

Appendix 1.

Training Manual, Field and Laboratory Protocols, and Sample Data Sheets
(Field and laboratory workshop conducted August 21-22, 2001)

**WETLAND MONITORING TRAINING PROGRAM –
BIOTIC INDICES FOR DEPRESSIONAL WETLANDS
& INTRODUCING FLORISTIC QUALITY ASSESSMENT
August 21-22, 2001 at DNR Research Center, Monona, WI (1350
Femrite Dr.)**

AGENDA

DAY ONE: TUESDAY, AUGUST 21, 2001

- 8:00AM INTRODUCTIONS
- 8:10 AM OBJECTIVES – Why are we here; What do we wish to accomplish? –
Bernthal
- 8:20 AM PROGRAM SCHEDULE AND LOGISTICS - Bernthal
- 8:30 AM OVERVIEW OF WETLAND MONITORING - Bernthal
 Why monitor wetlands?
 Types of assessment/monitoring methods
 Our strategy for monitoring wetlands and your role in it
- 8:45 AM OVERVIEW OF BIOTIC INTEGRITY RESEARCH - Lillie
 Why sample biota
 Wetlands sampled (N=104)
 Methods – general approach used
 Metric testing and development – general dose response
 Preliminary findings and limitations
 Ongoing work – new communities
 How this training program fits into the larger picture
- 9:00 AM MACROINVERTEBRATE BIOTIC INDEX - Lillie
 What groups are we dealing with?
 Field methodology
 Equipment
 When, where, and how to sample
 Handling, processing, and preserving samples
 Laboratory processing
 Description of process
 Data recording
 Data handling – Metric calculations
-

- 9:30 AM **WETLAND MACROINVERTEBRATES OVERVIEW - Lillie**
- 10:00AM **AQUATIC PLANT BIOTIC INDEX - Lillie**
 Level of taxonomy used
 Field methodology (Two-tiered approach)
 Equipment
 When, where, and how to sample
 Vouchers and data recording
 Data manipulation – Metric calculations
- 10:30 AM **PLANT IDENTIFICATION HINTS FOR IBI METRICS – Trochlell**
 Field guides – Pat’s picks
 Grasses, sedges, rushes
 Carex sedges
 Reed canary grass
 Canada Bluejoint grass
 Other “Good” aquatics – Potamogeton, Scirpus, Utricularia,
 Equisetum, Sagittaria, Polygonum
- 11:15 AM **FLORISTIC QUALITY ASSESSMENT - Bernthal**
 Background and development
 Coefficient of Conservatism
 Floristic Quality Index
 Sample calculation
- 11:45AM **REVIEW**
 Important Highlights
 Questions & Answer Period
 Afternoon schedule
-
- 12:00Noon –12:45 **LUNCH BREAK** –Sub sandwiches and beverages provided
-
- 1:00PM **DEPART FOR FIELDTRIP & COLLECTIONS**
 Assemble at RC/Monona
 Inventory and distribute equipment
 Drive to study site
- 1:45PM **FIELD SURVEYS – MACROINVERTEBRATES**
 Characterize study wetland site
 Demonstration of collection techniques
 Students collect and composite invert samples
- 2:30PM **FIELD SURVEYS – AQUATIC PLANTS**
-

Demonstration broad survey
Demonstration transect surveys
Demonstration plant collections
Students conduct surveys and press plants
Check of data sheets for completeness
Question & Answer?

4:00PM DEPART FIELD SITE FOR RETURN TO RC

4:30PM RETURN TO RC
Put equipment and samples away
Discuss schedule for next day
Adjourn for day (about 5PM)

**WETLAND MONITORING TRAINING PROGRAM –
BIOTIC INDICES FOR DEPRESSIONAL WETLANDS
& INTRODUCING FLORISTIC QUALITY ASSESSMENT
August 21-22, 2001 at DNR Research Center, Monona, WI (1350
Femrite Dr.)**

AGENDA

DAY TWO: WEDNESDAY, AUGUST 22, 2001

- 7:45AM REVIEW - Lillie
 Review schedule for day two
 Review labwork for macroinvertebrate biotic index
- 8:00AM INVERTEBRATE IDENTIFICATION – TAXONOMY - Lillie
 Basic identification – introduction to keys and level of ID needed
 Preserved specimens (pass around)
- 8:45AM PROCESS MACROINVERTEBRATE SAMPLES (move to lab) - Lillie
 Rinsing procedure
 Distribution of inverts in tray – randomization
 Picking and sub-sampling procedures
 Data recording
 QAQC checks of Ids and forms by instructors
- 11:00AM INVERT METRIC CALCULATIONS (in conference room) - Lillie
 Compute metric scores
 Evaluate wetland health based on findings
 Discuss problems, weaknesses, and review procedures

