiens capensis	0	vascular.plants	species
Osmunda	0.001	vascular.plants	genus
Lumbricidae	0.003	worms	family
Punctelia	0.011	lichens	genus
Symphyotrichum	0.011	vascular.plants	genus
Medeola virginiana	0.007	vascular.plants	species
Cornus alternifolia	0.017	vascular.plants	species
Triadenum virginicum	0.016	vascular.plants	species
Clematis virginiana	0.015	vascular.plants	species
Populus tremuloides	0.024	vascular.plants	species
Bidens tripartita	0.049	vascular.plants	species
Rubus idaeus ssp. idaeus	0.013	vascular.plants	species
Myelochroa	0.045	lichens	genus
Salicaceae	0.025	vascular.plants	family

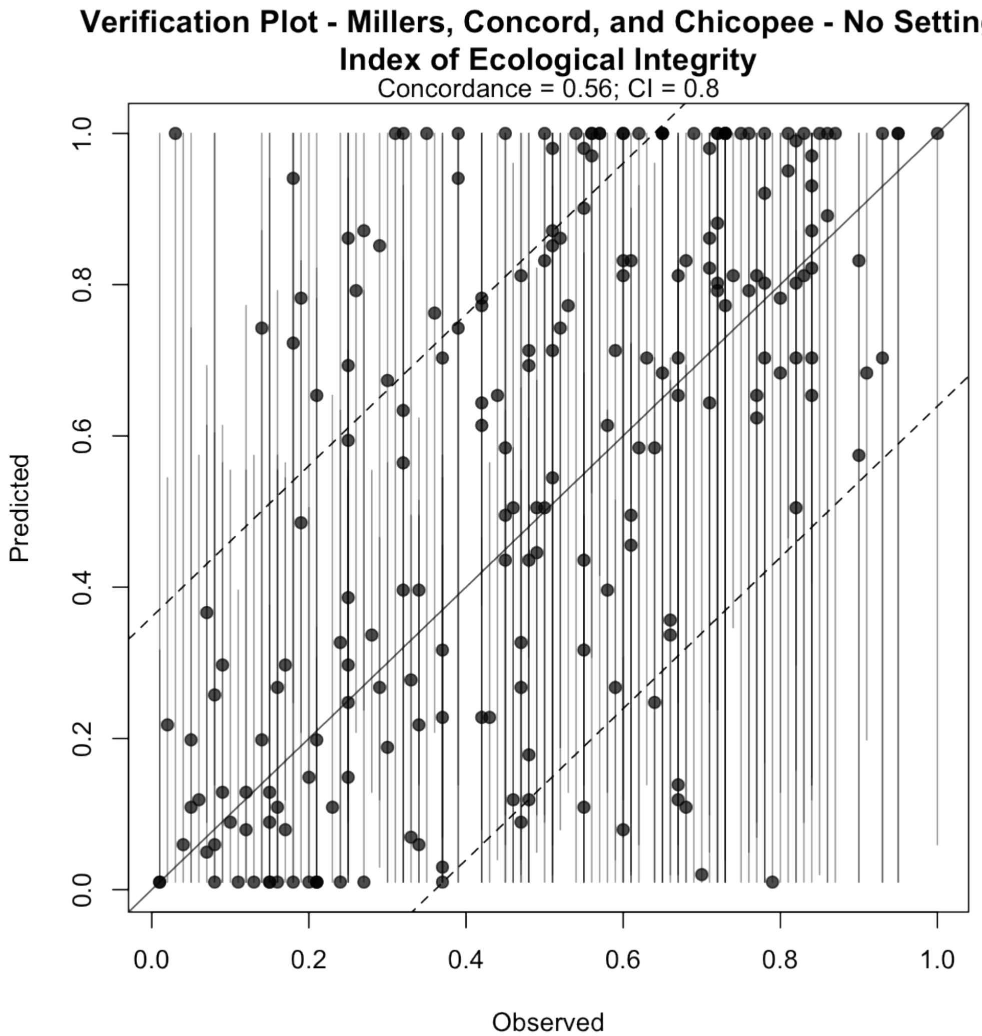

Figure 10*. Verification plot of IEI vs. IBI concordance for vascular plants, lichens and earthworms in the Miller's, Concord and Chicopee River watersheds analyzed without ecological settings variables (concordance = 0.56). Dotted lines are set to contain 80 percent of sites (40% above and 40% below the solid line).*

6. Plants, lichens and earthworms in the Miller's and Concord River watersheds without settings variables for IEI (145 sites)

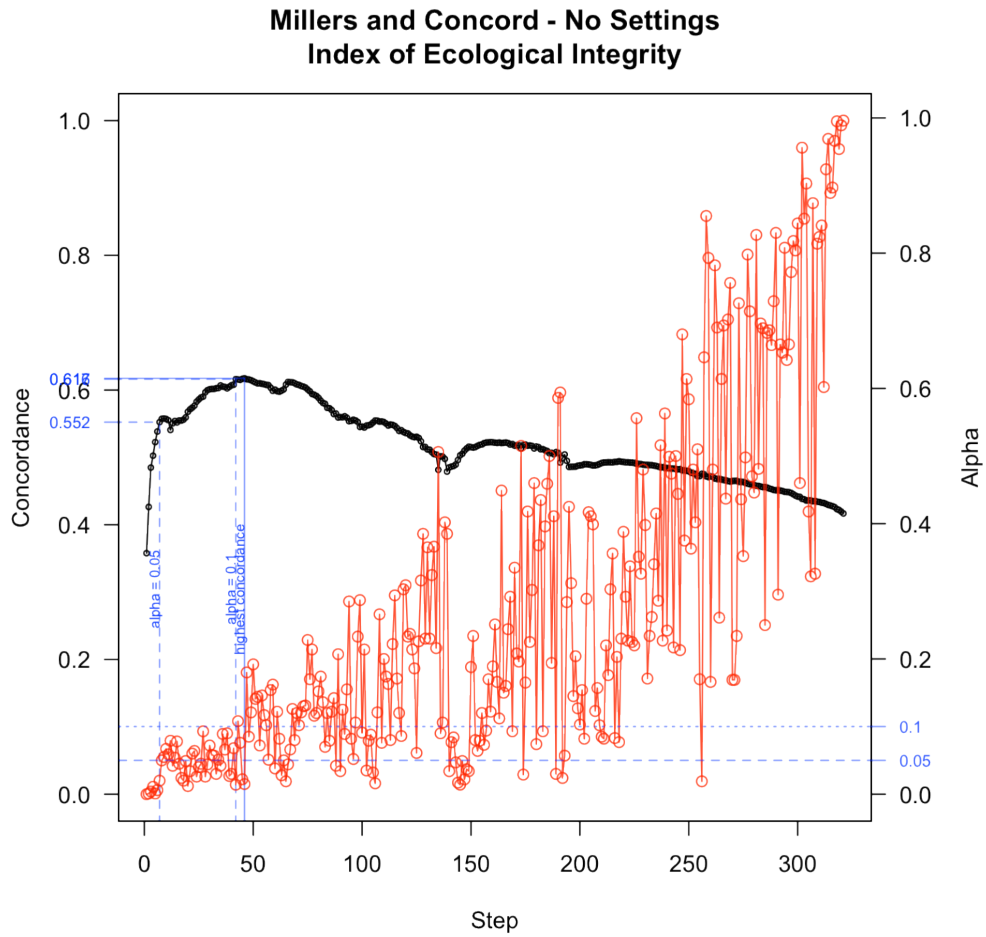

Figure 11. *Plot of the change in concordance for IEI as taxa are added in a stepwise fashion for vascular plants, lichens and earthworms in the Miller's and Concord River watersheds analyzed without ecological settings variables.*

Table 12. *Taxa included in the model (in the order in which they were added) for IEI and the associated P-value for vascular plants, lichens and earthworms in the Miller's and Concord River watersheds analyzed without ecological settings variables.*

Taxa	p.value	Group	Taxonomic.level
Impatiens capensis	0	vascular.plants	species
Punctelia	0.001	lichens	genus
Medeola virginiana	0.004	vascular.plants	species
Fraxinus nigra	0.011	vascular.plants	species
Triadenum virginicum	0.001	vascular.plants	species
Cornus alternifolia	0.006	vascular.plants	species
Oclemena acuminata	0.02	vascular.plants	species

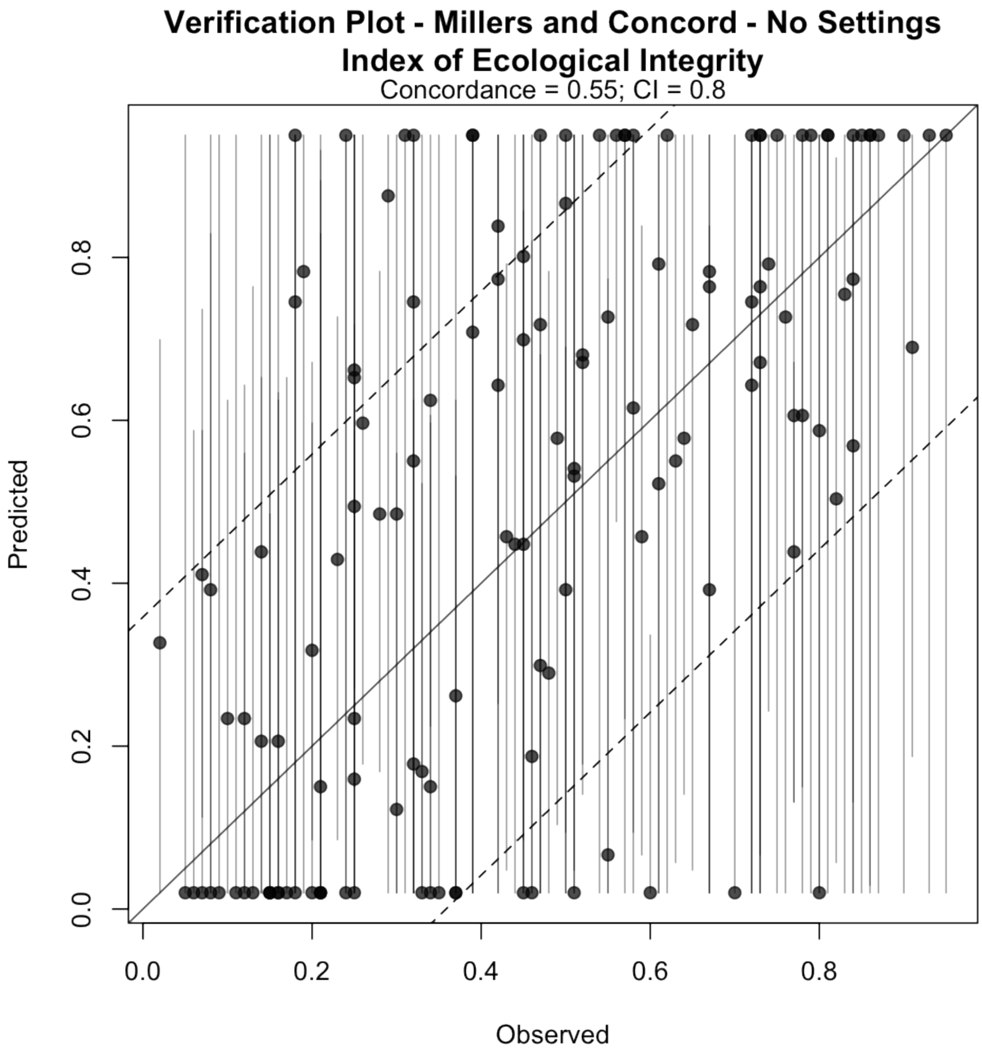

***Figure 12**. Verification plot of IEI vs. IBI concordance for vascular plants, lichens and earthworms in the Miller's and Concord River watersheds analyzed without ecological settings variables (concordance = 0.55). Dotted lines are set to contain 80 percent of sites (40% above and 40% below the solid line).*

7. Plants, lichens and earthworms in the Miller's and Concord River watersheds with settings variables for IEI (139 sites)

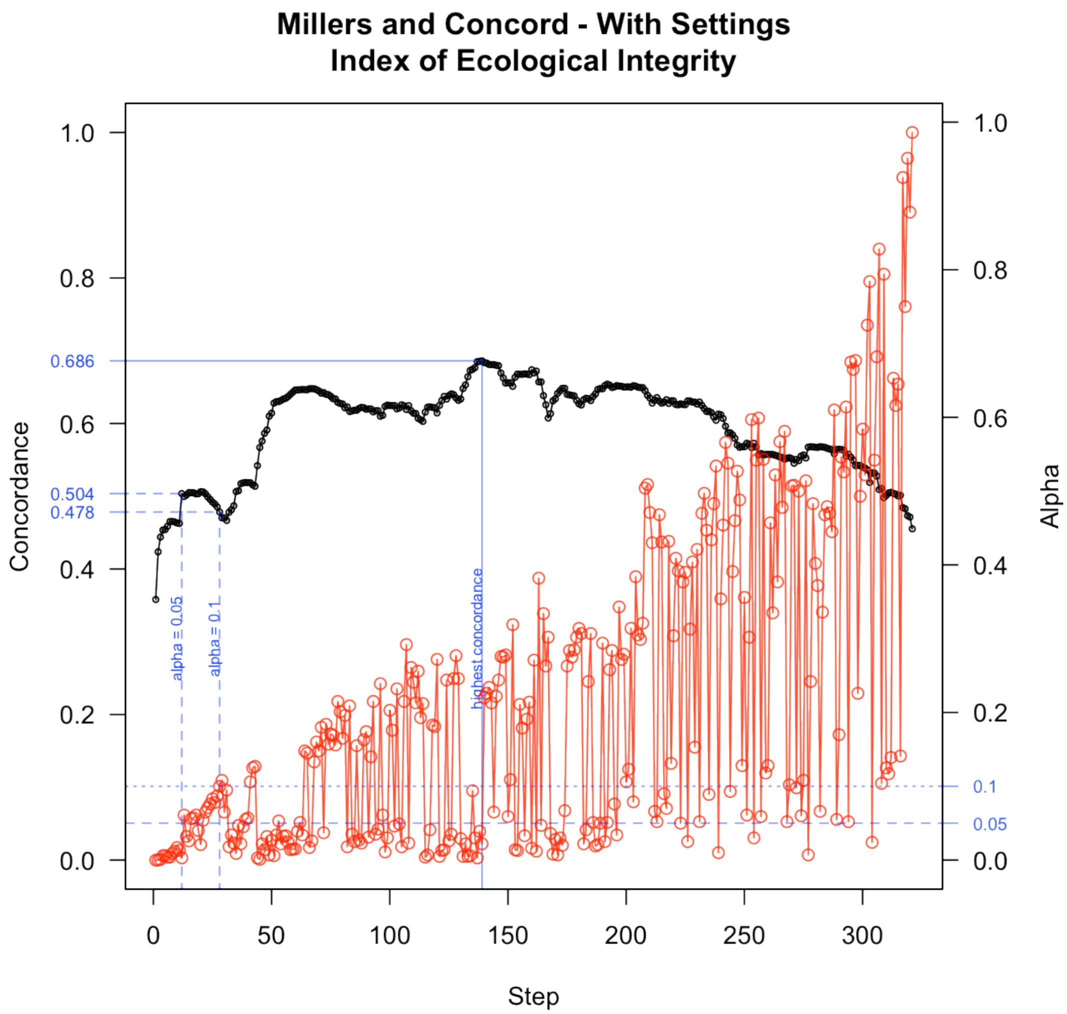

Figure 13*. Plot of the change in concordance for IEI as taxa are added in a stepwise fashion for vascular plants, lichens and earthworms in the Miller's and Concord River watersheds analyzed with ecological settings variables.*

***Table 13**. Taxa included in the model (in the order in which they were added) for IEI and the associated P-value for vascular plants, lichens and earthworms in the Miller's and Concord River watersheds analyzed with ecological settings variables.*

Taxa	p.value	Group	Taxonomic.level
Onoclea sensibilis	0	vascular.plants	species
Maianthemum racemosum	0	vascular.plants	species
Lumbricus	0.001	worms	genus
Rosa multiflora	0.006	vascular.plants	species
Phaeophyscia pusilloides	0.006	lichens	species
Geranium maculatum	0.004	vascular.plants	species
Onoclea	0.004	vascular.plants	genus
worm middens	0.009	middens	NA
Rosa	0.012	vascular.plants	genus
Geranium	0.017	vascular.plants	genus
Solanum dulcamara	0.013	vascular.plants	species
Rhododendron viscosum	0.003	vascular.plants	species

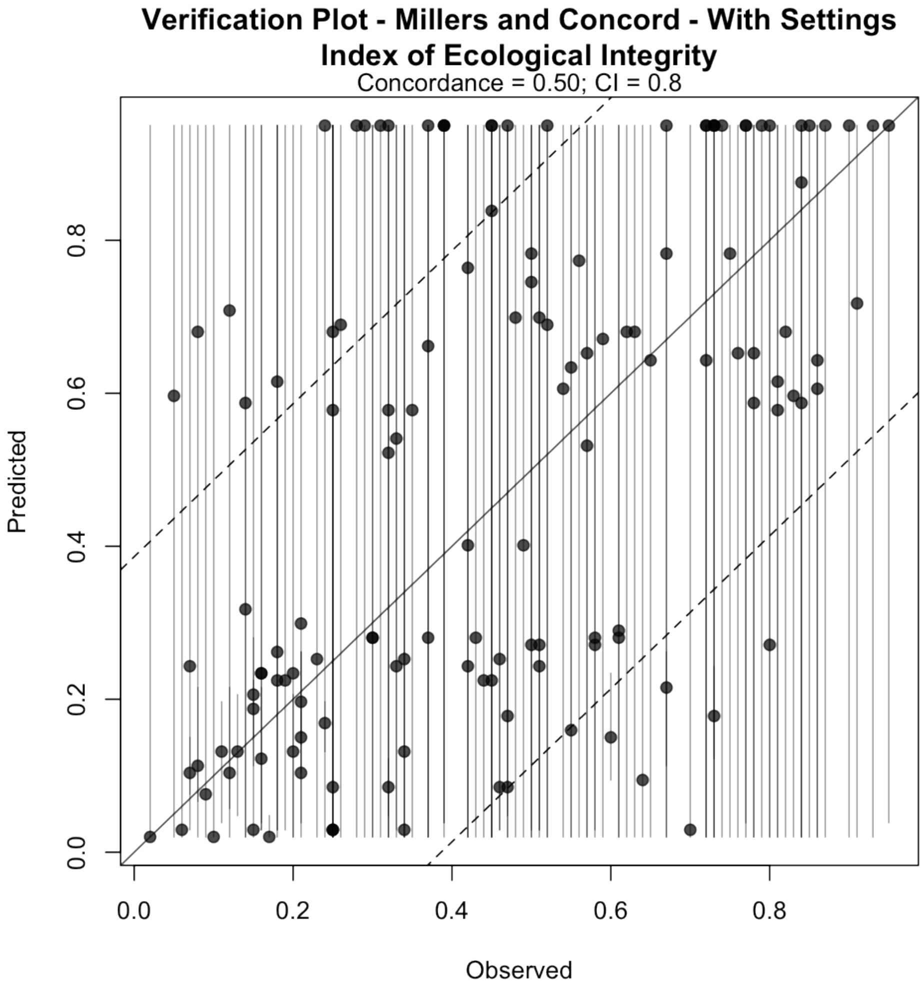

Figure 14. *Verification plot of IEI vs. IBI concordance for vascular plants, lichens and earthworms in the Miller's, Concord and Chicopee River watersheds analyzed with ecological settings variables (concordance = 0.50). Dotted lines are set to contain 80 percent of sites (40% above and 40% below the solid line).*

8. All taxa in the Chicopee River watershed without settings variables for the “Wetlands Buffer Insults” metric (56 sites)