12:00Noon – 12:45 PM LUNCH BREAK

- 12:50PM More time for macroinvertebrates if needed
- PLANT VOUCHERS & ID (in dry laboratory) - Trochlell
 Voucher preparation/mounting demonstration
 Complete plant Ids where required
 Verify vouchers with instructors
- 2:00PM PLANT METRIC CALCULATIONS & FQI DETERMINATIONS
 (in Conference room) - All
-

Compute Relative Importance Values
Compute plant metric scores
Compute FQA scores
Evaluate wetland health based on findings
Discuss problems, weaknesses, and review procedures

3:30PM **COMPARE TEAM'S FINDINGS - All**
Compare metric performance among teams and similarity or
dissimilarity in response of the three methods – discuss.

4:00PM **WRAP-UP & Q/A FOLLOW UP NEXT SPRING - All**
Evaluate training program (form?)
Discuss need for a winter refresher on macroinvertebrates
Explain what is expected next spring – discuss study site selection
and timing of sampling.
Distribute field equipment for next spring.
Adjourn (5PM)

Developed with the assistance of Wetland Grant # CD985491-01-0 and additional 106/316 funding to WDNR.

**METHODS MANUAL & FIELD GUIDE FOR APPLICATION
OF THE WISCONSIN WETLAND
MACROINVERTEBRATE BIOTIC INDEX**

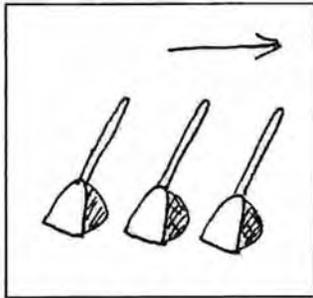
Prepared by:

**Richard A. Lillie
Wisconsin Department of Natural Resources
Bureau of Integrated Science Services
Fish and Habitat Section
1350 Femrite Drive, Monona, WI 53716**

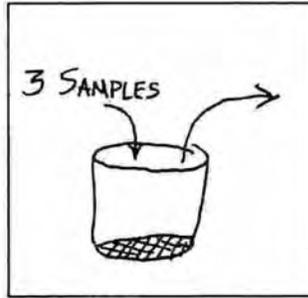
[August 2001]

OVERVIEW OF COLLECTING AND PROCESSING MACROINVERTEBRATE SAMPLES FOR CALCULATING BIOTIC INDEX SCORES

Field Collections:



Composite 3 net-sweeps



Rinse & concentrate
Into 1-quart container



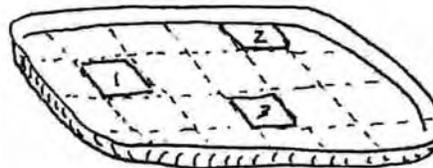
Preserve in 95% Ethanol
with water-proof label

Laboratory Processing:

Randomly select 3 cells. Pick and count the organisms in each cell and tally by taxon. Those taxa whose abundance are ≥ 15 (extrapolated ≥ 120) can be ignored in processing the balance of the sample.

After processing the first 3 cells, continue searching the remaining 21 cells (sample can be remixed if desired) for all additional specimens. Retain all specimens in 75% ethanol. It is important not to miss the rarer or concealed cryptic taxa (e.g., caddisflies in cases, translucent midges or cased midges, pigmy backswimmers, beetle larvae). Sum up the counts, including extrapolated numbers, on the laboratory sheet; calculate percent caddisflies; and conduct taxon richness counts. Finally, using the "Metric Scoring" sheets, calculate and record the individual metric scores on the laboratory sheet in the spaces provided. The sum of these individual scores represents the Biotic Index Score for the wetland basin.

Tray is partitioned into 24 cells:



The Wisconsin Wetland Macroinvertebrate Biotic Index (WWMBI)

The Wisconsin Wetland Macroinvertebrate Biotic Index (WWMBI) was developed for the specific purpose of evaluating the biological integrity of depressional basin wetlands of Wisconsin. Its performance in evaluating other types of wetland basins is untested.

The WWMBI is derived from an examination of the macroinvertebrate community found in a composite grab sample taken from three representative areas of a wetland basin. Metrics used in the WWMBI were selected after screening the responses of 69 individual community attributes to supposed measures of human disturbance in a set of 104 wetland basins. Further details regarding the data set and rationale in developing the WWMBI are provided in the final report to USEPA. Those attributes that demonstrated a strong, unidirectional response, consistent with theoretical impact of human disturbance, were selected as metrics. The WWMBI is comprised of fifteen component metrics, including two richness metrics (number of non-insect taxa, and total number of taxa), one percentage metric (percent of total abundance composed of caddisflies), and twelve abundance metrics. Metrics based on abundance include Mollusks (clams and snails), Annelids (worms, etc.), Fairy Shrimp (Anostraca), Damselflies (Zygoptera), Pigmy backswimmers (Pleidae), Water boatmen (Corixidae), Limnephilid caddisflies, Total caddisflies, Phantom midges (Chaoborus), Mosquitoes (Culicidae), Soldier fly larvae (Stratiomyidae), and total invertebrates. Each individual metric is assigned a score of 0, 1, 3, or 5 based on the metric's correlation with suspected levels of impact among the 104 wetland basin test set. The scores for the fifteen metrics are then summed to derive a final WWMBI for an individual basin or sample. Each basin is assigned one of six biological integrity classifications ranging from very poor to excellent based on the WWMBI.

The biological integrity rating system was designed to compare all other wetland basins with conditions found in the reference data set. Biological integrity ranged between 19 to 61 (maximum range possible 3-75) in the 33 reference basins examined during 1998. By definition, the breakpoint separating good (and better) and fair (and worse) biological integrity was set at the median WWMBI score in the reference wetlands (i.e., 43). This approach in assigning rating values to WWMBI scores is probably conservative in that the so-called reference set included basins that undoubtedly had been impacted to some extent. Consequently, lower thresholds of the 25th and 10th quantiles were used to separate fair from poor and poor from very poor, respectively. The 75th and 90th quantiles were used to separate good from very good and very good from excellent, respectively. A WWMBI score from another basin is compared with the reference data set as a means to evaluate relative biological integrity of the wetland in question. The sensitivity of the WWMBI has not been clearly established (ongoing studies), although field replication appears to provide classification within the same or adjacent biotic integrity class.

METRICS IN WISCONSIN WETLAND MACROINVERTEBRATE INDEX

• Mollusks	Abundance	Decreases with disturbance
• Annelids	Abundance	Decreases
• Fairy Shrimp	Abundance	Decreases (short duration basins)
• Non-Insects	Richness	Decreases
• Damselflies	Abundance	Decreases
• Pigmy Backswimmers	Abundance	Increases (longer duration basins)
• Water Boatmen	Abundance	Decreases
• Limnephelids	Abundance	Decreases
• Caddisflies	Abundance & %	Decreases
• Phantom Midges	Abundance	Decreases (longer duration basins)
• Mosquitoes	Abundance	Decreases
• Soldier Flies	Abundance	Increases
• Total Invertebrates	Abundance	Decreases
• Total Taxa	Richness	Decreases

Field Collection Procedures and Sorting & Identification

When to collect?

Dynamic shifts in macroinvertebrate community structure naturally occur within and across seasons. Wetland hydrology is complex and water levels (and more importantly water duration) may vary considerably from year to year. Periods of extended drought or wetness significantly affect macroinvertebrate community structure and abundance. The early spring community (April to early or mid-May in the north) best reflects conditions existing within the wetland during the previous year through the winter. Taxa richness and often times – abundance – highest or greatest during the early spring. Sampling in early spring reduces the confounding impact of emigration or emergence and immigration (colonization by numerous opportunists). Consequently, evaluation of wetland condition should be made only with samples collected during early spring.

Our data show that WWMBI can change dramatically from one month to another within a wetland basin. It is not known whether the direction of these changes is similar among all types of wetlands, so it is also not clear whether sampling in summer or fall months would produce values that could be compared with a similar set of summer or fall data from least-disturbed reference basins. For the time being it is recommended that WWMBI sampling be conducted only in early spring (April-May).

Where to collect?