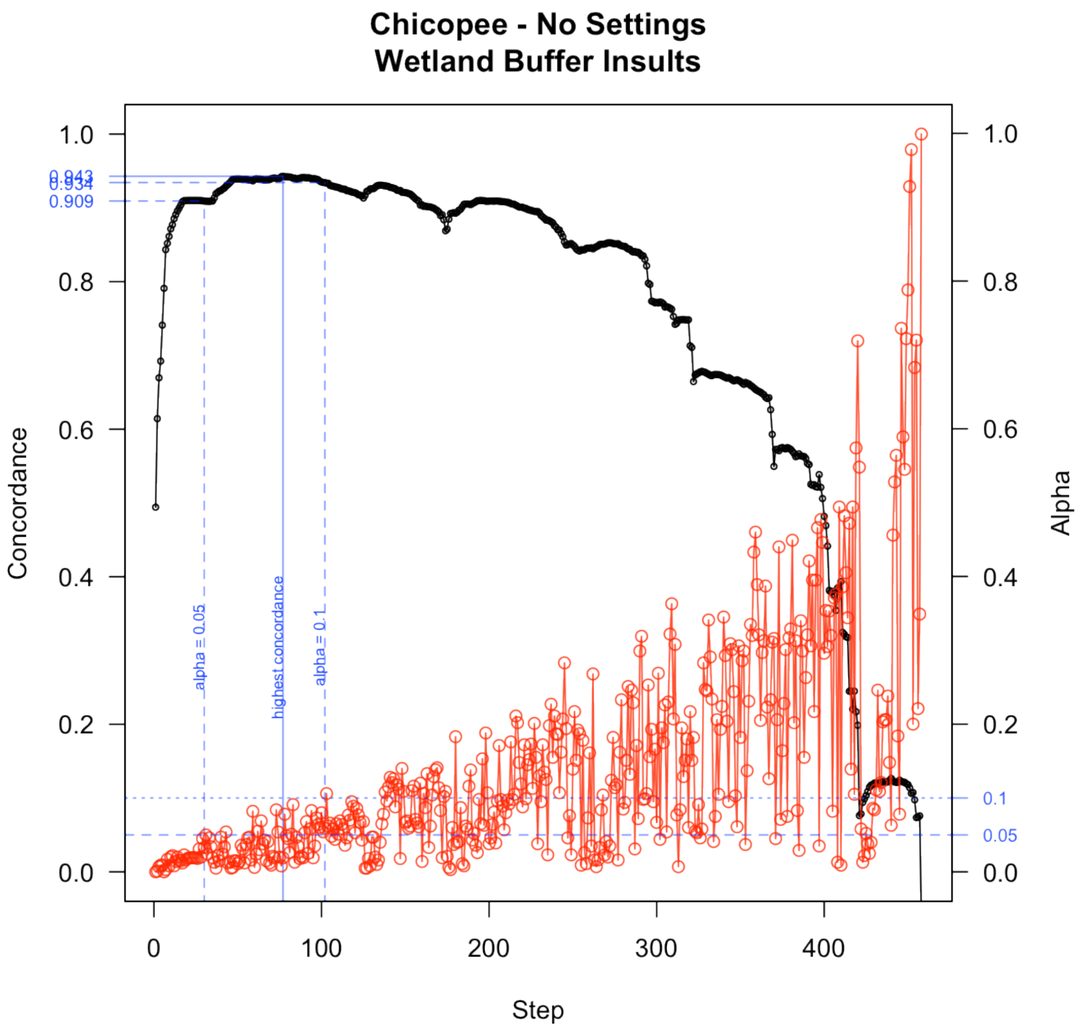

Figure 15. *Plot of the change in concordance for the “Wetlands Buffer Insults” metric as taxa are added in a stepwise fashion for all taxa in the Chicopee River watershed analyzed without ecological settings variables.*

Table 14. *Taxa included in the model (in the order in which they were added) for the "Wetlands Buffer Insults" metric and the associated P-value for all taxa in the Chicopee River watershed analyzed without ecological settings variables.*

Taxa	p.value	Group	Taxonomic.level
Nitzschia cf. palustris Hust.	0	diatoms	species
Rubus	0.001	vascular.plants	genus
Betula lenta	0.007	vascular.plants	species
Synedra	0.009	diatoms	genus
Quercus rubra	0.009	vascular.plants	species
Thalictrum pubescens	0	vascular.plants	species
Carabidlarva (Coleoptera)	0.003	invertebrates	genus
Flavoparmelia caperata	0.017	lichens	species
Clematis virginiana	0.008	vascular.plants	species
Dryopteris	0.02	vascular.plants	genus
Dicyrtoma (Collembola)	0.022	invertebrates	genus
Rhaphidophoridae (Orthoptera)	0.008	invertebrates	family
Bidens	0.014	vascular.plants	genus
Rubus hispidus	0.02	vascular.plants	species
Entomobryidae (Collembola)	0.016	invertebrates	family
Eunotia tautoniensis Hust. Ex Patrick	0.015	diatoms	species
Lyonia ligustrina	0.012	vascular.plants	species
Prunus serotina	0.023	vascular.plants	species
Meridion	0.016	diatoms	genus
Meridion circulare (Greville) Agardh	0.018	diatoms	species
Atrichum altecristatum	0.019	bryophytes	Species
Climacium americanum	0.019	bryophytes	Species
Leucobryum glaucum	0.019	bryophytes	Species
Polytrichum commune	0.019	bryophytes	Species
Nitzschia acidoclinata Lange Bertalot Hust.	0.019	diatoms	species
Nitzschia	0.018	diatoms	genus
worm middens	0.031	middens	NA
Bacillariaceae	0.02	diatoms	family
Maianthemum canadense	0.045	vascular.plants	species
Gomphonema parvulum (Kutz.) Kutz.	0.033	diatoms	species

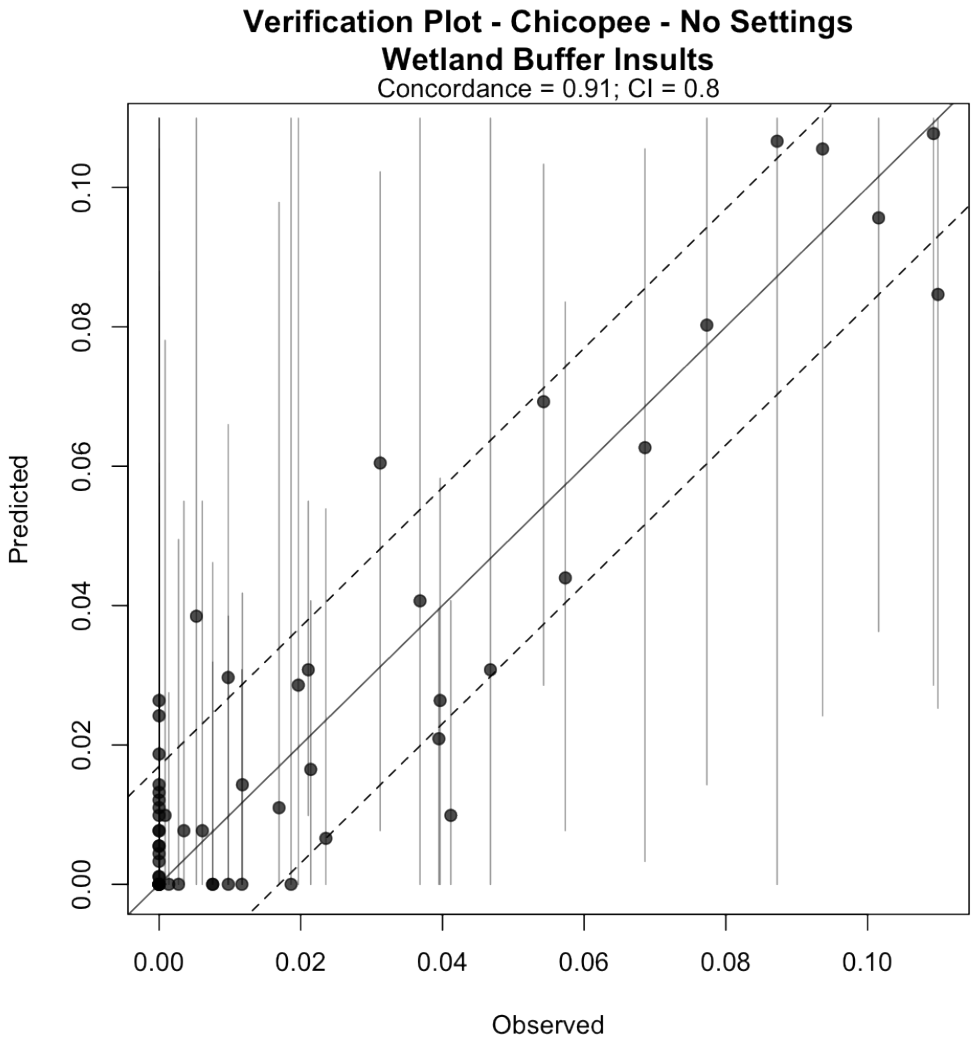

Figure 16*. Verification plot of "Wetlands Buffer Insults" metric vs. IBI concordance for all taxa in the Chicopee River watershed analyzed without ecological settings variables (concordance = 0.91). Dotted lines are set to contain 80 percent of sites (40% above and 40% below the solid line).*

9. Plants, lichens and earthworms in the Miller's, Concord and Chicopee River watersheds without settings variables for the "Wetlands Buffer Insults" metric (213 sites)

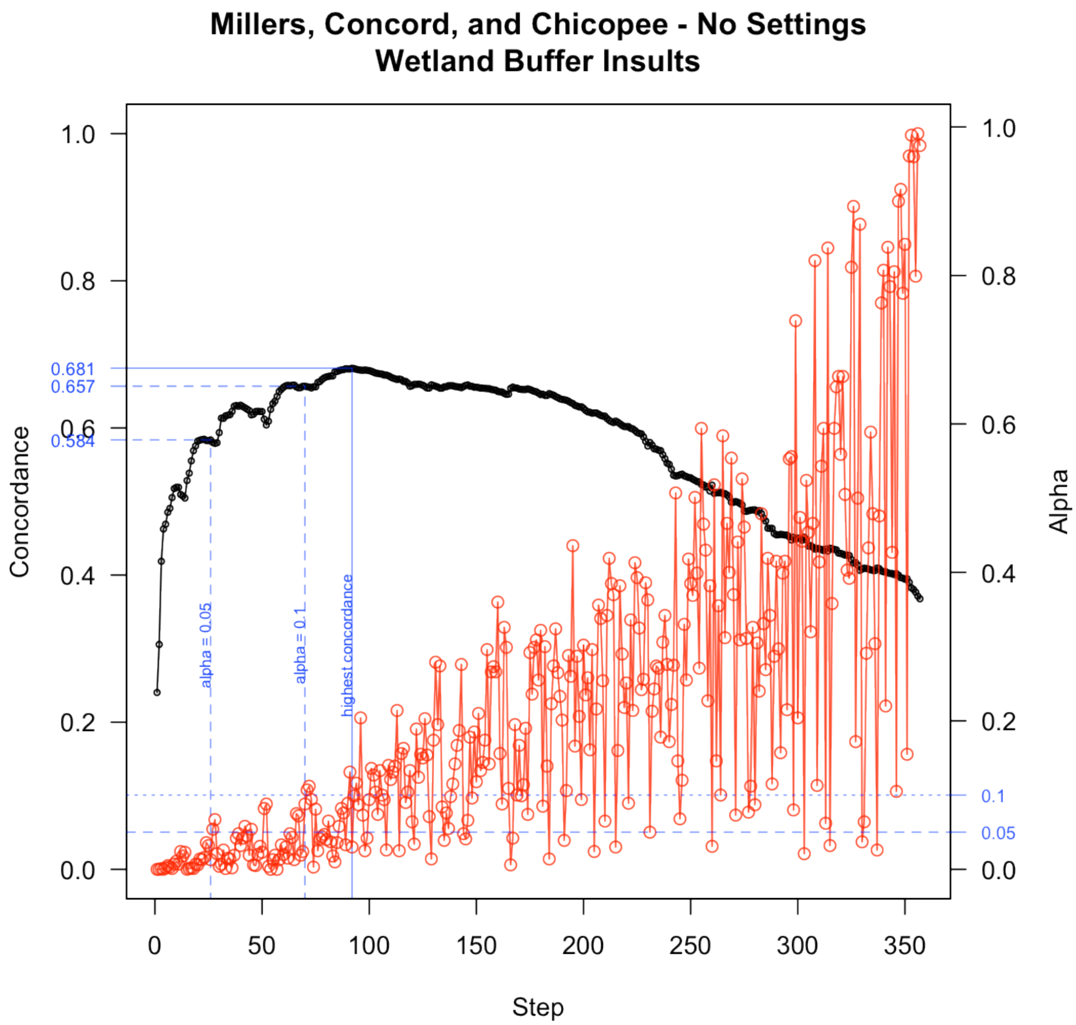

Figure 17. *Plot of the change in concordance for "Wetland Buffer Insults" metric as taxa are added in a stepwise fashion for vascular plants, lichens and earthworms in the Miller's, Concord and Chicopee River watersheds analyzed without ecological settings variables.*

Table 15. *Taxa included in the model (in the order in which they were added) for the "Wetlands Buffer Insults" metric and the associated P-value for vascular plants, lichens and earthworms in the Miller's, Concord and Chicopee River watersheds analyzed without ecological settings variables.*

Taxa	p.value	Group	Taxonomic.level
Physcia	0	lichens	genus
Rhamnaceae	0	vascular.plants	family
Geranium maculatum	0.001	vascular.plants	species
Acer platanoides	0	vascular.plants	species
Dryopteris carthusiana	0.002	vascular.plants	species
Caprifoliaceae	0.005	vascular.plants	family
Malus pumila	0.003	vascular.plants	species
Carya ovata	0.001	vascular.plants	species
Carex gracillima	0.007	vascular.plants	species
Fragaria virginiana	0.011	vascular.plants	species
worm middens	0.007	middens	NA
Thelypteris	0.024	vascular.plants	genus
Cladonia squamosa	0.018	lichens	species
Caltha palustris	0.023	vascular.plants	species
Clethra alnifolia	0	vascular.plants	species
Clethra	0.001	vascular.plants	genus
Lysimachia ciliata	0.002	vascular.plants	species
Taxus	0.001	vascular.plants	genus
Punctelia perreticulata	0.007	lichens	species
Clethraceae	0.006	vascular.plants	family
Dendrobaena octaedra	0.014	worms	species
Ribes	0.013	vascular.plants	genus
Rosa palustris	0.016	vascular.plants	species
Dendrobaena	0.036	worms	genus
Populus tremuloides	0.032	vascular.plants	species
Larix laricina	0.013	vascular.plants	species

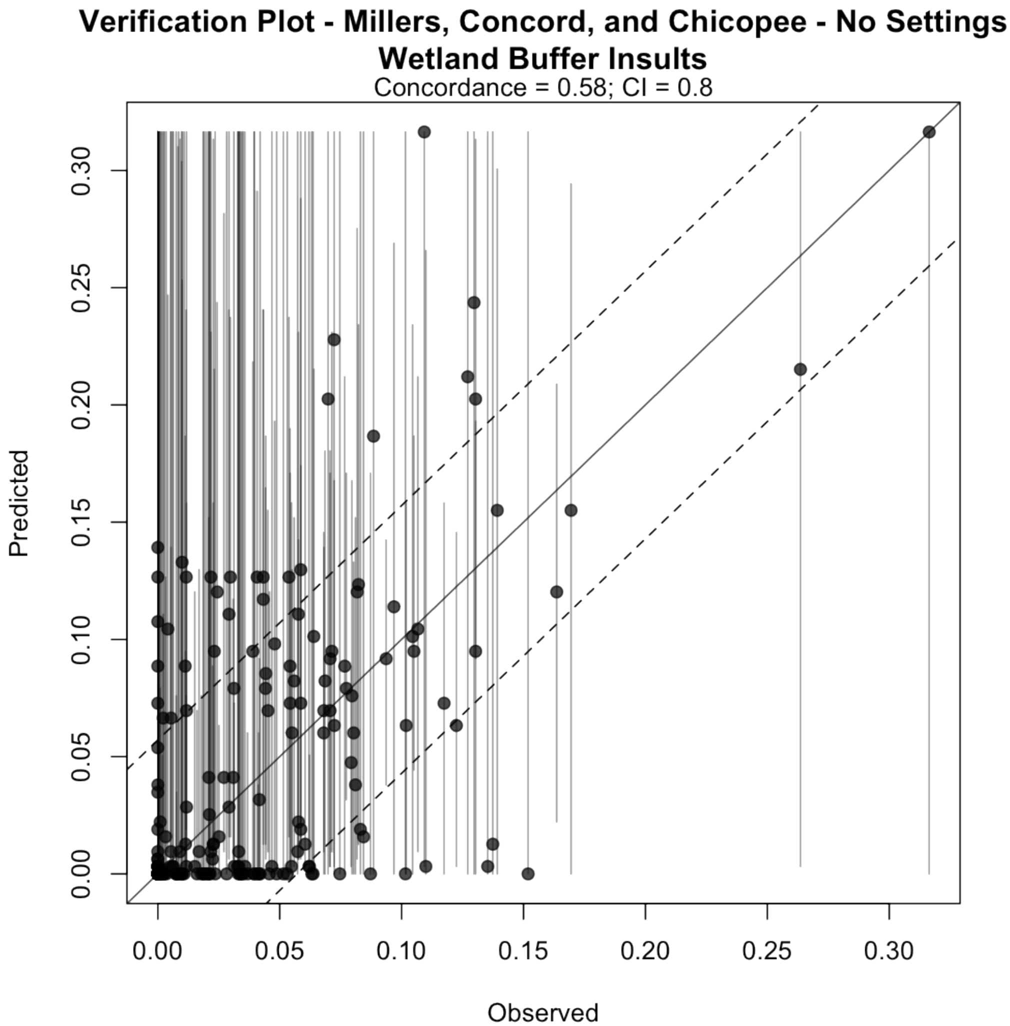

***Figure 18**. Verification plot of "Wetlands Buffer Insults" metric vs. IBI concordance for vascular plants, lichens and earthworms in the Miller's, Concord and Chicopee River watersheds analyzed without ecological settings variables (concordance = 0.58). Dotted lines are set to contain 80 percent of sites (40% above and 40% below the solid line).*

10. Plants, lichens and earthworms in the Miller's, Concord and Chicopee River watersheds without settings variables for the "Wetlands Buffer Insults" metric, log transformed (213 sites)

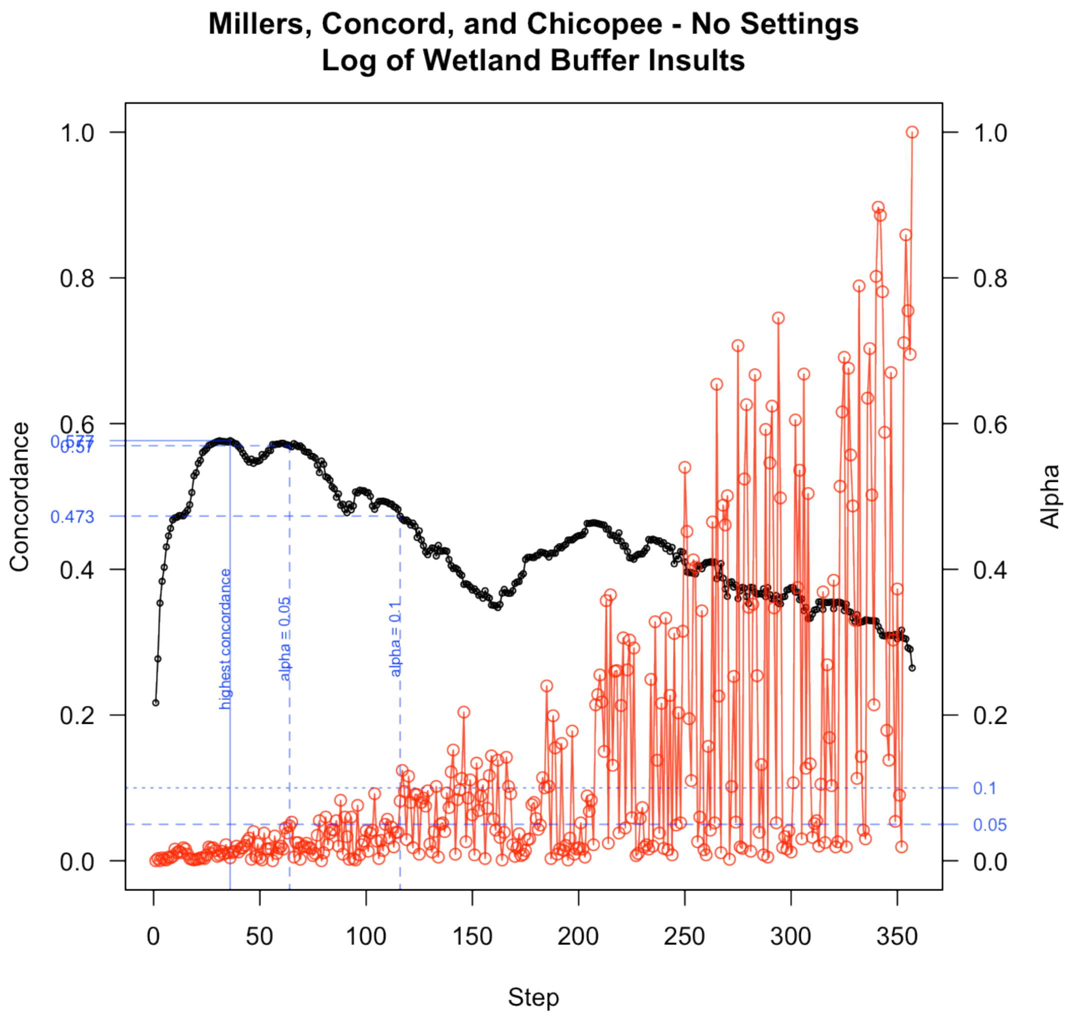

Figure 19. *Plot of the change in concordance for the log transformed "Wetland Buffer Insults" metric as taxa are added in a stepwise fashion for vascular plants, lichens and earthworms in the Miller's, Concord and Chicopee River watersheds analyzed without ecological settings variables.*

***Table 16**. Taxa included in the model (in the order in which they were added) for the log transformed "Wetlands Buffer Insults" metric and the associated P-value for vascular plants, lichens and earthworms in the Miller's, Concord and Chicopee River watersheds analyzed without ecological settings variables.*

Taxa	p.value	Group	Taxonomic.level
Osmunda regalis var. spectabilis	0	vascular.plants	species
Kalmia angustifolia	0.003	vascular.plants	species
Haplotaxida	0	worms	order
Anemone quinquefolia	0.004	vascular.plants	species
Punctelia perreticulata	0.002	lichens	species
Triadenum virginicum	0.001	vascular.plants	species
Larix laricina	0.005	vascular.plants	species
Trillium	0.004	vascular.plants	genus
Carya ovata	0.006	vascular.plants	species
Photinia pyrifolia	0.016	vascular.plants	species
Rubus idaeus ssp. idaeus	0.011	vascular.plants	species
Sorbus	0.013	vascular.plants	genus
worm middens	0.011	middens	NA
Kalmia latifolia	0.018	vascular.plants	species
Abies balsamea	0.016	vascular.plants	species
Larix	0.009	vascular.plants	genus
Carex trisperma var. trisperma	0.003	vascular.plants	species
Carex intumescens	0.002	vascular.plants	species
Viburnum lantanoides	0.001	vascular.plants	species
Rhododendron prinophyllum	0.002	vascular.plants	species
Rhamnus	0.002	vascular.plants	genus
Dennstaedtia punctilobula	0.004	vascular.plants	species
Abies	0.004	vascular.plants	genus
Betula papyrifera	0.003	vascular.plants	species
Taxus	0.008	vascular.plants	genus
Galium	0.019	vascular.plants	genus
Circaea	0.017	vascular.plants	genus
Cornus alternifolia	0.018	vascular.plants	species
Dryopteris cristata	0.014	vascular.plants	species
Symphyotrichum	0.006	vascular.plants	genus
Scutellaria	0.008	vascular.plants	genus
Melanelixia subaurifera	0.013	lichens	species
Arisaema triphyllum	0.009	vascular.plants	species
Punctelia rudecta	0.022	lichens	species
Vaccinium corymbosum	0.011	vascular.plants	species
Ilex verticillata	0.004	vascular.plants	species
Ligustrum vulgare	0.011	vascular.plants	species
Aster divaricatus	0.013	vascular.plants	species

Geum	0.02	vascular.plants	genus
Ligustrum	0.012	vascular.plants	genus
Pteridium aquilinum var. latiusculum	0.017	vascular.plants	species
Pteridium	0.018	vascular.plants	genus
Maianthemum racemosum	0.021	vascular.plants	species
Uvularia sessilifolia	0.027	vascular.plants	species
Osmunda	0.031	vascular.plants	genus
Amelanchier	0.002	vascular.plants	genus
Prunus serotina	0.04	vascular.plants	species
Carex folliculata	0.006	vascular.plants	species
Aquifoliaceae	0.023	vascular.plants	family
Cicuta	0.004	vascular.plants	genus
Salicaceae	0.001	vascular.plants	family
Anemone	0.038	vascular.plants	genus
Rhamnus cathartica	0.016	vascular.plants	species
Doellingeria umbellata	0.016	vascular.plants	species
Thelypteris simulata	0.017	vascular.plants	species
Betula populifolia	0	vascular.plants	species
Euonymus alata	0.034	vascular.plants	species
Lysimachia	0.01	vascular.plants	genus
Trillium undulatum	0.017	vascular.plants	species
Euonymus	0.02	vascular.plants	genus
Fraxinus nigra	0.016	vascular.plants	species
Cornus racemosa	0.045	vascular.plants	species
Dendrobaena octaedra	0.038	worms	species
Myelochroa aurulenta	0.048	lichens	species

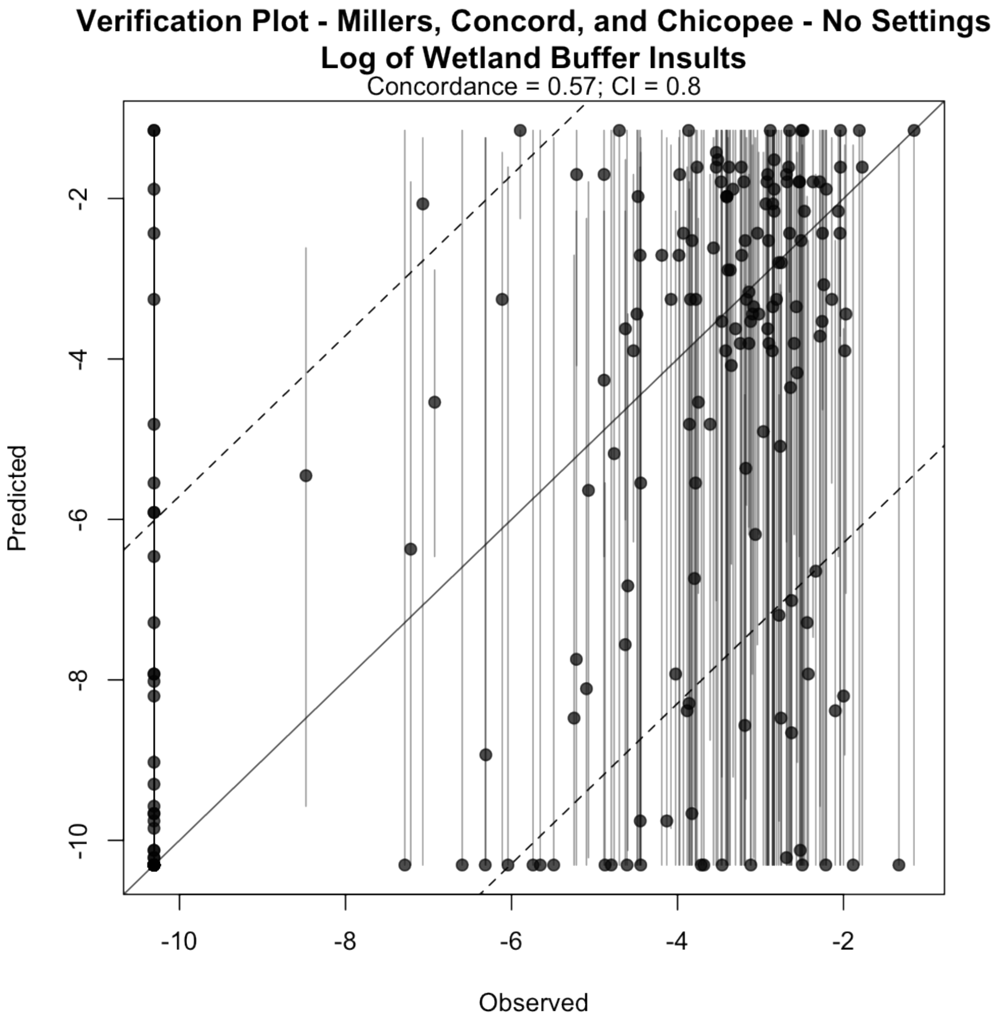

Figure 20. *Verification plot of log transformed "Wetlands Buffer Insults" metric vs. IBI concordance for vascular plants, lichens and earthworms in the Miller's, Concord and Chicopee River watersheds analyzed without ecological settings variables (concordance = 0.57). Dotted lines are set to contain 80 percent of sites (40% above and 40% below the solid line).*

We did an analysis to determine which taxa of the taxa groups that have unidentified samples (2009 samples) were most influential in determining concordance values for 2008 data and therefore most valuable for inclusion in future analyses. **Table 17** shows the improvement in concordance garnered by adding each taxonomic group to the pool of taxa used to predict IEI. In all of the runs vascular plants, lichens, and worms were included in the pool of taxa; data from those taxaonomic groups are available at all sites.

***Table 17**. Improvement in concordance by adding each taxonomic group to the pool of taxa used to predict IEI. (All taxa in the Chicopee River watershed without ecological settings variables.)*

Group	Delta	Percent	sd.delta	sd.pct
Diatoms	0.088	10.778	0.032	4.254
Collembola	0.025	3.084	0.022	2.663
Bryophytes	0.007	0.810	0.015	1.887
Hymenoptera	0.006	0.674	0.008	0.862
Hemiptera	0	0	0	0
Araneae	-0.003	-0.407	0.019	2.220
Coleoptera	-0.007	-0.842	0.028	3.332

Each run in which the group was used was compared to an otherwise identical run which didn't utilize the group. There were many such comparisons for each group which were summarized with both a mean and standard deviation. The delta column lists the mean difference in concordance while the percent column shows the mean percent improvement in concordance. The two sd columns shows the standard deviation in the same values.

We should be somewhat cautious based on the small sample size and on the fact that the same pool of pseudo-species was used for comparison across all runs but we are nonetheless optimistic about the potential usefulness of diatoms.

Discussion

At this point in the process all IBIs have to be considered preliminary in nature. As the number of taxa and sites included in the analyses increases we would expect the results to change. That said there are still some things that we can learn from these preliminary analyses.

<u>Is there evidence for a relationship between IEI scores and biological community structure?</u>

Obviously we can only draw inferences from the biological taxa groups that we sampled (e.g. vertebrates were not sampled as part of the SLAM). Results from analysis of all taxa in the Chicopee River watershed indicate a remarkably strong relationship (concordance of 0.94, **Figure 2**). Similarly, reasonably strong concordance values are found when we looked at selected taxa in the Chicopee River watershed: vascular plants only (0.78, **Figure 4**), diatoms only (0.61, **Figure 6**), and vascular plants, lichens and earthworms (0.77, **Figure 8**).

When we broaden our analysis to all three watersheds we find reason for caution in interpreting the results from the Chicopee alone. An analysis of vascular plants, lichens and earthworms for all three watersheds yields a relatively weak concordance value of 0.56 (**Figure 10**). It is not surprising that this value is less than the 0.94 from the Chicopee because important taxa groups (diatoms, invertebrates and bryophytes) were not yet available in the Miller’s and Chicopee River watersheds. However it was somewhat surprising to see the condorance for a comparable analysis using vascular plants, lichens and earthworms go from a value of 0.77 in the Chicopee River watershed (**Figure 8**) to a value of 0.56 when sites from the Miller’s and Concord River watersheds were added (**Figure 10**). An analysis of vascular plants, lichens and earthworms at 145 sites in just the Miller’s and Concord River watersheds yielded a similar concordance value of 0.55 (**Figure 12**).

There are a couple of possible explanations for the reduction in concordance as data from additional watersheds are included in the analysis. First, although our approach includes multiple steps to reduce the chance of over fitting the model these safeguards work best when the number of sites is large. Relying on a small number of sites for the Chicopee River watershed analysis may have resulted in model over fitting. If this is the case then we would expect a similar reduction in concordance value even if we were to add additional sites from the Chicopee River watershed.

A second possible explanation is that geographic variation in biotic communities is a strong confounding factor in our analysis. Charlie Eiseman, our field botanist, commented that he noticed that the plant communities were quite different from one watershed to another. If this was the case then additional sites from the Chicopee would be expected to improve concordance values even as adding sites from other watersheds reduced them. Once we have data for other taxa in the Miller's and Concord River watersheds we should be able to better understand these results.

<u>Does our understanding of relationships between IEI scores and biological community structure improve when we consider field-based ecologically settings data?</u>

At this point our only test of this question is the analysis of vascular plants, lichens and earthworm data from the Miller's and Concord River watershed (these ecological settings data were not collected in the Chicopee River watershed). We conducted analyses of these taxa groups in these watersheds both with and without the settings data. We found that the concordance value without settings variables (0.55, **Figure 12**) was higher than for our analysis with settings variables (0.50, **Figure 14**).

We would ordinarily expect concordance to improve as we are able to account for potentially confounding variables such as soil chemistry, soil organic content and site hydrology. However, it might be possible that the taxa available for use in these analyses (plants, lichens, worms) are relatively insensitive to these settings variables. Alternatively, the range of variation for these variables at the sites assessed may be too limited to have meaningful ecological effects.

It is too early to determine whether or not inclusion of these field-based ecological settings variables will improve our ability to develop meaningful IBIs. Further analyses that include additional taxa and more sites are likely to shed more light on this question.

<u>Is there evidence for a relationship between development in the buffer zone ("Wetland Buffer Insults" metric) and biological community structure?</u>

An analysis of wetland biological community structure against the Wetlands Buffer Insults metric using all taxa in the Chicopee River watershed suggests a strong relationship (concordance = 0.91; **Figure 16**). Analyses for vascular plants, lichens and earthworms in all three watersheds yielded a concordance value (0.58, **Figure 18**) similar to that for IEI (0.56, **Figure 10**). This value was not improved when log transformed Wetlands Buffer Insults scores were used (0.57, **Figure 20**).

These analyses suggest that a relationship does exist between development in the buffer zone and wetland biological community structure and that this relationship may be a strong one. However, the same concerns about over fitting of the model and geographic variability discussed with IEI also apply to these analyses. A better understanding of the strength of this relationship will have to wait for future analyses with more data and more sites.

Does it look like we will be able to development meaningful single-taxa group IBIs?

It is still too early in our analyses to say whether we will be able to create simplified IBIs based on particular taxa groups (e.g. vascular plants, diatoms). Results from the plants only (concordance = 0.78, **Figure 4**) and diatom only (concordance = 0.61, **Figure 6**) analyses suggest that this might be possible. Further our analysis of the improvement in concordance by adding each taxonomic group to the pool of taxa used to predict IEI suggests that diatoms may be a particularly useful taxa group (**Table 17**).

Conclusions

Results of these analyses suggest a potential strong relationship between both IEI and the Wetlands Buffer Insults metric and biological community composition in forested wetlands although there are reasons to believe that the relationship is not as strong as the concordance values in the Chicopee River watershed suggest. Concerns about over fitting the models and the potentially confounding effect of geography will be investigated in future analyses with additional taxa and more sites.

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SALT MARSH DATA AND PRELIMINARY ANALYSIS

In 2009 personnel from the Massachusetts Office of Coastal Zone Management (CZM) collected invertebrates from 41 sites using 3 different sampling methods: auger (40 sites), dipnet (39 sites), and quadrat (41 sites). The total number of invertebrates collected was 11,173. Dipnet samples had the highest total abundance (7,251) followed by quadrat samples (2,690) and auger samples (1,232). The invertebrates were classified into 7 phyla, 10 classes, 40 orders, 73 families, 5 genera, and 5 species (Appendix B, **Table 31**).

The total number of taxa collected was 105 (number of taxa at the finest level of classification). Talitridae has the highest frequency of occurrence followed by Araneae, Hemiptera, and Melampodidae. Abundant taxa include Leptocheliidae, Talitridae, Littorinidae, Haplotaxida, Melampodidae, and *Geukensia demissa* (Appendix B, **Table 32**).

The total number of taxa collected in the auger samples was 45. Frequently occurring taxa include Leptocheliidae, Capitellidae, and Haplotaxida. The most abundant taxon was Leptocheliidae (Appendix B, **Table 33**).

The total number of taxa collected in the dipnet samples was 89. Frequently occurring taxa include Talitridae, Fulgoridae, and Diptera. Abundant taxa include Leptocheliidae, Littorinidae, Haplotaxida and Gammaridae (Appendix B, **Table 34**).

The total number of taxa collected in the quadrat samples is 25. Frequently occurring taxa include Araneae, Talitridae, and Melampodidae. Abundant taxa include Talitridae, Melampodidae, and *Geukensia demissa* (Appendix B, **Table 35**).

Scatter plots and simple pair-wise correlation analyzes were evaluated to test for any preliminary relationships between IEI and 1) taxa richness, 2) Simpson's diversity and 3) taxon abundance. This was conducted for each sample method and combined. There were no strong relationships (**Figure 21**).

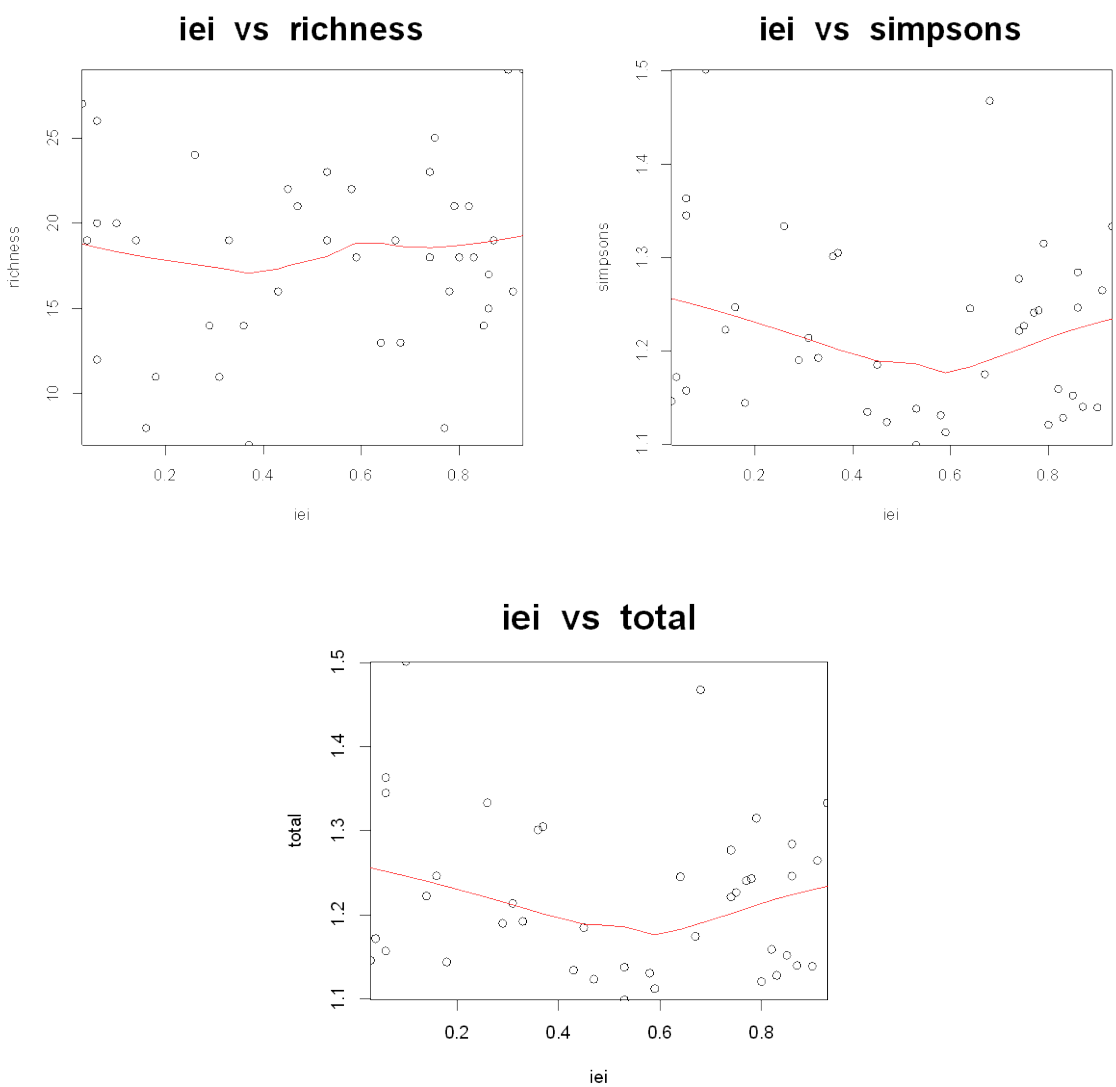

Figure 21. *Scatter plots of IEI and the combined salt marsh sample: richness, Simpsons' diversity and total abundance.*

Data from the 2010 field season are not yet available. Because the number of sites currently available for analysis is small (n=41) it is not likely that the statistical techniques used for forested wetlands would be successful in analyzing the salt marsh data from 2009.