Sampling macroinvertebrate communities in wetlands can be difficult and, at times, dangerous. Access may be difficult, poisonous or armored plants may be encountered, bottom substrates may be slippery or soft, and floating-bog mats may be thin. Precautions should be taken before simply wading in. A wading pole or the inverted end of the D-frame net is useful in determining bottom conditions.

The WWMBI is based on the macroinvertebrate community present in a composite of three D-frame net sweep samples. The relative position of the three sample locations are somewhat dependent upon the characteristics of the wetland being assessed. In most small (less than 2 acres) wetlands, samples should be collected from shoreline areas positioned to trisect the wetland perimeter. The first site should be selected in a random fashion (or arbitrarily near the point of access) and the remaining two sites at roughly equal distances to the left and right so as to trisect the shoreline perimeter (not necessary to be exact). The objective is to attempt to collect from three representative but distant locations. In wetlands with non-wadable areas (i.e., maximum depths greater than 60 cm), samples should be collected from points approximately mid-way between shore and the 60-cm depth contour (20-40 cm). Sampling too close to shore or in water closer to the deep-water edge may influence results. In shallower wetlands (i.e., entire basin wadable), samples should be collected approximately mid-way between shore and the center of the basin. Water depth at the sites may be less than the desired 20-40 cm. In some circumstances (e.g., bogs, seeps, sphagnum mats, etc.) it may be necessary to improvise or adjust sampling as necessary in order to obtain a sample. Dense emergents, duckweed, filamentous algae, or shrubs may

make dip-netting impossible or very difficult in some areas. While macroinvertebrates often display associations with various plant communities, adjusting the sampling locations slightly in order to get a “clean sweep” is acceptable if the edges of dense beds are included in the sample.

How to Collect

All samples should be collected with a D-frame net equipped with a 800 X 900 micron mesh net. Other forms of nets (e.g., rectangular dip nets) are also acceptable if equipped with suitable mesh. Use of a finer mesh net is not recommended. The WWMBI was developed based on samples collected with the standard net. A finer mesh net would collect all of the larger organisms collected by the standard net plus many smaller organisms that might substantially bias results. Also, the finer mesh net sizes would clog more rapidly in sampling most wetlands, particularly those wetlands with large volumes of coarse particulate organic matter. Samples should be collected as follows. Slowly wade out to the proper site, being careful to disturb the area as little as possible. Lower the dip net while held vertically at an arm's length though the water surface to the top of the bottom substrate. Rapidly sweep the water column at or just above the surface of the bottom in a 180-degree arc from right to left and lift the net from the water (see further precautions discussed below). This represents one net sweep sample, which will be combined with the remaining two samples to comprise the entire composite sample for the wetland. Ideally, the speed of sweeping should be uniform among samples and consistent among wetlands but speed is influenced by substrate and plant conditions present. If you ‘dip’ too deep into flocculent sediments, your net bag will quickly fill with solids that may or may not be able to be rinsed through the net. You want to get some of the bottom organisms, but avoid filling your net with massive amounts of sediment. Solid coverage of duckweed or long strings of filamentous algae also create serious problems in that the net may be full of plant material before even half of the sweep is completed if sweeping is conducted in the manner described. Cat-tails and other sturdy or persistent emergent stems interfere with sweeping and require either shallower sampling or variations in technique to obtain samples. The presence of woody debris (sticks, snags, etc.) or unseen barbed wire can cost you a ripped net (replacement bags \$55 each!). It may be necessary to make field modifications in order to obtain an adequate sample. These modifications are justified, but one should attempt to standardize the volume of water filtered as much as possible.

The sample should be transferred to a sieving bucket or other container (five gallon pail is a good substitute) until the remaining two samples are collected. Combine the three individual sweeps in the sieving bucket and reduce the volume of sample contents by vigorously washing and rinsing a series of small handfuls of organic material to remove attached macroinvertebrates. If you don't have a sieving bucket, you can recombine the contents of the three sweeps into the D-frame net as an alternative means to rinse the sample. Each handful of material should be examined carefully before it is discarded. Continue this procedure until the volume of material and macroinvertebrates remaining in the bucket will fit easily into a one-liter container (plastic preferred, but glass may be substituted). Preserve the sample for further processing with 95% ethanol (isopropyl is an acceptable alternative)