Preliminary analyses based on general biotic community metrics (taxa richness, Simpson's diversity index and taxon abundance) did not find any significant relationships between IEI and the biotic community (**Figure 21**). It is likely that we will have more success once we apply the same techniques to salt marsh data as are being used in forested wetlands. Once we have all the data from 2009 and 2010 we will begin using the more sophisticated analysis to look for relationships between IEI/metric scores and biotic communities in salt marshes.

CAPS and Important Habitat Maps

This past year a tremendous amount of work has been done on the CAPS modeling approach. Significant improvements have been made in nearly all of the metrics and several of the ecological settings variables. New metrics for coastal communities have been implemented (salt marsh ditching, tidal restriction, coastal structures, beach pedestrian traffic, off-road vehicle traffic) as well as coastal ecological settings variables (tidal hydrology, salinity, wind exposure, wave exposure). The Connectedness metric has been revised and split into two: terrestrial connectedness and aquatic connectedness. CAPS software has been rewritten to more efficiently use land cover in the implementation of models and to more realistically model flow patterns for watershed metrics.

A new statewide CAPS analysis is currently underway and is expected to be completed by March 5, 2011. We will be ready to create and post maps of Habitat of Potential Regional and Statewide Importance ("Important Habitat Maps") as soon as the analysis has been completed.

APPENDIX A: FORESTED WETLAND SPECIMEN DATA

***Table 18**. Taxonomic Resolution of forested wetland specimen data as of February 28, 2011.*

Taxa Group		Order	Family	Genus	Species	Total
Diatoms - Water samples	Total	0	0	629	14887	15516
	%	0	0	4	96	
Diatoms - Leaf Litter samples	Total	0	0	1576	38202	39778
	%	0	0	4	96	
Araneae - Pitfall Trap Samples	Total	191	345	316	1113	1965
	%	10	18	16	57	
Coleoptera - Pitfall Trap Samples	Total	0	0	3	1317	1320
	%	0	0	0	100	
Hemiptera - Pitfall Trap Samples	Total	0	68	1392	50	1510
	%	0	5	92	3	
Hemiptera - Emergence Trap Samples	Total	3	4	15	3	25
	%	12	8	60	12	
Hymenoptera - Pitfall Trap Samples	Total	1	132	1269	155	1557
	%	0	8	82	10	
Hymenoptera - Emergence Trap Samples	Total	0	17	9	0	26
	%	0	65	35	0	
Orthoptera - Pitfall Trap Samples	Total	0	21	47	2	70
	%	0	30	67	3	
Collembola – Pitfall Trap Samples	Total	34	7	10688	0	10729
	%	0.3	0.07	99.6	0	

Table 19*. 2008 Diatom Taxa (Leaf Litter). Total is the cumulative taxa abundance for all samples, # of sites obs. is the total number of sites at which that taxon was oserved, and max obs. is the maximum number of specimens identified at one site. *cf before a species name indicates "resembles."*

Genus	Species	Code	Total	# Sites Obs.	Max Obs.
Achnanthes	*biasolettiana Grunow*	ACHNBIAS	2	1	2
Achnanthes	*cf. chlidanos Hohn & Hellerman*	ACHNcf.CHLI	4	1	4
Achnanthes	*hauckiana var. rostrata*	ACHNHAUC	1	1	1
Achnanthes	*nodosa Cleve_Euler*	ACHNNODO	6	2	4
Achnanthes	*cf. rosenstockii Lange_Bertalot*	ACHNcf.ROSE	198	4	147
Achnanthidium	*exiguum (Grunow) D.B. Czarnecki*	ACHNEXIG	3	1	3
Achnanthidium	*minutissimum (Kützing) Czarnecki*	ACHNMINU	776	21	274
Achnanthidium	*minutissimum var. microcephala Hust.*	ACHNMINUmi	128	3	93
Achnanthidium	*Achnanthidium sp.*	ACHNsp.	24	9	6
Aulacoseira	*crenulata (Ehrenberg) Thwaites*	AULACREN	494	8	345
Aulacoseira	*lacustris (Grunow) Krammer*	AULALACU	22	1	22
Aulacoseira	*nygaardii (Camburn) Camburn & Charles*	AULANYGA	336	3	333
Aulacoseira	*perglabra (Østrup) E.Y. Haw.*	AULAPERG	2	2	1
Aulacoseira	*Aulacoseira sp.*	AULAsp.	6	2	3
Brachysira	*brebissonii R. Ross*	BRACBREB	2	2	1
Brachysira	*microcephala (Grunow) Compère*	BRACMICRO	4	2	2
Caloneis	*bacillum (Grunow) P.T.Cleve*	CALOBACI	12	5	4
Caloneis	*ventricosa (Ehrenb.) Meist.*	CALOVENT	2	1	2
Caloneis	*Caloneis sp.*	CALOsp.	4	2	2
Chamaepinnularia	*hassiaca (Krasske) Cantonati & Lange_Bertalot*	CHAMHASS	2	1	2
Chamaepinnularia	*soehrensis (Krasske) Lange_Bert.*	CHAMSOEH	11	5	4
Chamaepinnularia	*Chamaepinnularia sp.*	CHAMsp.	71	10	33
Cocconeis	*pediculus Ehr.*	COCCPEDI	1	1	1
Cocconeis	*neodiminuta Krammer*	COCCNEOD	1	1	1
Cocconeis	*placentula Ehr.*	COCCPLAC	5	4	2
Cocconeis	*Cocconeis sp.*	COCCsp.	1	1	1
Cyclotella	*ocellata Pant.*	CYCLOCEL	18	1	18
Cyclotella	*Cyclotella sp.*	CYCLsp.	2	1	2
Cymbella	*affinis Kütz*	CYMBAFFI	1	1	1
Cymbella	*aspera (Ehrenb.) H. Perag.*	CYMBASPE	5	4	2
Cymbella	*cuspidata Kützing*	CYMBCUSP	2	1	2
Cymbella	*hauckii Van Heurck*	CYMBHAUC	8	2	7

Cymbella	*cf. hebridica Grunow ex Cleve*	CYMBcf.HEBR	2	1	2
Cymbella	*naviculaformis Auersw. ex Heribaud*	CYMBNAVI	49	4	39
Cymbella	*tumidula Grun.*	CYMBTUMI	2	1	2
Decussata	*placenta (Ehrenberg) Lange_Bertalot & Mezeltin*	DECUPLAC	89	21	15
Denticula	*kuetzingii Grunow*	DENTKUET	2	1	2
Diadesmis	*biceps Arnott ex Grunow*	DIADBICE	2	1	2
Diadesmis	*contenta (Grunow) D.G. Mann*	DIADCONT	11	4	4
Diadesmis	*paracontenta Lange_Bertalot and Werum*	DIADPARA	3	3	1
Diadesmis	*perpusilla (Kützing) D.G. Mann*	DIADPERP	6	3	3
Diatoma	*anceps (Ehrenberg) Kirchner*	DIATANCE	237	17	117
Diatoma	*anceps var. linearis M.Perag.*	DIATANCEli	57	1	57
Diatoma	*mesodon (Ehrenberg) Kützing*	DIATMESO	4	2	2
Diploneis	*elliptica (Kützing) P.T. Cleve*	DIPLOELLI	4	4	1
Encyonema	*silesiacum (Bleisch in Rabenhorst) D.G. Mann*	ENCYSILE	11	6	3
Encyonema	*minutum (Hilse in Rabenhorst) D.G. Mann*	ENCYMINU	49	14	12
Encyonema	*norvegica (Grunow in A. Schmidt) Bukhtiyarova*	ENCYNORV	2	1	2
Encyonema	*norvegica var. lapponica (A. Cleve) EY Haw. & MG Kelly*	ENCYNORVla	4	2	2
Encyonema	*ventricosum v. angustatum Krammer*	ENCYVENTan	1	1	1
Encyonemopsis	*cf. subminuta Krammer & Reichardt*	ENCYcf.SUBM	2	1	2
Eunotia	*arculus (Grun.) Lange_Bertalot & Norpel*	EUNOARCU	2	1	2
Eunotia	*bigibba Kütz.*	EUNOBIGI	10	4	5
Eunotia	*bilunaris Ehr. Mills.*	EUNOBILU	517	27	175
Eunotia	*carolina Patrick*	EUNOCARO	225	8	111
Eunotia	*crista_gallii P.T. Cl.*	EUNOCRIS	2	1	2
Eunotia	*curvata (Kütz.) Lagerst*	EUNOCURV	47	4	18
Eunotia	*curvata v. subarcuata Woodhead & Tweed*	EUNOCURVsu	11	2	9
Eunotia	*curvata f. bergii Woodhead & Tweed*	EUNOCURVfb	1909	48	226
Eunotia	*denticulata (Bréb. ex Kütz.) Rabenh.*	EUNODENT	4	2	2
Eunotia	*elegans Østrup*	EUNOELEG	188	7	82
Eunotia	*exigua (Breb. Ex Kütz.) Rabenh.*	EUNOEXIG	2120	53	393
Eunotia	*fallax A. Cleve*	EUNOFALL	192	16	84
Eunotia	*flexuosa Bréb. ex Kütz.*	EUNOFLEX	126	9	39
Eunotia	*cf. glacialis F. Meister.*	EUNOcf.GLAC	4	1	4
Eunotia	*girdle view 12_23 µm*	EUNOgirdlS	3276	58	300
Eunotia	*girdle view 30_45 µm*	EUNOgirdl	264	18	93
Eunotia	*incisa W. Sm. ex Greg,*	EUNOINCI	34	3	20

Eunotia	*meisteri Boyer*	EUNOMEIS	23	3	20
Eunotia	*microcephala Migula*	EUNOMICR	7	3	3
Eunotia	*naegeli Migula*	EUNONAEG	605	12	310
Eunotia	*monodon Ehr.*	EUNOMONO	10	4	5
Eunotia	*nymanniana Grun.*	EUNONYMA	2	1	2
Eunotia	*paludosa v. paludosa Grun.*	EUNOPALUpa	2061	37	580
Eunotia	*paludosa v. trinacria (Krasske) Norpel*	EUNOPALUtr	1316	23	545
Eunotia	*paralella Ehr.*	EUNOPARA	55	10	19
Eunotia	*pectinalis (O.F. Müller) Rabenhorst*	EUNOPECT	1580	45	288
Eunotia	*perpusilla Grun.*	EUNOPERP	97	12	42
Eunotia	*praerupta Ehr.*	EUNOPRAE	263	11	99
Eunotia	*cf. praerupta Her.*	EUNOcf.PRAE	1	1	1
Eunotia	*rhomboidea Hust.*	EUNORHOM	197	16	59
Eunotia	*septentrionalis Østrup*	EUNOSEPT	1116	31	256
Eunotia	*serra (Ralfs) Ehr.*	EUNOSERR	29	5	14
Eunotia	*siolii Hust. Ehr.*	EUNOSIOL	2	2	1
Eunotia	*soleirolii Boyer*	EUNOSOLE	316	11	150
Eunotia	*steineckii Peters.*	EUNOSTEI	14	4	9
Eunotia	*subarcuatoides Alles, Norpel & Lange_Bertalot*	EUNOSUBA	27	9	9
Eunotia	*sudetica O.F. Muller*	EUNOSUDE	21	7	9
Eunotia	*GSMNP sp. 1*	EUNOSP.1	5	2	3
Eunotia	*GSMNP sp. 17*	EUNOSP.17	1	1	1
Eunotia	*tautoniensis Hust. Ex Patrick*	EUNOTAUT	582	19	141
Eunotia	*tenella (Grunow) Hustedt*	EUNOTENE	102	7	51
Fragilaria	*cf. acidobiontica Camburn & Charles*	FRAGcf.ACID	240	3	155
Fragilaria	*neoproducta Lange_Bertalot*	FRAGNEOP	2	1	2
Fragilaria	*vaucheria (Kütz.) Peters.*	FRAGVAUC	345	9	300
Fragilariaforma	*virescens (Ralfs) Williams & Round*	FRAIVIRE	4984	41	561
Fragilariaforma	*Fragilariaforma sp.*	FRAIFRAG	1	1	1
Frustulia	*crassinervia Lange_Bertalot & Krammer*	FRUSCRAS	4	2	2
Frustulia	*krammeri Lange_Bertalot & Metzeltin*	FRUSKRAM	13	6	8
Frustulia	*pseudomagaliesmontana Camburn & Charles*	FRUSPSEU	1	1	1
Frustulia	*saxonica Rabh*	FRUSSAXO	529	25	133
Frustulia	*vulgaris (Thwaites) DeToni*	FRUSVULG	40	12	13
Frustulia	*Frustulia sp.*	FRUSsp.	6	1	6
Gomphonema	*affine Kützing*	GOMPAFFI	5	1	5
Gomphonema	*angustatum (Kütz.) Rabenh.*	GOMPANGU	248	28	42

Gomphonema	*gracile Ehr.*	GOMPGRAC	80	17	12
Gomphonema	*parvulum (Kütz.) Kütz.*	GOMPPARV	937	30	177
Gomphonema	*subclavatum (Grunow) Grunow*	GOMPSUBC	10	5	2
Gomphonema	*truncatum Ehrenb.*	GOMPTRUN	2	1	2
Gomphonema	*Gomphonema sp. (girdle views)*	GOMPsp.	512	34	66
Hantzschia	*amphioxys (Ehr.) Grunow*	HANTAMPH	9	2	5
Hantzschia	*vivax (W. Smith) Tempère*	HANTVIVA	1	1	1
Hantzschia	*Hantzschia sp.*	HANTsp.	1	1	1
Hippodonta	*capitata (Ehrenb.) Lange_Bert., Metzeltin & Witkowski*	HIPPCAPI	1	1	1
Karayeva	*clevei (Hustedt) Round & Bukhtiyarova*	KARACLEV	2	1	2
Kobayasiella	*Kobayasiella sp.*	KOBAsp.	2	1	2
Luticola	*cohnii (Hilse) D.G. Mann*	LUTICOHN	4	1	4
Luticola	*mutica (Kütz.) DG Mann*	LUTIMUTI	7	5	2
Luticola	*undulata (Hilse) Mann*	LUTIUNDU	1	1	1
Luticola	*Luticola sp.*	LUTIsp.	5	1	5
Meridion	*allensmithii Brandt*	MERIALLE	46	9	25
Meridion	*circulare (Greville) Agardh*	MERICIRC	2635	35	291
Meridion	*Meridion sp.*	MERIsp.	122	4	63
Microcostatus	*krasskei (Hustedt) Johansen & Sray*	MIRCKRAS	165	3	162
Navicula	*angusta Grun.*	NAVIANGU	14	3	6
Navicula	*asellus Weinhold ex Hustedt*	NAVIASEL	1	1	1
Navicula	*bacillum Ehrenb.*	NAVIBACI	5	2	3
Navicula	*bryophila Petersen*	NAVIBRYO	10	5	3
Navicula	*cocconeiformis Greg. ex Greville*	NAVICOCC	10	3	5
Navicula	*cryptocephala Kütz*	NAVICRYP	372	15	177
Navicula	*cryptotenella Lange_Bertalot*	NAVICRYT	10	3	4
Navicula	*exigua (W. Gregory) O. Müller*	NAVIEXIG	2	1	2
Navicula	*festiva Krasske*	NAVIFEST	5	1	5
Navicula	*gregaria Donkin*	NAVIGREG	8	3	4
Navicula	*hambergii Hust.*	NAVIHAMB	9	5	2
Navicula	*cf. hustedtii Krasske*	NAVIcf.HUST	2	1	2
Navicula	*keelii Patr.*	NAVIKEEL	1	1	1
Navicula	*cf. lanceolata (C. Agardh) Kütz.*	NAVIcf.LANC	56	5	46
Navicula	*cf. lenzii Hust.*	NAVIcf.LENZ	2	1	2
Navicula	*cf. leptostriata E. Jorgensen*	NAVIcf.LEPT	16	5	4
Navicula	*libonensis Schumann*	NAVILIBO	2	1	2
Navicula	*minima Grunow in Van Heurck*	NAVIMINI	2	1	2
Navicula	*notha Wallace*	NAVINOTH	11	4	6

Navicula	*cf. perminuta Grunow*	NAVIcf.PERM	2	1	2
Navicula	*protracta (Grun.) Cl.*	NAVIPROT	3	1	3
Navicula	*pseudolanceolata Lange_Bertalot*	NAVIPSEU	3	2	2
Navicula	*pseudoventralis Hustedt*	NAVIPSVE	2	1	2
Navicula	*rhynchocephala Kütz*	NAVIRHYN	2	1	2
Navicula	*scuteloides W. Smith*	NAVISCUT	1	1	1
Navicula	*submuralis Hust.*	NAVISUBM	13	4	5
Navicula	*cf. tantula Hust.*	NAVIcf.TANT	25	8	8
Navicula	*tenelloides Hust.*	NAVITENE	2	1	2
Navicula	*tenuicephala Hust.*	NAVITENU	2	1	2
Navicula	*variostriata Krasske*	NAVIVARI	40	7	18
Navicula	*Navicula sp.*	NAVIsp.	389	22	72
Neidium	*affine v. amphirynchus*	NEIDAFFIam	2	1	2
Neidium	*affine v. undulatum (Grunow) Cleve*	NEIDAFFIun	6	2	4
Neidium	*alpinum Hust.*	NEIDALPI	2	1	2
Neidium	*ampliatum (Ehr.) Krammer*	NEIDAMPL	64	7	43
Neidium	*bisucatum (Lagerst.) Cl.*	NEIDBISU	80	20	23
Neidium	*Neidium sp.*	NEIDsp.	6	4	2
Nitzschia	*acidoclinata Lange_Bertalot Hust.*	NITZACID	548	23	90
Nitzschia	*amphibia Grunow*	NITZAMPH	7	1	7
Nitzschia	*clausii Hantzsch*	NITZCLAU	4	1	4
Nitzschia	*dissipata (Kütz.) Grun.*	NITZDISS	5	4	2
Nitzschia	*dissipata var. media (Hantzsch) Grunow*	NITZDISSme	9	5	2
Nitzschia	*filiformis (W.Sm.) Van Heurck*	NITZFILI	10	2	8
Nitzschia	*cf. flexa Schumann*	NITZcf.FLEX	1	1	1
Nitzschia	*frustulum (Kütz.) Grun*	NITZFRUS	40	5	12
Nitzschia	*gracilis Hantzsch*	NITZGRAC	55	5	39
Nitzschia	*cf. nana Grun.*	NITZcf.NANA	64	9	32
Nitzschia	*cf. normanii Grun.*	NITZcf.NORM	2	1	2
Nitzschia	*palea (Kütz.) W. Smith*	NITZPALE	37	7	15
Nitzschia	*cf. paleacea Grunow*	NITZcf.PALA	4	2	2
Nitzschia	*cf. palustris Hust.*	NITZcf.PALU	141	17	32
Nitzschia	*cf. recta Hantz.*	NITZcf.RECT	18	1	18
Nitzschia	*cf. vermicularis (Kütz.) Hantz.*	NITZcf.VERM	2	1	2
Nitzschia	*Nitzschia sp.*	NITZsp.	233	24	62
Nupela	*neglecta Ponader, Lowe & Potapova*	NUPENEGL	9	4	3
Nupela	*Nupela sp.*	NUPEsp.	8	4	4
Nupela	*wellneri (Lange_bertalot) Lange_bertalot*	NUPEWELL	4	1	4
Pinnularia	*abaujensis v. lacustris Camburn & Charles*	PINNABAUla	42	11	14

Pinnularia	*abaujensis v. linearis (Hust.) Patr.*	PINNABAULi	31	7	10
Pinnularia	*abaujensis v. rostrata Patr.*	PINNABAUro	8	1	8
Pinnularia	*abaujensis v. subundulata (Mayer) Patrick*	PINNABAUsu	13	2	12
Pinnularia	*acrosphaeria Rabh.*	PINNACRO	9	4	4
Pinnularia	*acuminata v. interrupta (Boyer) Patr.*	PINNACUM	4	1	4
Pinnularia	*biceps W. Greg.*	PINNBICE	3	2	2
Pinnularia	*borealis (Ehrenberg) Rabenhorst*	PINNBORE	5	4	2
Pinnularia	*brebissonii (Kütz.) Rabh.*	PINNBREB	43	9	22
Pinnularia	*brebissonii var. minuta*	PINNBREBmi	2	1	2
Pinnularia	*burkii Patr.*	PINNBURK	9	5	2
Pinnularia	*cf. Kwacksii Camb. & Charles*	PINNcf.KWAC	2	1	2
Pinnularia	*cf. dactylus Ehrenberg*	PINNcf.DACT	2	1	2
Pinnularia	*divergens W. Smith*	PINNDIVE	14	3	6
Pinnularia	*divergentissima var. subrostrata*	PINNDIVRsu	3	1	3
Pinnularia	*flexuosa A. Cleve_Euler*	PINNFLEX	2	1	2
Pinnularia	*gentilis (Donkin) Cleve*	PINNGENT	4	1	4
Pinnularia	*gibbiformis Krammer*	PINNGIBB	2	1	2
Pinnularia	*girdle view*	PINNgirdle	1113	55	163
Pinnularia	*hilseana Janisch ex Rabh.*	PINNHILS	286	11	74
Pinnularia	*legumen (Ehr.) Ehr.*	PINNLEGU	9	3	4
Pinnularia	*maior (Kütz.) Cleve*	PINNMAIO	18	6	7
Pinnularia	*cf. mesogonglya Ehr.*	PINNcf.MESO	6	2	4
Pinnularia	*microstauron (Ehr.) Cl.*	PINNMICR	2	1	2
Pinnularia	*microstauron v. adarondakensis Camburn & Charles*	PINNMICRad	104	15	45
Pinnularia	*nodosa (Ehr.) W. Sm.*	PINNNODO	25	6	9
Pinnularia	*obscura Krasske*	PINNOBSC	18	7	9
Pinnularia	*rupestris Hantzsch*	PINNRUPE	137	19	54
Pinnularia	*cf. ruttneri Hust.*	PINNcf.RUTT	1	1	1
Pinnularia	*stomatophora Grun.*	PINNSTOM	4	3	2
Pinnularia	*streptoraphe Cleve*	PINNSTRE	28	2	27
Pinnularia	*subcapitata Greg.*	PINNSUBC	104	22	17
Pinnularia	*subcapitata var. paucistriata (Grun.) Cl.*	PINNSUBCpa	16	8	3
Pinnularia	*substomatophora Hust.*	PINNSUBS	1	1	1
Pinnularia	*termitina (Ehr.) Patr.*	PINNTERM	928	21	251
Pinnularia	*viridiformis Krammer*	PINNVIRI	81	1	81
Pinnularia	*viridis (Nitzsch) Ehrenberg*	PINNVIRD	14	5	7
Pinnularia	*viridis var. minor Cleve*	PINNVIRDmi	9	5	4
Pinnularia	*wisconsinensis Camburn & Charles*	PINNWISC	2	1	2

Pinnularia	*Pinnularia sp.*	PINNsp.	3	2	2
Placoneis	*elginensis (Greg.) E. J. Cox*	PLACELGI	46	14	13
Placoneis	*abiskoensis (Hustedt). Lange_Bertalot & Metzeltin*	PLACABIS	5	4	2
Placoneis	*neglecta (Krasske) Lowe*	PLACNEGL	2	1	2
Planothidium	*dubium (Grunow) Round et Bukhtiyarova*	PLANDUBI	4	1	4
Planothidium	*frequentissimum (Lange_Bert.) Round et L.Bukhtiyarova*	PLANFREQ	66	7	47
Planothidium	*lanceolatum (Bréb. ex (Kütz.) Round & Bukhtiyarova*	PLANLANC	994	16	268
Planothidium	*Planothidium sp.*	PLANsp.	8	3	4
Pseudostaurosira	*brevistriata (Grunow) Williams & Round*	PSEUBREV	3	2	2
Rhopalodia	*gibba (Ehrenb.) O. Müll.*	RHOPGIBB	1	1	1
Rhopalodia	*gibberula (Ehrenb.) O. Müll.*	RHOPGIBE	2	1	2
Sellaphora	*pupula (Kütz.) Mereschk.*	SELLPUPU	41	9	21
Sellaphora	*cf. seminulum (Grunow) D.G. Mann*	SELLcf.SEMI	17	4	8
Stauroneis	*anceps Ehr.*	STAUANCE	88	15	53
Stauroneis	*anceps f. linearis (Ehrenberg) Cleve*	STAUANCP	42	3	24
Stauroneis	*cf. kriegeri Patr.*	STAUcf.KRIE	86	17	18
Stauroneis	*phoenicentron (Nitz.) Ehr.*	STAUPHOE	29	10	8
Stauroneis	*smithii var. incisa*	STAUSMIT	2	1	2
Staurosira	*construens Ehr.*	STAUCONS	9	2	8
Staurosira	*construens v. venter (Ehr.) Hamilton*	STAUCONSve	32	6	14
Staurosirella	*leptostauron (Ehr.) D.M.Williams et Round*	STAULEPT	6	3	2
Staurosirella	*pinnata (Ehrenberg) Williams & Round*	STAUPINN	3	2	2
Stenopterobia	*delicatissima (Lewis) Breb. ex VH*	STENDELI	9	2	7
Stenopterobia	*Stenopterobia sp.*	STENsp.	3	2	2
Stephanodiscus	*Stephanodiscus sp.*	STEPsp.	2	1	2
Surirella	*angustata Kütz.*	SURIANGU	4	2	2
Surirella	*Surirella sp.*	SURIsp.	2	1	2
Synedra	*acus Kütz.*	SYNEACUS	83	2	62
Synedra	*acus var. radians (Kütz.) Hust.*	SYNEACUSra	37	7	13
Synedra	*amphicephala v. austriaca Grunow*	SYNEAMPH	4	1	4
Synedra	*rumpens Kütz.*	SYNERUMP	42	6	18
Synedra	*rumpens v. fragilarioides Grun.*	SYNERUMPfr	104	2	103
Synedra	*Synedra sp.*	SYNEsp.	126	10	62
Tabellaria	*binalis (Ehr.) Grun.*	TABEBINA	1	1	1
Tabellaria	*fenestrata (Lyngb.) Kütz.*	TABEFENE	2	1	2
Tabellaria	*floculosa (Roth) Kütz*	TABEFLOC	1310	35	194

Tabellaria	*quadricepta*	TABEQUAD	5	4	2
Tetracyclus	*rupestris (Braun) Grun.*	TETRRUPE	2	1	2
Tryblionella	*debilis (Arn.) Grunow*	TRYBDEBI	1	1	1
Tryblionella	*marginulata (Grunow) DG Mann*	TRYBMARG	1	1	1
Ulnaria	*ulna (Nitz.) Compere*	ULNAULNA	41	5	34
Uknown	*Unknown genus*	UNKNOWN	9	2	8

Table 20. *2008 Diatom Taxa (Water Samples). Total is the cumulative taxa abundance for all samples, # of sites obs. is the total number of sites at which that taxon was oserved, and max obs. is the maximum number of specimens identified at one site. *cf before a species name indicates "resembles."*

Genus	Species	Code	Total	# Sites Obs.	Max Obs.
Achnanthes	*cf. rosenstockii Lange_Bertalot*	ACHNcf.ROSE	13	1	13
Achnanthes	*cf. pseudoswazi J.R. Carter*	ACHNcf.PSEO	43	1	43
Achnanthidium	*minutissimum (Kützing) Czarnecki*	ACHNMINU	29	4	16
Achnanthidium	*minutissimum var. microcephala Hust.*	ACHNMINUmi	3	1	3
Achnanthidium		ACHNsp.	21	3	15
Asterionella	*formosa*	ASTEFORM	12	2	10
Aulacoseira	*crenulata (Ehrenberg) Thwaites*	AULACREN	566	5	379
Aulacoseira		AULAsp.	2	1	2
Caloneis	*bacillum (Grunow) P.T.Cleve*	CALOBACI	3	1	3
Caloneis	*hyalina*	CALOHYAL	3	1	3
Caloneis	*ventricosa (Ehrenb.) Meist.*	CALOVENT	2	1	2
Caloneis		CALOsp.	4	2	2
Chamaepinnularia	*soehrensis (Krasske) Lange_Bert.*	CHAMSOEH	3	1	3
Chamaepinnularia		CHAMsp.	41	6	17
Cymbella	*cuspidata Kützing*	CYMBCUSP	31	1	31
Cymbella	*hauckii Van Heurck*	CYMBHAUC	1	1	1
Cymbella		CYMBsp.	1	1	1
Decussata	*placenta (Ehrenberg) Lange_Bertalot & Mezeltin*	DECUPLAC	20	7	9
Diadesmis	*biceps Arnott ex Grunow*	DIADBICE	2	1	2
Diadesmis	*contenta (Grunow) D.G. Mann*	DIADCONT	1	1	1
Diadesmis	*perpusilla (Kützing) D.G. Mann*	DIADPERP	1	1	1
Diatoma	*anceps (Ehrenberg) Kirchner*	DIATANCE	1	1	1
Diatoma	*anceps var. linearis M.Perag.*	DIATANCEli	12	1	12
Diploneis	*elliptica (Kützing) P.T. Cleve*	DIPLOELLI	3	1	3
Encyonema	*silesiacum (Bleisch in Rabenhorst) D.G. Mann*	ENCYSILE	5	2	3
Encyonema	*minutum (Hilse in Rabenhorst) D.G. Mann*	ENCYMINU	62	11	15
Eunotia	*bigibba Kütz.*	EUNOBIGI	5	2	3
Eunotia	*bilunaris Ehr. Mills.*	EUNOBILU	81	6	28
Eunotia	*carolina Patrick*	EUNOCARO	31	4	21
Eunotia	*crista_gallii P.T. Cl.*	EUNOCRIS	9	1	9
Eunotia	*curvata (Kütz.) Lagerst*	EUNOCURV	113	11	35
Eunotia	*curvata v. subarcuata Woodhead &*	EUNOCURVsu	248	2	235

	Tweed				
Eunotia	*curvata f. bergii Woodhead & Tweed*	EUNOCURVfb	373	16	126
Eunotia	*diodon*	EUNODIOD	24	2	22
Eunotia	*elegans Østrup*	EUNOELEG	11	2	7
Eunotia	*exigua (Breb. Ex Kütz.) Rabenh.*	EUNOEXIG	827	21	176
Eunotia	*fallax A. Cleve*	EUNOFALL	35	4	17
Eunotia	*flexuosa Bréb. ex Kütz.*	EUNOFLEX	22	2	19
Eunotia	*formica Ehr.*	EUNOFORM	3	2	2
Eunotia	*cf. glacialis F. Meister*	EUNOcfGLAC	9	3	4
Eunotia	*girdle view 12_23 µm*	EUNOgirdlS	2320	26	360
Eunotia	*girdle view 30_45 µm*	EUNOgirdl	27	2	20
Eunotia	*incisa W. Sm. ex Greg,*	EUNOINCI	1	1	1
Eunotia	*major*	EUNOMAJO	7	1	7
Eunotia	*microcephala Migula*	EUNOMICR	14	4	7
Eunotia	*naegeli Migula*	EUNONAEG	331	8	160
Eunotia	*nymanniana Grun.*	EUNONYMA	5	3	3
Eunotia	*paludosa v. paludosa Grun.*	EUNOPALUpa	1281	20	156
Eunotia	*paludosa v. trinacria (Krasske) Norpel*	EUNOPALUtr	149	13	35
Eunotia	*paralella Ehr.*	EUNOPARA	1	1	1
Eunotia	*pectinalis (O.F. Müller) Rabenhorst*	EUNOPECT	303	17	125
Eunotia	*perpusilla Grun.*	EUNOPERP	32	1	32
Eunotia	*praerupta Ehr.*	EUNOPRAE	36	6	10
Eunotia	*praerupta v. monodon f. polaris (Berg.) Symoens*	EUNOPRAEmo	14	1	14
Eunotia	*rhomboidea Hust.*	EUNORHOM	71	10	19
Eunotia	*septentrionalis Østrup*	EUNOSEPT	509	15	214
Eunotia	*serra (Ralfs) Ehr.*	EUNOSERR	15	4	7
Eunotia	*soleirolii Boyer*	EUNOSOLE	119	5	87
Eunotia	*steineckii Peters.*	EUNOSTEI	7	4	3
Eunotia	*sudetica O.F. Muller*	EUNOSUDE	74	4	27
Eunotia	*tautoniensis Hust. Ex Patrick*	EUNOTAUT	216	7	78
Eunotia	*tenella (Grunow) Hustedt*	EUNOTENE	55	6	37
Fragilaria	*cf. acidobiontica Camburn & Charles*	FRAGcf.ACID	2	1	2
Fragilaria	*cf. tenera*	FRAGcfTENE	134	1	134
Fragilaria	*vaucheria (Kütz.) Peters.*	FRAGVAUC	25	2	21
Fragilariaforma	*virescens (Ralfs) Williams & Round*	FRAIVIRE	1594	12	463
Frustulia	*crassinervia Lange_Bertalot & Krammer*	FRUSCRAS	15	2	10
Frustulia	*krammeri Lange_Bertalot & Metzeltin*	FRUSKRAM	5	2	3
Frustulia	*pseudomagaliesmontana Camburn &*	FRUSPSEU	1	1	1

	Charles				
Frustulia	*saxonica Rabh*	FRUSSAXO	210	10	67
Frustulia	*vulgaris (Thwaites) DeToni*	FRUSVULG	15	3	7
Gomphonema	*acuminatum Ehr.*	GOMPACUM	1	1	1
Gomphonema	*angustatum (Kütz.) Rabenh.*	GOMPANGU	19	5	6
Gomphonema	*gracile Ehr.*	GOMPGRAC	55	7	21
Gomphonema	*cf minutum Agardh.*	GOMPcfMINU	17	2	16
Gomphonema	*parvulum (Kütz.) Kütz.*	GOMPPARV	320	10	136
Gomphonema	*subclavatum (Grunow) Grunow*	GOMPSUBC	9	2	5
Gomphonema	*variostriatum Camburn & Charles*	GOMPVARI	5	2	4
Gomphonema		GOMPsp.	172	9	60
Lemnicola	*hungarica (Grun.) Round*	LEMNHUNG	4	1	4
Luticola	*mutica (Kütz.) DG Mann*	LUTIMUTI	2	1	2
Meridion	*allensmithii Brandt*	MERIALLE	2	1	2
Meridion	*circulare (Greville) Agardh*	MERICIRC	714	13	150
Navicula	*angusta Grun.*	NAVIANGU	3	1	3
Navicula	*asellus Weinhold ex Hustedt*	NAVIASEL	2	1	2
Navicula	*cryptocephala Kütz*	NAVICRYP	190	5	172
Navicula	*cryptotenella Lange_Bertalot*	NAVICRYT	3	1	3
Navicula	*gregaria Donkin*	NAVIGREG	1	1	1
Navicula	*cf lanceolata (C. Agardh) Kütz.*	NAVICcfLANC	3	1	3
Navicula	*minima Grunow in Van Heurck*	NAVIMINI	6	2	3
Navicula	*cf obsoleta Hust.*	NAVIcfOBSO	3	1	3
Navicula	*phyllepta Kutz.*	NAVIPHYL	7	1	7
Navicula	*subrotundata Hust.*	NAVISUBR	18	1	18
Navicula	*cf. tantula Hust.*	NAVIcfTANT	31	6	17
Navicula	*tenelloides Hust.*	NAVITENE	1	1	1
Navicula	*tenuicephala Hust.*	NAVITENU	8	1	8
Navicula	*variostriata Krasske*	NAVIVARI	20	4	8
Navicula	*ventralis*	NAVIVENT	17	3	13
Navicula		NAVIsp.	185	11	36
Neidium	*affine v. amphirynchus*	NEIDAFFIam	10	1	10
Neidium	*ampliatum (Ehr.) Krammer*	NEIDAMPL	41	8	17
Neidium	*bisucaltum (Lagerst.) Cl.*	NEIDBISU	63	7	21
Neidium		NEIDIRID	1	1	1
Neidium		NEIDsp.	2	1	2
Nitzschia	*acicularis*	NITZACIC	8	1	8
Nitzschia	*acidoclinata Lange_Bertalot Hust.*	NITZACID	9	1	9
Nitzschia	*amphibia Grunow*	NITZAMPH	10	2	7

Nitzschia	*dissipata (Kütz.) Grun.*	NITZDISS	11	3	5
Nitzschia	*frustulum (Kütz.) Grun*	NITZFRUS	24	5	9
Nitzschia	*gracilis Hantzsch*	NITZGRAC	99	4	73
Nitzschia	*linearis*	NITZLINE	4	1	4
Nitzschia	*cf. nana Grun.*	NITZcf.NANA	50	4	28
Nitzschia	*palea (Kütz.) W. Smith*	NITZPALE	29	4	14
Nitzschia	*cf. paleacea Grunow*	NITZcf.PALA	43	4	21
Nitzschia	*cf. palustris Hust.*	NITZcf.PALU	31	6	11
Nitzschia		NITZsp.	142	8	68
Nupela	*neglecta Ponader, Lowe & Potapova*	NUPENEGL	1	1	1
Nupela		NUPEsp.	15	3	9
Pinnularia	*abaujensis v. abujensis (Pant.) Ross*	PINNABAUab	6	3	3
Pinnularia	*abaujensis v. lacustris Camburn & Charles*	PINNABAUla	35	9	10
Pinnularia	*abaujensis v. linearis (Hust.) Patr.*	PINNABAUli	14	4	4
Pinnularia	*abaujensis v. subundulata (Mayer) Patrick*	PINNABAUsu	1	1	1
Pinnularia	*acrosphaeria Rabh.*	PINNACRO	12	3	7
Pinnularia	*biceps W. Greg.*	PINNBICE	1	1	1
Pinnularia	*biceps v. pusilla Camburn and Charles*	PINNBICE.1	14	1	14
Pinnularia	*brebissonii (Kütz.) Rabh.*	PINNBREB	7	4	3
Pinnularia	*brebissonii var. minuta*	PINNBREBmi	1	1	1
Pinnularia	*burkii Patr.*	PINNBURK	40	4	20
Pinnularia	*gibbiformis Krammer*	PINNGIBB	11	1	11
Pinnularia	*girdle view*	PINNgirdle	506	26	64
Pinnularia	*hilseana Janisch ex Rabh.*	PINNHILS	1	1	1
Pinnularia	*cf intermedia*	PINNcfINTE	3	1	3
Pinnularia	*legumen (Ehr.) Ehr.*	PINNLEGU	3	1	3
Pinnularia	*maior (Kütz.) Cleve*	PINNMAIO	15	2	13
Pinnularia	*cf. mesogonglya Ehr.*	PINNcf.MESO	3	1	3
Pinnularia	*mesolepta*	PINNMESL	6	1	6
Pinnularia	*microstauron (Ehr.) Cl.*	PINNMICR	6	3	3
Pinnularia	*microstauron v. adarondakensis Camburn & Charles*	PINNMICRad	34	6	13
Pinnularia	*nodosa (Ehr.) W. Sm.*	PINNNODO	14	4	6
Pinnularia	*nodosa var. constricta f. truncata Fusey*	PINNNODOco	3	1	3
Pinnularia	*obscura Krasske*	PINNOBSC	5	2	3
Pinnularia	*rupestris Hantzsch*	PINNRUPE	100	13	25
Pinnularia	*cf. ruttneri Hust.*	PINNcf.RUTT	20	2	17