present in the sample. Some organisms should be recorded but excluded from the calculation of the WWMBI. This includes small zooplankton or water fleas (i.e., copepods and *Daphnia*), fish, crayfish, and amphibians (e.g., polywogs). These taxa should be listed on the tally sheet but should not be used in the calculation of the WWMBI. Record on a tally sheet (see sample in Appendix) the number of specimens of each individual taxon found within each of the first three randomly selected cells. Tally sheets should be printed on waterproof paper if available. Tally the counts in the first three cells. For those taxa that exceed a sum of 15 specimens, you may elect to extrapolate the approximated total in the entire sample by multiplying the count by a factor of 8 (assuming your tray has 24 grids). This time-savings effort accounts for the more dominant organisms in a sample. After extrapolating the numbers of the dominant organisms, continue to sort, pick, and tally the balance of the organisms present in the remaining cells. You can ignore all specimens of the dominant organisms being careful not to miss look-alike taxa resembling the dominant taxa. You can simply continue to scan and pick from the remaining 21 cells or recombine and spread the contents of the uncounted cells among all 24 cells. It is important that you search and find the rarer, less commonly occurring taxa present in the sample.

Quality Control Checks:

If you are concerned that you might have missed something; don't worry – you did! The question is was it important? Generally speaking, if you have scanned a sample thoroughly once and re-scanned it two or three times (about 2 hours), you have probably encountered 90-95% of the specimens present. The actual capture rate depends on the density and composition of the detritus and the experience of the investigator. Developing a visual search pattern takes practice. I have gone through an entire sample and later discovered that I had missed several specimens of a particular taxon that was not in my search image (e.g., dark beetles or transparent midge larvae). This is why it is important to re-scan the sample a second or third time to pick up additional taxa. Some investigators elect to use various stains or dyes that enhance discovery of cryptic taxa as a means to ensure complete coverage. I have found that dependence on dyes leads to missing taxa that do not absorb the stains; i.e., the investigator becomes too dependent upon the stain to find specimens and misses several common taxa. If you have someone willing to devote an hour or two, you could ask them to scan the sample to see what you have missed. Alternatively, return the balance of the tray contents to the original sample jar (may be easiest to pour through D-frame net to re-concentrate the sample to fit into the container), add fresh preservative (with correct label), and deliver to another lab for a quality control check. Keep in mind that unless you want to spend 4 or more hours on a sample, you are going to miss specimens (in highly organic samples). If you are consistently missing certain taxa you have a potentially serious problem. The only way you will know is to have a second person look over your sample remnants. Do not be afraid to find out! Specimens picked for the WWMBI may be preserved (in 70% ethanol and labeled) for laboratory verification, vouchers, or discarded as desired.

[See Flow chart with illustrated guide to macroinvertebrates.]

Calculation of WWMBI.

The WWMBI is calculated based on twelve abundance metrics, two richness metrics, and one percentage metric of among fifteen macroinvertebrate taxonomic groups (see Table). Scores were assigned based on the response of the various community attributes to suspected human disturbance. Abundance thresholds for mollusks, annelids, fairy shrimp, damselflies, pigmy backswimmers, water boatmen, limnephelid caddisflies, total caddisflies, phantom midges, mosquitoes, soldier flies, and total invertebrates were calculated from their response among the least-disturbed reference wetlands sampled during 1998 (see USEPA final report for further details). Richness metrics are based primarily on family-level or coarser level taxonomy. The single percentage metric based on representation by all caddisflies in a sample may be somewhat redundant, but covers those instances (e.g., in early spring) when larvae are not developed to the extent that they can be identified to a particular family.

On the tally sheet, total all organisms and taxa counts. Divide the abundance of total caddisflies by the total invertebrate abundance. Using the metric scoring sheet provided, record the appropriate metrics scores for each of the highlighted taxa (note two scores for caddisflies) and sum individual scores to derive the final WWMBI. Refer to the rating scales provided for the WWMBI to assign a biological integrity classification ranging from very poor to excellent.

Interpretation of WWMBI – reference goals, classes.