Pinnularia	*subcapitata Greg.*	PINNSUBC	92	7	28
Pinnularia	*subcapitata var. paucistriata (Grun.) Cl.*	PINNSUBCpa	17	2	10
Pinnularia	*termitina (Ehr.) Patr.*	PINNTERM	674	13	195
Pinnularia	*viridis (Nitzsch) Ehrenberg*	PINNVIRD	50	5	39
Pinnularia		PINNsp.	16	6	8
Placoneis	*elginensis (Greg.) E. J. Cox*	PLACELGI	24	5	8
Placoneis		PLACsp.	3	1	3
Planothidium	*dubium (Grunow) Round et Bukhtiyarova*	PLANDUBI	2	1	2
Planothidium	*frequentissimum (Lange_Bert.) Round et L.Bukhtiyarova*	PLANFREQ	8	2	7
Planothidium	*lanceolatum (Bréb. ex (Kütz.) Round & Bukhtiyarova*	PLANLANC	104	5	81
Psammothidium	*subatomoides (Hust.) Bukhtiyarova & Round*	PSAMSUBA	5	1	5
Pseudostaurosira	*parasitica*	PSEUPARA	5	1	5
Pseudostaurosira	*brevistriata (Grunow) Williams & Round*	PSEUBREV	1	1	1
Rhopalodia	*gibba (Ehrenb.) O. Müll.*	RHOPGIBB	3	1	3
Sellaphora	*pupula (Kütz.) Mereschk.*	SELLPUPU	17	3	12
Sellaphora	*cf. seminulum (Grunow) D.G. Mann*	SELLcf.SEMI	8	2	5
Stauroneis	*anceps Ehr.*	STAUANCE	125	5	110
Stauroneis	*anceps f. linearis (Ehrenberg) Cleve*	STAUANCP	13	2	11
Stauroneis	*cf. kriegeri Patr.*	STAUcf.KRIE	46	7	19
Stauroneis	*phoenicentron (Nitz.) Ehr.*	STAUPHOE	4	2	3
Stauroneis	*smithii var. incisa*	STAUSMIT	3	1	3
Stauroneis		STAUsp.	3	2	2
Staurosira	*construens v. venter (Ehr.) Hamilton*	STAUCONSve	38	1	38
Stenopterobia	*curvula (W. Smith) Krammer*	STENCURV	1	1	1
Stenopterobia	*delicatissima (Lewis) Breb. ex VH*	STENDELI	13	3	5
Surirella	*angustata Kütz.*	SURIANGU	1	1	1
Surirella		SURIsp.	8	2	7
Synedra	*acus var. radians (Kütz.) Hust.*	SYNEACUSra	22	1	22
Synedra	*rumpens Kütz.*	SYNERUMP	209	2	208
Synedra		SYNEsp.	1	1	1
Tabellaria	*fenestrata (Lyngb.) Kütz.*	TABEFENE	6	1	6
Tabellaria	*flocculosa (Roth) Kütz*	TABEFLOC	456	16	114
Tabellaria	*quadricepta*	TABEQUAD	1	1	1
Ulnaria	*ulna (Nitz.) Compere*	ULNAULNA	1	1	1
		UNKNOWN	6	3	3

Table 21. *2008 Taxa collected in emergence traps. Total is the cumulative taxa abundance for all samples, # of sites obs. is the total number of sites at which that taxon was oserved, and max obs. is the maximum number of specimens identified at one site.*

Order	Family	Genus	Species	Total	# Sites Obs.	Max Obs.
Hemiptera	Aphididae			1	1	1
Hemiptera	Cicadellidae	*Agallia*	*quadripunctata*	1	1	1
Hemiptera	Cicadellidae	*Coelidia*	*olitoria*	1	1	1
Hemiptera	Cicadellidae	*Dikraneura*		1	1	1
Hemiptera	Cicadellidae	*Erythroneura*		3	3	1
Hemiptera	Cicadellidae	*Eupteryx*	*flavoscuta*	1	1	1
Hemiptera	Cicadellidae	*Scaphoideus*		10	6	2
Hemiptera	Cicadellidae			1	1	1
Hemiptera	Miridae	*Neolygus*		1	1	1
Hemiptera	Miridae			1	1	1
Hemiptera	Nabidae			1	1	1
Hemiptera				3	3	1
Hymenoptera	Ceraphronidae			1	1	1
Hymenoptera	Diapriidae			13	9	3
Hymenoptera	Formicidae	*Camponotus*		5	4	2
Hymenoptera	Formicidae	*Formica*		2	1	2
Hymenoptera	Formicidae	*Temnothorax*		1	1	1
Hymenoptera	Ichneumonidae			1	1	1
Hymenoptera	Scelionidae			2	2	1
Hymenoptera	Scelionidae	*Trimorus*		1	1	1

Table 22. *2008 Araneae taxa collected in pitfall traps. Total is the cumulative taxa abundance for all samples, # of sites obs. is the total number of sites at which that taxon was oserved, and max obs. is the maximum number of specimens identified at one site.*

Order	Family	Genus	Species	Total	# Sites Obs.	Max Obs.
Araneae	Agelenidae	*Agelenopsis*		7	7	1
Araneae	Agelenidae	*Tegenaria*		1	1	1
Araneae	Agelenidae			1	1	1
Araneae	Amaurobiidae	*Amaurobius*	*borealis*	1	1	1
Araneae	Amaurobiidae	*Amaurobius*		1	1	1
Araneae	Amaurobiidae	*Callobius*		1	1	1
Araneae	Amaurobiidae	*Coras*		3	3	1
Araneae	Amaurobiidae	*Wadotes*	*calcaratus*	2	2	1
Araneae	Amaurobiidae	*Wadotes*	*hybridus*	16	7	4
Araneae	Amaurobiidae	*Wadotes*		85	35	5
Araneae	Amaurobiidae			3	3	1
Araneae	Araneidae	*Mangora*		1	1	1
Araneae	Clubionidae	*Clubiona*	*spiralis*	1	1	1
Araneae	Clubionidae	*Clubiona*		2	2	1
Araneae	Clubionidae			3	2	2
Araneae	Corinnidae	*Castianeira*	*cingulata*	6	4	3
Araneae	Corinnidae	*Castianeira*		1	1	1
Araneae	Corinnidae	*Phrurotimpus*	*alarius*	22	12	4
Araneae	Corinnidae	*Phrurotimpus*	*borealis*	6	5	2
Araneae	Corinnidae	*Phrurotimpus*		15	10	4
Araneae	Dictynidae	*Cicurina*	*brevis*	1	1	1
Araneae	Dictynidae	*Cicurina*	*robusta*	5	5	1
Araneae	Dictynidae	*Cicurina*		13	10	2
Araneae	Dictynidae			1	1	1
Araneae	Gnaphosidae	*Haplodrassus*		1	1	1
Araneae	Gnaphosidae	*Herpyllus*	*ecclesiasticus*	2	2	1
Araneae	Gnaphosidae	*Sergiolus*	*capulatus*	1	1	1
Araneae	Gnaphosidae	*Zelotes*	*duplex*	1	1	1
Araneae	Gnaphosidae	*Zelotes*	*subterraneus*	3	3	1
Araneae	Gnaphosidae	*Zelotes*		4	3	2
Araneae	Gnaphosidae	*Zeloteshentzi*		1	1	1
Araneae	Gnaphosidae			2	2	1
Araneae	Hahniidae	*Antistea*	*brunnea*	19	9	7
Araneae	Hahniidae	*Antistea*		1	1	1
Araneae	Hahniidae	*Cryphoeca*	*montana*	1	1	1

Araneae	Hahniidae	*Hahnia*		2	2	1
Araneae	Hahniidae	*Hahnia*	*cinerea*	1	1	1
Araneae	Hahniidae	*Neoantistea*	*agilis*	46	20	5
Araneae	Hahniidae	*Neoantistea*	*magna*	426	54	30
Araneae	Hahniidae	*Neoantistea*	*radula*	1	1	1
Araneae	Hahniidae	*Neoantistea*		23	12	5
Araneae	Hahniidae			4	4	1
Araneae	Linyphiidae	*Bathyphantes*	*pallida*	7	3	5
Araneae	Linyphiidae	*Bathyphantes*		8	7	2
Araneae	Linyphiidae	*Centromerus*	*cornupalpis*	1	1	1
Araneae	Linyphiidae	*Ceraticelus*	*fissiceps*	1	1	1
Araneae	Linyphiidae	*Ceraticelus*	*minutus*	1	1	1
Araneae	Linyphiidae	*Ceraticelus*		3	3	1
Araneae	Linyphiidae	*Ceratinops*		6	1	6
Araneae	Linyphiidae	*Dicymbium*	*elongatum*	2	2	1
Araneae	Linyphiidae	*Diplocephalus*	*subrostratus*	2	2	1
Araneae	Linyphiidae	*Diplocephalus*		1	1	1
Araneae	Linyphiidae	*Eperigone*	*entomologica*	1	1	1
Araneae	Linyphiidae	*Eperigone*	*tridentata*	6	2	5
Araneae	Linyphiidae	*Eperigone*	*trilobata*	1	1	1
Araneae	Linyphiidae	*Erigone*		1	1	1
Araneae	Linyphiidae	*Gnathonaroides*	*pedalis*	1	1	1
Araneae	Linyphiidae	*Idionella*		1	1	1
Araneae	Linyphiidae	*Lepthyphantes*	*zebra*	1	1	1
Araneae	Linyphiidae	*Lepthyphantes*		2	1	2
Araneae	Linyphiidae	*Oedothorax*	*trilobatus*	20	6	7
Araneae	Linyphiidae	*Pityohyphantes*		1	1	1
Araneae	Linyphiidae	*Pocadicnemis*	*americana*	4	3	2
Araneae	Linyphiidae	*Pocadicnemis*	*pumila*	6	6	1
Araneae	Linyphiidae	*Sisicottus*		1	1	1
Araneae	Linyphiidae	*Walckenaeria*	*castenea*	1	1	1
Araneae	Linyphiidae	*Walckenaeria*	*communis*	4	4	1
Araneae	Linyphiidae	*Walckenaeria*	*directa*	3	3	1
Araneae	Linyphiidae	*Walckenaeria*	*indirecta*	4	3	2
Araneae	Linyphiidae	*Walckenaeria*	*minuta*	1	1	1
Araneae	Linyphiidae	*Walckenaeria*	*vigilax*	1	1	1
Araneae	Linyphiidae	*Walckenaeria*		24	13	5
Araneae	Linyphiidae			119	42	11
Araneae	Liocranidae	*Agroeca*	*minuta*	2	1	2

Araneae	Liocranidae	*Agroeca*	*ornata*	8	8	1
Araneae	Lycosidae	*Pirata*	*montanus*	53	3	49
Araneae	Lycosidae	*Pirata*	*piratica*	1	1	1
Araneae	Lycosidae	*Pirata*		72	18	41
Araneae	Lycosidae	*Piratainsularis*		260	25	57
Araneae	Lycosidae	*Schizocosa*	*crassipes*	2	2	1
Araneae	Lycosidae	*Schizocosa*		3	2	2
Araneae	Lycosidae	*Trebacosa*	*marxi*	134	20	56
Araneae	Lycosidae	*Trebacosa*		3	2	2
Araneae	Lycosidae	*Trochosa*	*terricola*	2	1	2
Araneae	Lycosidae	*Trochosa*		12	10	2
Araneae	Lycosidae			191	37	60
Araneae	Lyvosidae	*Pirata*	*insularis*	1	1	1
Araneae	Philodromidae	*Philodromus*	*rufus*	2	2	1
Araneae	Salticidae	*Chinattus*	*parvulus*	2	2	1
Araneae	Salticidae	*Habrocestoides*	*parvulum*	1	1	1
Araneae	Salticidae	*Marpissa*	*lineata*	3	1	3
Araneae	Salticidae			5	5	1
Araneae	Tetragnathidae	*Pachygnatha*	*brevis*	3	1	3
Araneae	Tetragnathidae	*Pachygnatha*		10	5	4
Araneae	Tetragnathidae			6	2	3
Araneae	Theridiidae	*Robertus*	*riparius*	3	3	1
Araneae	Theridiidae			1	1	1
Araneae	Thomisidae	*Ozyptila*	*americana*	1	1	1
Araneae	Thomisidae	*Ozyptila*	*distans*	1	1	1
Araneae	Thomisidae	*Ozyptila*		3	3	1
Araneae	Thomisidae	*Xysticus*		3	3	1
Araneae	Thomisidae			1	1	1
Araneae	Zoridae			1	1	1
Araneae				190	51	13

Table 23. *2008 Coleoptera taxa collected in pitfall traps. Total is the cumulative taxa abundance for all samples, # of sites obs. is the total number of sites at which that taxon was oserved, and max obs. is the maximum number of specimens identified at one site.*

Order	Family	Genus	Species	Total	# Sites Obs.	Max Obs.
Coleoptera	Anthribidae	*anthribid*	*anthribid #1*	1	1	1
Coleoptera	Apionidae	*Apion*	*finitimus*	1	1	1
Coleoptera	Cantharidae	*cantharid_larva*	*cantharid_larva #1*	4	4	1
Coleoptera	Cantharidae	*cantharid_larva*	*cantharid_larva #2*	2	2	1
Coleoptera	Cantharidae	*Rhagonycha*	*Rhagonycha #1*	17	14	3
Coleoptera	Cantharidae	*Rhagonycha*	*Rhagonycha #2*	1	1	1
Coleoptera	Carabidae	*Agonum*	*affine*	1	1	1
Coleoptera	Carabidae	*Agonum*	*fidele*	41	26	6
Coleoptera	Carabidae	*Agonum*	*gratiosum*	31	20	4
Coleoptera	Carabidae	*Agonum*	*melanarium*	1	1	1
Coleoptera	Carabidae	*Agonum*	*mutatum*	18	7	5
Coleoptera	Carabidae	*Agonum*	*palustre*	1	1	1
Coleoptera	Carabidae	*Agonum*	*retractum*	7	4	4
Coleoptera	Carabidae	*Agonum*	*thoreyi*	1	1	1
Coleoptera	Carabidae	*Amphasia*	*interstitialis*	3	3	1
Coleoptera	Carabidae	*Bembidion*	*Bembidion #1*	1	1	1
Coleoptera	Carabidae	*Bembidion*	*concretum*	12	7	5
Coleoptera	Carabidae	*carabid*	*carabid #1*	1	1	1
Coleoptera	Carabidae	*carabid_larva*	*carabid_larva #1*	3	3	1
Coleoptera	Carabidae	*carabid_larva*	*carabid_larva #2*	10	9	2
Coleoptera	Carabidae	*carabid_larva*	*carabid_larva #3*	1	1	1
Coleoptera	Carabidae	*carabid_larva*	*carabid_larva #4*	1	1	1
Coleoptera	Carabidae	*Cymindis*	*limbata*	3	3	1
Coleoptera	Carabidae	*Dicaelus*	*Dicaelus #1*	1	1	1
Coleoptera	Carabidae	*Elaphrus*	*americanus*	1	1	1
Coleoptera	Carabidae	*Loricera*	*pilicornis*	4	2	3
Coleoptera	Carabidae	*Notiophilus*	*aeneus*	2	2	1
Coleoptera	Carabidae	*Olisthopus*	*micans*	1	1	1
Coleoptera	Carabidae	*Oodes*	*fluvialis*	6	5	2
Coleoptera	Carabidae	*Oxypselaphus*	*pusillus*	3	3	1
Coleoptera	Carabidae	*Patrobus*	*longicornis*	1	1	1
Coleoptera	Carabidae	*Platynus*	*decentis*	6	6	1
Coleoptera	Carabidae	*Poecilus*	*lucublandus*	4	1	4
Coleoptera	Carabidae	*Pterostichus*	*adoxus*	3	2	2

Coleoptera	Carabidae	*Pterostichus*	*caudicalis*	1	1	1
Coleoptera	Carabidae	*Pterostichus*	*commutabilis*	13	11	2
Coleoptera	Carabidae	*Pterostichus*	*coracinus*	42	31	3
Coleoptera	Carabidae	*Pterostichus*	*corvinus*	10	7	2
Coleoptera	Carabidae	*Pterostichus*	*diligendus*	2	2	1
Coleoptera	Carabidae	*Pterostichus*	*luctuosus*	31	15	6
Coleoptera	Carabidae	*Pterostichus*	*mutus*	2	2	1
Coleoptera	Carabidae	*Pterostichus*	*patruelis*	2	2	1
Coleoptera	Carabidae	*Pterostichus*	*pennsylvanicus*	11	8	3
Coleoptera	Carabidae	*Pterostichus*	*rostratus*	4	3	2
Coleoptera	Carabidae	*Pterostichus*	*tenuis*	2	2	1
Coleoptera	Carabidae	*Pterostichus*	*tristis*	25	13	6
Coleoptera	Carabidae	*Sphaeroderus*	*canadensis*	5	5	1
Coleoptera	Carabidae	*Sphaeroderus*	*stenostomus*	6	6	1
Coleoptera	Carabidae	*Synuchus*	*impunctatus*	32	23	3
Coleoptera	Carabidae	*Trichiotichnus*	*autumnalis*	1	1	1
Coleoptera	Carabidae			1	1	1
Coleoptera	Cercopidae	*Clastoptera*	*Clastoptera #1*	1	1	1
Coleoptera	Chrysomelidae	*Altica*	*Altica #1*	1	1	1
Coleoptera	Chrysomelidae	*Capraita*	*subvittata*	1	1	1
Coleoptera	Chrysomelidae	*chrysomelid_larva*	*chrysomelid_larva #1*	5	5	1
Coleoptera	Cryptophagidae	*Caenoscelis*	*Caenoscelis #1*	2	2	1
Coleoptera	Curculionidae	*Anthonomus*	*Anthonomus #1*	2	1	2
Coleoptera	Curculionidae	*Barypeithes*	*pellucidus*	2	2	1
Coleoptera	Curculionidae	*Conotrachelus*	*posticatus*	4	3	2
Coleoptera	Curculionidae	*Dryophthorus*	*americanus*	1	1	1
Coleoptera	Curculionidae	*Sphenophorus*	*Sphenophorus #1*	1	1	1
Coleoptera	Curculionidae	*Trachyphloeus*	*bifoveolatus*	1	1	1
Coleoptera	Curculionidae	*Xylosandrus*	*germanus*	2	2	1
Coleoptera	Dytiscidae	*Agabus*	*Agabus #1*	1	1	1
Coleoptera	Dytiscidae	*Agabus*	*Agabus #2*	1	1	1
Coleoptera	Dytiscidae	*Agabus*	*Agabus #3*	1	1	1
Coleoptera	Dytiscidae	*dytiscid_larva*	*dytiscid_larva #1*	1	1	1
Coleoptera	Dytiscidae	*dytiscid_larva*	*dytiscid_larva #2*	3	1	3
Coleoptera	Dytiscidae	*Hydaticus*	*aruspex*	2	2	1
Coleoptera	Elateridae	*Dalopius*	*Dalopius #1*	1	1	1
Coleoptera	Elateridae	*Dalopius_larva*	*Dalopius_larva #1*	4	4	1
Coleoptera	Elateridae	*elaterid*	*elaterid #1*	1	1	1
Coleoptera	Elateridae	*elaterid_larva*	*elaterid_larva #1*	1	1	1

Coleoptera	Elateridae	*elaterid_larva*	*elaterid_larva #2*	1	1	1
Coleoptera	Formicidae	*Camponotus*		1	1	1
Coleoptera	Geotrupidae	*Geotrupes*	*balyi*	1	1	1
Coleoptera	Hydraenidae	*Hydraena*	*Hydraena #1*	4	4	1
Coleoptera	Hydrophilidae	*Anacaena*	*limbata*	4	4	1
Coleoptera	Hydrophilidae	*Cercyon*	*connivens*	3	3	1
Coleoptera	Hydrophilidae	*Cryptopleurum*	*Cryptopleurum #2*	1	1	1
Coleoptera	Hydrophilidae	*Cymbiodyta*	*vindicata*	1	1	1
Coleoptera	Hydrophilidae	*hydrophilid_larva*	*hydrophilid_larva #1*	1	1	1
Coleoptera	Lampyridae	*lampyrid*	*lampyrid #1*	1	1	1
Coleoptera	Lampyridae	*lampyrid_larva*	*lampyrid_larva #3*	5	5	1
Coleoptera	Lampyridae	*lampyrid_larva*	*lampyrid_larva #4*	11	10	2
Coleoptera	Lampyridae	*lampyrid_larva*	*lampyrid_larva #5*	1	1	1
Coleoptera	Lampyridae	*lampyrid_larva*	*lampyrid_larva #6*	1	1	1
Coleoptera	Lampyridae	*lampyrid_larva*	*lampyrid_larva #8*	2	2	1
Coleoptera	Lampyridae	*Photinus*	*Photinus #1*	3	1	3
Coleoptera	Lampyridae	*Pyractomena*	*Pyractomena #1*	3	3	1
Coleoptera	Lampyridae	*Pyropyga*	*decipiens*	3	3	1
Coleoptera	Leiodidae	*Agathidium*	*oniscoides*	2	2	1
Coleoptera	Leiodidae	*Catops*	*hornianus*	2	1	2
Coleoptera	Leiodidae	*Leiodes*	*Leiodes #1*	1	1	1
Coleoptera	Lycidae	*Plateros*	*Plateros #1*	1	1	1
Coleoptera	Lycidae	*Plateros*	*Plateros #2*	1	1	1
Coleoptera	Melandryidae	*Dicerea*	*literata*	1	1	1
Coleoptera	Melandryidae	*melandryid_larva*	*melandryid_larva #1*	1	1	1
Coleoptera	Nitidulidae	*Pallodes*	*pallidus*	38	24	8
Coleoptera	Nitidulidae	*Stelidota*	*geminata*	1	1	1
Coleoptera	Nitidulidae	*Stelidota*	*octomaculata*	2	1	2
Coleoptera	Ptiliidae	*Acrotrichus*	*Acrotrichus #1*	8	5	3
Coleoptera	Ptiliidae	*Nephanes*	*Nephanes #1*	5	4	2
Coleoptera	Ptiliidae	*Nossidium*	*Nossidium #1*	1	1	1
Coleoptera	Ptiliidae	*Ptenidium*	*Ptenidium #1*	3	3	1
Coleoptera	Ptiliidae	*ptiliid_larva*	*ptiliid_larva #1*	1	1	1
Coleoptera	Scarabaeidae	*Dialytes*	*striatulus*	1	1	1
Coleoptera	Scarabaeidae	*Serica*	*Serica #1*	1	1	1
Coleoptera	Scirtidae	*Cyphon*	*Cyphon #1*	13	12	2
Coleoptera	Scirtidae	*Cyphon*	*Cyphon #2*	4	4	1
Coleoptera	Scirtidae	*Cyphon*	*Cyphon #3*	2	2	1
Coleoptera	Scirtidae	*Cyphon*	*Cyphon #4*	1	1	1

Coleoptera	Scirtidae	*Cyphon_larva*	*Cyphon_larva #1*	22	4	19
Coleoptera	Scydmaenidae	*Euconnus*	*Euconnus #1*	1	1	1
Coleoptera	Scydmaenidae	*Euconnus*	*Euconnus #2*	1	1	1
Coleoptera	Scydmaenidae	*Euconnus*	*Euconnus #3*	4	4	1
Coleoptera	Scydmaenidae	*Parascydmus*	*Parascydmus #1*	13	9	3
Coleoptera	Scydmaenidae	*scydmaenid_larva*	*scydmaenid_larva #1*	3	2	2
Coleoptera	Scydmaenidae	*scydmaenid_larva*	*scydmaenid_larva #2*	1	1	1
Coleoptera	Silphidae	*Nicrophorus*	*defodiens*	3	1	3
Coleoptera	Sphindidae	*Eurysphindus*	*hirtus*	1	1	1
Coleoptera	Staphylinidae	*Acylophorus*	*caseyi*	1	1	1
Coleoptera	Staphylinidae	*Aleocharinae*		2	2	1
Coleoptera	Staphylinidae	*Aleocharinae*	*Aleocharinae #2*	19	12	3
Coleoptera	Staphylinidae	*Aleocharinae*	*Aleocharinae #4*	1	1	1
Coleoptera	Staphylinidae	*Aleocharinae*	*Aleocharinae #5*	1	1	1
Coleoptera	Staphylinidae	*Aleocharinae*	*Aleocharinae #6*	1	1	1
Coleoptera	Staphylinidae	*Aleocharinae*	*Aleocharinae #7*	1	1	1
Coleoptera	Staphylinidae	*Aleocharinae*	*Aleocharinae #8*	2	2	1
Coleoptera	Staphylinidae	*Aleocharinae*	*Aleocharinae #9*	13	9	3
Coleoptera	Staphylinidae	*Aleocharinae_larva*	*Aleocharinae_larva #1*	1	1	1
Coleoptera	Staphylinidae	*Bibloplectus*	*ruficeps*	2	2	1
Coleoptera	Staphylinidae	*Bryoporus*	*rufescens*	1	1	1
Coleoptera	Staphylinidae	*Carpelimus*	*Carpelimus #1*	43	21	9
Coleoptera	Staphylinidae	*Cordalia*	*Cordalia #1*	2	2	1
Coleoptera	Staphylinidae	*Euaesthetus*	*Euaesthetus #1*	11	9	2
Coleoptera	Staphylinidae	*Eubaeocera*	*Eubaeocera #1*	6	5	2
Coleoptera	Staphylinidae	*Eubaeocera*	*Eubaeocera #2*	16	15	2
Coleoptera	Staphylinidae	*Eubaeocera*	*Eubaeocera #3*	1	1	1
Coleoptera	Staphylinidae	*Eubaeocera*	*Eubaeocera #5*	1	1	1
Coleoptera	Staphylinidae	*Gabrius*	*Gabrius #1*	1	1	1
Coleoptera	Staphylinidae	*Gyrophaena*	*Gyrophaena #1*	4	3	2
Coleoptera	Staphylinidae	*Gyrophaena*	*Gyrophaena #2*	2	2	1
Coleoptera	Staphylinidae	*Ischnosoma*	*pictum*	1	1	1
Coleoptera	Staphylinidae	*Laetulonthus*	*laetulus*	1	1	1
Coleoptera	Staphylinidae	*Lathrobium*	*Lathrobium #1*	4	4	1
Coleoptera	Staphylinidae	*Lithocharis*	*Lithocharis #1*	1	1	1
Coleoptera	Staphylinidae	*Lordithon*	*Lordithon #1*	1	1	1
Coleoptera	Staphylinidae	*Philonthus*	*caeruleipennis*	1	1	1
Coleoptera	Staphylinidae	*Philonthus*	*Philonthus #1*	3	3	1
Coleoptera	Staphylinidae	*Platydracus*	*viridianus*	55	25	7

Coleoptera	Staphylinidae	*Proteinus*	*Proteinus #1*	4	4	1
Coleoptera	Staphylinidae	*Quedius*	*Quedius #1*	1	1	1
Coleoptera	Staphylinidae	*Rybaxis*	*Rybaxis #1*	2	1	2
Coleoptera	Staphylinidae	*Sepedophilus*	*Sepedophilus #1*	1	1	1
Coleoptera	Staphylinidae	*staph_larva*	*staph_larva #1*	4	3	2
Coleoptera	Staphylinidae	*staph_larva*	*staph_larva #2*	1	1	1
Coleoptera	Staphylinidae	*staph_larva*	*staph_larva #3*	1	1	1
Coleoptera	Staphylinidae	*Stenus*	*Stenus #1*	1	1	1
Coleoptera	Staphylinidae	*Tachinus*	*fumipennis*	1	1	1
Coleoptera	Staphylinidae	*Tachinus*	*scrutator*	1	1	1
Coleoptera	Staphylinidae	*Tasgius*	*Tasgius #1*	1	1	1
Coleoptera	Staphylinoidea	*larva*	*larva #1*	1	1	1
Coleoptera	Tenebrionidae	*Anaedus*	*brunneus*	1	1	1
Coleoptera	Tenthredinidae	*tenthredinid_larva*	*tenthredinid_larva #1*	2	2	1
Coleoptera	Tetratomidae	*Orchesia*	*ovata*	2	2	1
Coleoptera	Thripidae	*Thripidae*	*Thripidae #1*	2	1	2
Coleoptera	Throscidae	*Aulonothroscus*	*constrictor*	1	1	1

Table 24. *2008 Collembola Taxa (Pitfall Trap Samples). Total Abundance is the cumulative taxa abundance for all samples, # Sites Obs. is the total number of sites at which that taxon was oserved.*

Taxon	Total Abundance	# Sites Obs.
Dicyrtoma	400	61
Entomobrya	28	17
Folsomia	9	7
Hypogastrura	1003	59
Isotoma	107	39
Lepidocyrtus	106	41
Orchesella	199	51
Pseudachorutes	181	60
Tomocerus	333	58
Sinella	253	49
Onychiurus	22	17
Sminthurus	2	2
Neanura	2	2
Willemia	2	1
Bourletiella	1	1
Metisotoma	1	1
Neosminthurus	4	4
Microgastrura	4	4
Odontella	9	6
Heteromurus	1	1
Isotomiella	2	2
Sphyrotheca	1	1
Sminthurides	4	4
Entomobryidae	6	3
Paranura	2	2
Podura	1	1
Hypogastruridae	1	1
Proisotoma	2	2
Dagamaea	1	1
Arrhopalites	2	2
Isotomurus	9	1

Table 25. *2008 Hemiptera taxa collected in pitfall traps. Total is the cumulative taxa abundance for all samples, # of sites obs. is the total number of sites at whcih that taxon was oserved, and max obs. is the maximum number of specimens identified at one site.*

Order	Family	Genus	Species	Total	# Sites Obs.	Max Obs.
Hemiptera	Achilidae	*Epiptera*		1	1	1
Hemiptera	Achilidae			10	9	2
Hemiptera	Aleyrodidae			2	2	1
Hemiptera	Anthocoridae	*Orius*		1	1	1
Hemiptera	Aphididae			23	12	8
Hemiptera	Ceratocombidae	*Ceratocombus*	*vagans*	26	20	3
Hemiptera	Cercopidae	*aphrophora*	*cribrata*	1	1	1
Hemiptera	Cercopidae			2	2	1
Hemiptera	Cicadellidae	*Agallia*	*constricta*	1	1	1
Hemiptera	Cicadellidae	*Agallia*	*quadripunctata*	1	1	1
Hemiptera	Cicadellidae	*Agallia*		21	17	3
Hemiptera	Cicadellidae	*Agalliopsis*		2	2	1
Hemiptera	Cicadellidae	*Alebra*		1	1	1
Hemiptera	Cicadellidae	*Coelidia*	*olitoria*	1	1	1
Hemiptera	Cicadellidae	*Erythroneura*		1	1	1
Hemiptera	Cicadellidae	*Ponana*		1	1	1
Hemiptera	Cicadellidae	*Scaphoideus*		303	58	34
Hemiptera	Cicadellidae	*Typhlocyba*		1	1	1
Hemiptera	Cicadellidae			4	4	1
Hemiptera	Cixiidae	*Cixius*	*meridionalis*	1	1	1
Hemiptera	Delphacidae	*Nothodelphax*		1	1	1
Hemiptera	Delphacidae	*Pissonotus*		3	2	2
Hemiptera	Delphacidae			3	2	2
Hemiptera	Derbidae	*Cedusa*		1	1	1
Hemiptera	Flatidae	*Metcalfa*	*pruinosa*	1	1	1
Hemiptera	Heteroptera			1	1	1
Hemiptera	Miridae	*Fulvius*	*slateri*	1	1	1
Hemiptera	Miridae	*Phytocoris*		1	1	1
Hemiptera	Miridae			7	7	1
Hemiptera	Nabidae	*Hoplistoscelis*	*sordidus*	1	1	1
Hemiptera	Nabidae	*Lasiomerus*	*annulatus*	1	1	1
Hemiptera	Nabidae			6	5	2
Hemiptera	Ortheziidae			2	2	1
Hemiptera	Psyllidae			2	2	1

Hemiptera	Reduviidae	*Barce*	2	2	1
Hemiptera	Rhyparochromidae	*Rhyparochromus*	1	1	1
Hemiptera	Saldidae	*Saldula*	10	7	4
Hemiptera	Veliidae	*Microvelia*	7	4	3

Table 26. *2008 Hymenoptera taxa collected in pitfall traps. Total is the cumulative taxa abundance for all samples, # of sites obs. is the total number of sites at which that taxon was oserved, and max obs. is the maximum number of specimens identified at one site.*

Order	Family	Genus	Species	Total	# Sites Obs.	Max obs.
Hymenoptera	Aphelinidae			1	1	1
Hymenoptera	Braconidae			5	5	1
Hymenoptera	Ceraphronidae			24	21	2
Hymenoptera	Chalcidoidea			1	1	1
Hymenoptera	Cynipidae			1	1	1
Hymenoptera	Diapriidae			17	15	2
Hymenoptera	Dryinidae			9	6	4
Hymenoptera	Encyrtidae			5	5	1
Hymenoptera	Eulophidae			4	4	1
Hymenoptera	Figitidae			4	4	1
Hymenoptera	Formicidae	*Aphaenogaster*		55	33	4
Hymenoptera	Formicidae	*Camponotus*		26	19	4
Hymenoptera	Formicidae	*Formica*		9	1	9
Hymenoptera	Formicidae	*Lasius*	*flavus*	25	4	12
Hymenoptera	Formicidae	*Lasius*	*niger*	17	15	2
Hymenoptera	Formicidae	*Lasius*	*umbratus*	78	4	39
Hymenoptera	Formicidae	*Lasius*		16	6	10
Hymenoptera	Formicidae	*Myrmecina*	*americana*	11	6	4
Hymenoptera	Formicidae	*Myrmica*	*rubra*	1	1	1
Hymenoptera	Formicidae	*Myrmica*		28	17	3
Hymenoptera	Formicidae	*Ponera*	*pennsylvanica*	2	2	1
Hymenoptera	Formicidae	*Stenamma*		4	3	2
Hymenoptera	Formicidae	*Tapinoma*		1	1	1
Hymenoptera	Formicidae	*Temnothorax*		26	11	12
Hymenoptera	Formicidae			3	3	1
Hymenoptera	Halictidae			1	1	1
Hymenoptera	Ichneumonidae			6	6	1
Hymenoptera	Megaspilidae			1	1	1
Hymenoptera	Mymaridae			6	6	1
Hymenoptera	Platygastridae			4	4	1
Hymenoptera	Pompilidae	*Anoplius*		1	1	1
Hymenoptera	Pteromalidae			1	1	1
Hymenoptera	Scelionidae	*Baeus*		7	7	1
Hymenoptera	Scelionidae	*Trimorus*		253	58	32
Hymenoptera	Scelionidae			19	15	3

Hymenoptera	Tenthredinidae	*Macrophya*		1	1	1
Hymenoptera				1	1	1

Table 27. *2008 Orthoptera taxa collected in pitfall traps. Total is the cumulative taxa abundance for all samples, # of sites obs. is the total number of sites at which that taxon was oserved, and max obs. is the maximum number of specimens identified at one site.*

Order	Family	Genus	Species	Total	# Sites Obs.	Max Obs.
Orthoptera	Gryllidae	*Gryllus*		33	22	5
Orthoptera	Gryllidae	*Neoxabea*	*bipunctata*	1	1	1
Orthoptera	Gryllidae	*Oecanthus*	*fultoni*	1	1	1
Orthoptera	Gryllidae	*Oecanthus*		1	1	1
Orthoptera	Gryllidae			21	10	5
Orthoptera	Rhaphidophoridae	*Ceuthophilus*		13	12	2

Table 28*. Upland Forest Earthworm Taxa collected in 2007. Total Abundance is the cumulative taxa abundance for all samples, # Sites Obs. is the total number of sites at which that taxon was oserved.*

Taxon	Total Abundance	# Sites Obs.
Dendrobaena octaedra	178	27
Lumbricidae	65	24
Aporrectodea	116	20
Lumbricus	78	17
Lumbricus terrestris	15	12
Octolasion	6	2
Octolasion tyrtaeum	2	2
Aporrectodea tuberculata	3	2
Aporrectodea caliginosa complex	2	2
Aporrectodea longa	1	1
Octolasion cyaneum	1	1
Amynthas	6	1
Dendrodrilus rubidus	1	1
Aporrectodea rosea	1	1
Aporrectodea trapezoides	1	1

Table 29*. Forested Wetland Earthworm Taxa collected in 2008 and 2009. Total Abundance is the cumulative taxa abundance for all samples, # Sites Obs. is the total number of sites the taxon was observed.*

Taxon	Total Abundance	# Sites Obs.
Dendrobaena octaedra	30	17
Lumbricus	28	16
Aporrectodea	26	16
Lumbricus terrestris	8	7
Amynthas	7	6
Lumbricidae	10	6
Octolasion	4	4
Octolasion tyrtaeum	6	4
Lumbricus rubellus	4	3
Aporrectodea caliginosa	2	2
Aporrectodea rosea	1	1
Aporrectodea caliginosa complex	1	1

Table 30. *2008 Bryophyte Taxa*.