The WWMBI score can range between minimum and maximum possible scores of 2 and 75, respectively. We established a rating system for the WWMBI based on a set of 33 reference kettle wetlands (see Final report to USEPA). The reference kettles represented the least disturbed conditions in the three major ecoregions of Wisconsin. We assigned wetlands to the reference category (i.e., ‘least-disturbed’) on the basis of the basin’s proximity to human disturbance and without regard to natural factors that may influence macroinvertebrate community composition. In retrospect, this appears to have been unwise because, although the basin may have been relatively undisturbed in terms of human disturbance, the basin may not have represented ideal conditions for supporting a diverse assemblage of macroinvertebrates. Many remote, pristine, wetland basins are naturally organically enriched with dense mats of vegetation covering the entire surface of the basin, thus limiting exchange of oxygen and other chemicals between the air and water. Such circumstances may represent very harsh environmental conditions for many groups of macroinvertebrates, which would (and does) result in a lowering of the WWMBI. Consequently, WWMBI scores may range from very high to very low despite the lack of (or low degree) of human disturbance. Truly impacted basins consistently score lower than most reference basins.

To compare your wetland with the reference wetlands, simply compute the WWMBI score and plot it on the figure based on water duration and history. The division points are given along the margin.

Lillie Wetland Biotic Index Study

METRICS SCORES FOR THE WETLAND MACROINVERTEBRATE INDEX

Taxon	Attribute	Response	Score=0	Score=1	Score=3	Score=5	Adjustments
Mollusks	Abundance	Decrease	0	1-10	11-99	>99	None
Annelids	Abundance	Decrease	-	0-10	11-25	>25	None
Fairy Shrimp	Abundance	Decrease	-	0-8	9-25	>25	Duration
Non-Insects	Richness	Decrease	0	1-2	3-5	>5	Prairies?
Damselflies	Abundance	Decrease	0	1-2	3-15	>15	Kettles?
Pigmy B.S.	Abundance	Increase	0	1-2 & >100	3-5 & 11-99	6-10	Duration
Boatmen	Abundance	Decrease	0	1-4	5-10	>10	None
Limnephilid	Abundance	Decrease	0	1-10	11-50	>50	?
Caddisflies	Abundance	Decrease	0	1-10	11-60	>60	Duration?
Caddisflies	Percentage	Decrease	0	< 8%	8-15%	> 15%	Redundant?
Phantom M.	Abundance	Decrease	0	1-8	9-25	> 25	Duration
Mosquitoes	Abundance	Decrease	0	1-10	11-99	>100	Duration?
Soldier Flies	Abundance	Increase	-	> 25	8-24	< 7	Duration
Total Invert	Abundance	Decrease	< 150	150-500	500-1500	> 1500	None*
Total Taxa	Richness	Decrease	< 5	6-11	12-19	> 19	K vs P?

* May need to incorporate an adjustment based on a dominance type metric?

NEW MODIFIED BUG INDEX FOR LONG DURATION WETLANDS

Table M7. The Modified WWMBI for long duration wetlands, with scores.

Taxa Group	Attribute	Adjustments	Response	Score = 0	Score = 1	Score = 3	Score = 5
Mollusks	Abundance	Low Calcium or Alkalinity*	Decrease	0	1-9	10-99	≥100
Pigmy backswimmers	Abundance	None	Decrease	0	1-3	4-11	≥12
Water Boatmen	Abundance	Low total invertebrate abundance**	Increase	≥12	5-11	1-4	0
Caddisflies	Abundance	None	Decrease	0	1-2	3-7	≥8
Soldier Flies	Abundance	None	Decrease	0	1-2	3-9	≥10
Non-Insects	Richness	None	Decrease	0	1-2	3-4	≥5
Insects	Richness	None	Decrease	<3	3-7	8-11	≥12
All Macro-invertebrates	Diversity*	None	Decrease	<1	1-2	2-3	≥3

- If either calcium < 5 or alkalinity < 25 occurs, then substitute average of other seven metrics.
- ** If boatmen abundance < 5 and total invertebrates < 100, then substitute '2'.
- *** Margalef's Diversity D = (Total Taxon Richness - 1)/Log_n Total Macroinvertebrate abundance.