Taxa	# of Sites	Taxa	# of Sites
Sphagnum palustre	57	*Polytrichum pallidisetum*	3
Aulacomnium palustre	54	*Rhytidiadelphus squarrosus*	3
Thuidium delicatulum	50	*Sphagnum capillifolium var tenellum*	2
Dicranum flagellare	47	*Polytrichum formosum*	2
Hypnum imponens	44	*Diphyscium foliosum*	2
Dicranum scoparium	43	*Amblystegium tenax*	2
Pallavicinia lyellii	38	*Anomodon attenuatus*	2
Leucobryum glaucum	38	*Plagiochila porelloides*	2
Callicladium haldanianum	37	*Plagiothecium cavifolium*	2
Tetraphis pellucida	37	*Dicranum fulvum*	2
Bazzania trilobata	35	*Plagiomnium ellipticum*	2
Bryhnia novae angliae	29	*Helodium paludosum*	2
Mnium hornum	22	*Pellia neesiana*	2
Sphagnum fimbriatum	20	*Climacium americanum var kindbergii*	2
Sphagnum magellanicum	20	*Sphagnum cuspidatum*	2
Atrichum altecristatum	20	*Lophocolea heterophylla*	2
Polytrichum commune	17	*Conocephalum conicum*	2
Calypogeia muelleriana	15	*Pellia epiphylla*	2
Climacium americanum	15	*Leptodictyum riparium*	2
Pseudobryum cinclidioides	15	*Odontoschisma prostratum*	2
Climacium dendroides	15	*Ptilidium pulcherrimum*	1
Plagiomnium ciliare	14	*Sphagnum centrale*	1
Sphagnum girgensohnii	13	*Drepanocladus fluitans*	1
Rhizomnium appalachianum	12	*Polytrichum strictum*	1
Sphagnum capillifolium	11	*Pseudotaxiphyllum elegans*	1
Sphagnum subsecundum	11	*Nowellia curvifolia*	1
Cephalozia lunulifolia	10	*Brachythecium oxycladon*	1
Herzogiella striatella	10	*Brachythecium plumosum*	1
Sphagnum fallax	9	*Eurhynchium pulchellum*	1
Sphagnum flexuosum	9	*Polytrichum juniperinum*	1
Brotherella recurvans	8	*Dicranum montanum*	1
Brachythecium salebrosum	8	*Chiloscyphus polyanthos*	1
Kurzia sylvatica	8	*Platygyrium repens*	1
Plagiomnium cuspidatum	8	*Sphagnum russowii*	1
Calypogeia fissa	7	*Fontinalis novae angliae*	1
Rhizomnium punctatum	7	*Loeskeobryum brevirostre*	1

Calliergon cordifolium	7	*Geocalyx graveolens*	1
Plagiothecium denticulatum	6	*Pohlia nutans*	1
Brachythecium rivulare	5	*Lepidozia reptans*	1
Brachythecium rutabulum	5	*Odontoschisma denudatum*	1
Polytrichum ohioense	5	*Riccardia multifida*	1
Sphagnum squarrosum	5	*Fissidens dubius*	1
Pseudotaxiphyllum distichaceum	4	*Hypnum cupressiforme*	1
Pleurozium schreberi	4	*Dicranum fuscescens*	1
Atrichum angustatum	4	*Drepanocladus aduncus*	1
Plagiomnium rostratum	4	*Trichocolea tomentella*	1
Jamesoniella autumnalis	3	*Brachythecium campestre*	1
Dicranella heteromalla	3	*Dicranum viride*	1
Hypnum lindbergii	3	*Rhytidiadelphus triquetrus*	1
Scapania nemorea	3	*Pohlia*	1
Plagiothecium latebricola	3	*Riccia fluitans*	1
Rhynchostegium serrulatum	3		

APPENDIX B: SALT MARSH 2009 SPECIMEN DATA

***Table 31**. Salt marsh invertebrate data taxonomy.*

Division/Phylum	Class	Order	Family	Genus	Species
Annelida	Polychaeta	Phyllodocida	Nereidae	*Diadumene*	*lineata*
Arthropoda	Anthozoa	Tanaidacea	Leptocheliidae	*Hemigraspus*	*sanguineus*
Chordata	Arachnida	Capitellida	Capitellidae	*Limulus*	*polyphemus*
Cnidaria	Ascidiacea	Mesogastropoda	Hydrobiidae	*Carcinus*	*maenas*
Mollusca	Bivalvia	Spionida	Maldanidae	*Geukensia*	*demissa*
Nematoda	Bivalvia.Pelecypoda	Haplotaxida	Syllidae		
Nemertea	Crustacea	Terebellida	Spionidae		
	Gastropoda	Hemiptera	Ampharetidae		
	Insecta	Tubificida	Naididae		
	Merostomata	Veneroida	Tellinidae		
	Oligochaeta	Neograstropoda	Nassariidae		
		Diptera	Tipulidae		
		Amphipoda	Aoridae		
		Orbiniida	Gammaridae		
		Eunicida	Littorinidae		
		Lepidoptera	Orbiniidae		
		Basommatophora	Terebellidae		
		Acarina	Eunicidae		
		Coleoptera	Phyllodocidae		
		Araneae	Chironomidae		
		Trichoptera	Arabellidae		
		Cumacea	Melampodidae		
		Mytiloida	Ampeliscidae		
		Opheliida	Tabanidae		
		Myoida	Talitridae		
		Hymenoptera	Clubionidae		
		Decapoda	Arenicolidae		
		Isopoda	Nephtyidae		
		Sabellida	Mytilidae		
		Collembola	Curculionidae		
		Scaphandridae	Opheliidae		
		Orthoptera	Fulgoridae		
		Cirratulida	Myidae		
		Dermaptera	Hydropsychidae		
		Actiniaria	Scalibregmidae		
		Pseudoscorpiones	Palaemonidae		
		Xiphosura	Janiridae		

Pectinariidae	Sabellidae
Cheilostomata	Ceratopogonidae
Mantodea	Cancridae
	Micryphantidae
	Aphididae
	Hydroptilidae
	Lycosidae
	Miridae
	Culicidae
	Ephydridae
	Platygastridae
	Idoteidae
	Rhyacophilidae
	Lumbrineridae
	Mactridae
	Paraonidae
	Xanthidae
	Dolichopodidae
	Crangonidae
	Dorvilleidae
	Saldidae
	Corophiidae
	Tettigonidae
	Ocypodidae
	Cicadellidae
	Gryllidae
	Chiridotea
	Varunidae
	Mogulaso
	Poduridae
	Portunidea
	Formicidae
	Linyphidae
	Molgulidae
	Rhagionidae
	Rhyacephilidae

Table 32. *Salt marsh invertebrate abundance and frequency of occurrence (all samples combined).*

Taxon	Min	Max	Mean	Median	Total	% of Sites Absent	No. of Sites
Acarina	1	3	1.4	1	30	49	21
Actinaria	1	1	1.0	1	2	95	2
Ampeliscidae	1	1	1.0	1	2	95	2
Ampharetidae	1	23	5.7	2	51	78	9
Aoridae	1	48	8.4	2	76	78	9
Aphididae	1	35	12.3	1	37	93	3
Arabellidae	1	4	2.0	1	6	93	3
Araneae	1	19	3.7	2	139	7	38
Arenicolidae	1	5	2.3	1	7	93	3
Bivalvia	13	13	13.0	13	13	98	1
Cancridae	1	3	1.5	1	6	90	4
Capitellidae	1	18	4.4	2	102	44	23
Carcinus maenas	1	1	1.0	1	1	98	1
Ceratopogonidae	1	8	2.7	2	16	85	6
Chiridotea	1	1	1.0	1	1	98	1
Chironomidae	1	7	2.0	1	22	73	11
Cicadellidae	1	14	6.2	4	31	88	5
Clubionidae	1	8	2.0	1	44	46	22
Coleoptera	1	6	1.8	1	48	37	26
Collembola	1	7	2.8	2	17	85	6
Corophiidae	1	1	1.0	1	1	98	1
Crangonidae	6	6	6.0	6	6	98	1
Culicidae	1	3	1.6	1.5	13	80	8
Cumacea	1	22	6.2	1.5	37	85	6
Curculionidae	1	1	1.0	1	4	90	4
Decapoda	5	5	5.0	5	5	98	1
Dermaptera	1	1	1.0	1	1	98	1
Diadumene lineata	1	1	1.0	1	2	95	2
Diptera	1	26	5.2	2.5	135	37	26
Dolichopodidae	2	3	2.5	2.5	5	95	2
Dorvilleidae	1	1	1.0	1	1	98	1
Ephydridae	1	5	2.0	1	12	85	6
Eunicidae	2	2	2.0	2	4	95	2
Formicidae	1	1	1.0	1	1	98	1
Fulgoridae	1	50	5.2	2.5	136	37	26
Gammaridae	1	36	7.9	3	158	51	20

Gastropoda	2	2	2.0	2	2	98	1
Geukensia demissa	1	78	11.8	2.5	213	56	18
Gryllidae	1	1	1.0	1	1	98	1
Haplotaxida	1	152	10.3	2	268	37	26
Hemigraspus sanguineus	1	1	1.0	1	1	98	1
Hemiptera	1	22	3.8	2	123	22	32
Hydrobiidae	1	71	8.3	2	191	44	23
Hydropsychidae	1	3	1.3	1	8	85	6
Hydroptilidae	1	1	1.0	1	1	98	1
Hymenoptera	1	3	1.5	1	20	68	13
Idoteidae	1	1	1.0	1	2	95	2
Insecta	1	2	1.5	1.5	3	95	2
Isopoda	1	4	2.2	2	11	88	5
Janiridae	1	139	35.5	1	142	90	4
Lepidoptera	1	2	1.5	1.5	3	95	2
Leptocheliidae	1	254	30.3	4	698	44	23
Limulus polyphemus	1	1	1.0	1	2	95	2
Linyphidae	2	2	2.0	2	2	98	1
Littorinidae	1	88	12.1	2	326	34	27
Lumbrineridae	1	1	1.0	1	2	95	2
Lycosidae	1	3	1.6	1	8	88	5
Mactridae	1	12	6.5	6.5	13	95	2
Maldanidae	2	33	8.4	3	59	83	7
Mantodea	1	1	1.0	1	1	98	1
Melampodidae	1	48	7.1	3	219	24	31
Micryphantidae	2	5	3.7	4	11	93	3
Miridae	1	9	2.0	1	18	78	9
Mogulaso	9	9	9.0	9	9	98	1
Molgulidae	1	1	1.0	1	1	98	1
Myidae	1	1	1.0	1	3	93	3
Mytilidae	1	1	1.0	1	3	93	3
Naididae	1	3	1.7	1	5	93	3
Nassariidae	1	2	1.7	2	5	93	3
Nematoda	1	1	1.0	1	2	95	2
Nemertea	1	2	1.5	1.5	3	95	2
Nephtyidae	1	1	1.0	1	1	98	1
Nereidae	1	16	2.7	2	53	51	20
Ocypodidae	1	6	2.5	2	15	85	6
Oligochaeta	55	55	55.0	55	55	98	1
Opheliidae	1	2	1.5	1.5	3	95	2
Orbiniidae	1	2	1.2	1	6	88	5

Orthoptera	1	12	2.7	2	30	73	11
Palaemonidae	1	64	13.0	5	169	68	13
Paraonidae	2	3	2.5	2.5	5	95	2
Pectinariidae	1	1	1.0	1	1	98	1
Phyllodocidae	1	4	1.6	1	8	88	5
Platygastridae	1	1	1.0	1	2	95	2
Poduridae	1	1	1.0	1	1	98	1
Polychaeta	2	2	2.0	2	2	98	1
Portunidea	1	4	1.8	1	16	78	9
Pseudoscorpiones	1	1	1.0	1	1	98	1
Rhagionidae	1	1	1.0	1	1	98	1
Rhyacephilidae	1	1	1.0	1	1	98	1
Rhyacophilidae	1	1	1.0	1	1	98	1
Sabellidae	1	58	14.2	4	71	88	5
Saldidae	2	2	2.0	2	2	98	1
Scalibregmidae	1	1	1.0	1	1	98	1
Scaphandridae	1	1	1.0	1	1	98	1
Spionidae	1	85	15.4	3	185	71	12
Syllidae	1	3	2.3	3	7	93	3
Tabanidae	1	2	1.3	1	5	90	4
Talitridae	1	61	8.2	3	335	0	41
Tellinidae	1	1	1.0	1	2	95	2
Terebellidae	1	161	24.7	1	173	83	7
Tettigonidae	2	2	2.0	2	2	98	1
Tipulidae	1	4	1.6	1	13	80	8
Trichoptera	1	1	1.0	1	1	98	1
Xanthidae	1	1	1.0	1	1	98	1
unknown	1	10	5.5	5.5	11	95	2

***Table 33**. Salt marsh invertebrate abundance and frequency occurrence of taxa collected in the auger samples.*

Taxon	Min	Max	Mean	Median	Total	% of Sites Absent	No. of Sites
Acarina	1	3	2	1	6	90	4
Ampeliscidae	1	1	1	1	1	98	1
Ampharetidae	1	23	9	6	36	90	4
Aoridae	2	13	6	4.5	24	90	4
Arabellidae	1	4	3	2.5	5	95	2
Arenicolidae	1	5	3	3	6	95	2
Capitellidae	1	13	3	1	53	58	17
Chiridotea	1	1	1	1	1	98	1
Chironomidae	1	1	1	1	3	93	3
Clubionidae	1	1	1	1	1	98	1
Coleoptera	1	1	1	1	1	98	1
Cumacea	1	1	1	1	2	95	2
Curculionidae	1	1	1	1	1	98	1
Diadumene lineata	1	1	1	1	1	98	1
Diptera	1	26	10	5	48	88	5
Eunicidae	2	2	2	2	4	95	2
Fulgoridae	1	1	1	1	1	98	1
Gammaridae	1	35	11	6.5	66	85	6
Haplotaxida	1	13	3	2	47	60	16
Hemiptera	1	4	2	1.5	8	90	4
Hydrobiidae	1	34	6	1	45	80	8
Insecta	1	1	1	1	1	98	1
Lepidoptera	2	2	2	2	2	98	1
Leptocheliidae	1	125	18	4	333	53	19
Littorinidae	1	3	1	1	8	85	6
Maldanidae	2	33	8	3	59	83	7
Melampodidae	1	1	1	1	1	98	1
Myidae	1	1	1	1	1	98	1
Mytilidae	1	1	1	1	2	95	2
Naididae	1	1	1	1	1	98	1
Nassariidae	2	2	2	2	2	98	1
Nephtyidae	1	1	1	1	1	98	1
Nereidae	1	6	2	2	31	63	15
Opheliidae	2	2	2	2	2	98	1
Orbiniidae	1	2	2	1.5	3	95	2
Phyllodocidae	1	4	2	1	8	88	5

Pseudoscorpiones	1	1	1	1	1	98	1
Spionidae	1	28	5	2	49	78	9
Syllidae	1	3	2	2	4	95	2
Tabanidae	1	1	1	1	2	95	2
Talitridae	1	4	2	1.5	8	90	4
Tellinidae	1	1	1	1	1	98	1
Terebellidae	1	7	3	1	9	93	3
Tipulidae	1	2	1	1	4	93	3
Trichoptera	1	1	1	1	1	98	1

Table 34. *Salt marsh invertebrate abundance and frequency occurrence of taxa collected in the dipnet samples.*

Taxon	Min	Max	Mean	Median	Total	% of Sites Absent	No. of Sites
Acarina	1	3	2	1	15	77	9
Actinaria	1	1	1	1	2	95	2
Ampeliscidae	1	1	1	1	1	97	1
Ampharetidae	2	6	3	2	15	87	5
Aoridae	1	49	21	1	148	82	7
Aphididae	1	35	12	1	37	92	3
Arabellidae	1	1	1	1	1	97	1
Araneae	1	2	1	1	7	85	6
Arenicolidae	1	1	1	1	1	97	1
Cancridae	1	3	2	1	6	90	4
Capitellidae	1	18	6	3	63	72	11
Carcinus maenas	1	1	1	1	1	97	1
Ceratopogonidae	1	8	3	2	16	85	6
Chironomidae	1	7	3	1	28	72	11
Clubionidae	1	14	3	1	57	44	22
Coleoptera	1	4	2	1	12	79	8
Collembola	1	7	3	2	17	85	6
Corophiidae	1	1	1	1	1	97	1
Crangonidae	6	6	6	6	6	97	1
Culicidae	1	3	2	1.5	13	79	8
Cumacea	1	22	9	6	35	90	4
Curculionidae	1	1	1	1	4	90	4
Diadumene lineata	1	12	7	6.5	13	95	2
Diptera	1	16	4	2	108	36	25
Dolichopodidae	2	3	3	2.5	5	95	2
Dorvilleidae	1	1	1	1	1	97	1
Ephydridae	1	5	2	1	12	85	6
Formicidae	1	1	1	1	1	97	1
Fulgoridae	1	50	5	2.5	136	33	26
Gammaridae	1	165	21	4	359	56	17
Gastropoda	2	2	2	2	2	97	1
Haplotaxida	1	152	23	4	387	56	17
Hemigraspus sanguineus	1	1	1	1	1	97	1
Hemiptera	1	3	2	1	12	79	8
Hydrobiidae	1	71	9	4.5	203	44	22
Hydropsychidae	1	3	1	1	8	85	6
Hydroptilidae	1	1	1	1	1	97	1

Hymenoptera	1	3	2	1	18	72	11
Idoteidae	1	1	1	1	2	95	2
Janiridae	1	139	36	1	142	90	4
		111					
Leptocheliidae	1	8	111	7	1887	56	17
Limulus polyphemus	1	1	1	1	2	95	2
Linyphidae	2	2	2	2	2	97	1
Littorinidae	1	139	26	7	521	49	20
Lumbrineridae	1	1	1	1	2	95	2
Lycosidae	1	3	2	1	8	87	5
Mactridae	1	12	7	6.5	13	95	2
Maldanidae	12	12	12	12	12	97	1
Melampodidae	3	15	8	7	25	92	3
Micryphantidae	2	5	4	4	11	92	3
Miridae	1	9	2	1	18	77	9
Mogulaso	9	9	9	9	9	97	1
Molgulidae	1	1	1	1	1	97	1
Myidae	1	1	1	1	2	95	2
Mytilidae	1	1	1	1	1	97	1
Naididae	1	3	2	2	4	95	2
Nassariidae	1	2	1	1	4	92	3
Nematoda	1	1	1	1	2	95	2
Nemertea	1	2	2	1.5	3	95	2
Nereidae	1	59	12	2	85	82	7
Oligochaeta	55	55	55	55	55	97	1
Opheliidae	1	1	1	1	1	97	1
Orbiniidae	1	1	1	1	3	92	3
Orthoptera	1	2	2	1.5	3	95	2
Palaemonidae	1	64	13	5	169	67	13
Paraonidae	2	3	3	2.5	5	95	2
Pectinariidae	1	1	1	1	1	97	1
Phyllodocidae	3	15	9	9	18	95	2
Platygastridae	1	1	1	1	2	95	2
Poduridae	1	1	1	1	1	97	1
Polychaeta	2	2	2	2	2	97	1
Pseudoscorpiones	3	3	3	3	3	97	1
Rhagionidae	1	1	1	1	1	97	1
Rhyacephilidae	1	1	1	1	1	97	1
Rhyacophilidae	1	1	1	1	1	97	1
Sabellidae	1	58	14	4	71	87	5
Saldidae	2	2	2	2	2	97	1
Scalibregmidae	1	1	1	1	1	97	1

Scaphandridae	1	1	1	1	1	97	1
Spionidae	2	85	41	48.5	246	85	6
Syllidae	3	3	3	3	3	97	1
Tabanidae	1	2	2	1.5	3	95	2
Talitridae	1	57	6	2	172	31	27
Tellinidae	1	1	1	1	1	97	1
Terebellidae	1	161	33	1	165	87	5
Tettigonidae	2	2	2	2	2	97	1
Tipulidae	1	7	3	1.5	16	85	6
Xanthidae	1	1	1	1	1	97	1
unknown	1	1	1	1	1	97	1

***Table 35**. Salt marsh invertebrate abundance and frequency occurrence of taxa collected in the quadrat samples.*

Taxon	Min	Max	Mean	Median	Total	% of Sites Absent	No. of Sites
Acarina	1	2	1	1	19	61	16
Actinaria	2	2	2	2	2	98	1
Araneae	1	26	5	3	177	7	38
Bivalvia	13	13	13	13	13	98	1
Cicadellidae	1	14	6	4	31	88	5
Coleoptera	1	6	2	1.5	39	51	20
Decapoda	5	5	5	5	5	98	1
Dermaptera	1	1	1	1	1	98	1
Diadumene lineata	4	4	4	4	4	98	1
Diptera	1	2	1	1	7	88	5
Geukensia demissa	1	78	12	2.5	213	56	18
Gryllidae	1	1	1	1	1	98	1
Hemiptera	1	22	5	2	130	34	27
Hymenoptera	1	1	1	1	2	95	2
Insecta	2	2	2	2	2	98	1
Isopoda	1	4	2	2	11	88	5
Lepidoptera	1	1	1	1	1	98	1
Littorinidae	1	58	8	2	127	63	15
Mantodea	1	1	1	1	1	98	1
Melampodidae	1	48	8	3	225	27	30
Ocypodidae	1	6	3	2	15	85	6
Orthoptera	1	12	3	2	27	78	9
Portunidea	1	4	2	1	16	78	9
Talitridae	1	74	12	6	440	7	38
unknown	10	10	10	10	10	98	1