WETLAND =		Date sampled: 21 AUGUST 2001	Biotic Index	
County = SAMPLE		Collected By: R. LILLIE	51	
Type:		Analyzed: R. LILLIE on 21 Sep 2001		
Macroinvertebrate Name	Cells 1-3 (+ 15?)	Balance (X8 - Extrapolated?)	Sum	Metric Score
Snails (Gastropods)				
Snail-Type 1 (Orbs)	///	///	39	
Snail-Type 2 (left)				
Snail-Type 3 (right)				
Snail-Type other?				
Clams (Pelecypods)				
Mollusks Sum =	/// (20)	→	160	
Amphipods or Scuds	//	///	199	A 5
Isopods or Sowbugs	/	///	24	
Springtails (Collembola)		///	4	
Spiders (Arachnids)		//	2	
Mites (Hydracarina)	//	///	8	
Worms (Annelids)				A 0
Leeches (Hirudinea)		//	2	
Fairy Shrimp (Anostraca)				A 1/5
Clam Shrimp (Conchostraca)	/	///	5	
Seed Shrimp (Ostracods)		/	1	
Other Non-Insect Invertebrates				
Non-Insect Taxa				
Mayflies (Ephemeroptera)			9	R 5
Caenidae	///	///	43	
Baetidae				
Other mayflies				
Damselflies (Zygoptera)				
Coenagrionidae	//	///	11	A 3
Lestidae			10	
Other damselflies		/	1	
Dragonflies (Anisoptera)				
Aeshnidae	/	//	3	
Corduliidae		3	1	
Libellulidae		3	1	
Other dragonflies				
True Bugs (Hemiptera)				
Pigmy backswimmers (Pleidae)	///	///	51	A 3
Water boatmen (Corixidae)	//	///	15	A 5
Other bug families			1	
Caddisflies (Trichoptera) [2 %?]			16	A+% 3+1
Polycentropodidae				
Phryganeidae				
Limnephilidae	///	///	16	A 3
Leptoceridae				
Other families				
Beetles (Coleoptera)				
Crawling Water beetles (Halplidae)	//	///	7	
Predaceous Diving beetles (Dytiscidae)	/	///	12	
Water Scavenger beetles (Hydrophilidae)		///	3	
Marsh beetles (Helodidae or Scirtidae)				
Weevils (Curculionidae)		//	2	
Other beetle families	unidentified	/	1	
Flies (Diptera)				
Midges (Chironomids)	/// (27)	→	216	
Biting midges (Ceratopogonids)	/	///	4	
Phantom midges (Chaoborids)	///	///	33	A 5
Crane flies (Tipulids)				
Mosquitoes (Culicids)				A 0
Soldier Flies (Stratiomyidae)		//	2	A 5
Other families	Muscidae	/	1	
Other Aquatic Insects				
Aquatic Insect Taxa				
Other Terrest Insects				
Total Invertebrates			667	A 3
Total Taxa			20	R 5

discuss

MACROINVERTEBRATE IDENTIFICATION

Taxonomy:

1. Designed for the non-entomologist!
2. Simplified to easily recognizable forms or groups of major organisms.
3. Includes all macroinvertebrates – insects and non-insects.
4. To compute the 15 metrics used in the WWMBI you only need to identify about a dozen important taxa. In addition you need to be able to separate non-insects to order (body form for snails) and insects to family level. Includes adults and larva.
5. Non-insect taxa list includes 14 groups.
6. Insect taxa list includes 23 families (plus miscellaneous families).

Keys to Identification:

1. Wisconsin key to Aquatic Insects by Hilsenhoff (1995). \$6 each. See key to insect Orders on page 3-4. "The" key to Wisconsin aquatic insect Genera. Designed for professional entomologist but should get you to the correct family without too much trouble.
 2. Aquatic Entomology by McCafferty (1998). \$55 each. Chapter 6 has key to insect Orders – pages 84-90; Non-insects presented in Chapters 5 and 21-23. Designed for layman (anglers). Easiest keys to use for Order and to insect families.
 3. Aquatic Insects of North America by Merritt & Cummins (1996). Sorry, not provided!(was \$75 per copy). Primary key for aquatic entomologists. Basic key to insect Orders on pages 110-112 may be useful. Many illustrations can help you confirm identifications.
 4. "Key to Life in the Wetland" is the product of a joint effort between WDNR and UW-Extension. What you are getting is a 'modification' of "Key to Life in the Pond". We have taken some illustrations from other keys to build a key more suitable for use in identifying wetland fauna. Please do not copy or distribute this laminated key. This key is extremely easy to use but still sufficient to get you into the right group of organisms for calculating the biotic index. All of the major non-insect taxa commonly occurring in wetlands are illustrated. The two families of mayflies shown represent the Baetidae and Caenidae. The various families of Odonata (dragonflies and damselflies), Trichoptera (caddisflies), and Coleoptera (beetles) require further illustration (provided later) but several are illustrated in the key. The commonly occurring wetland bugs, including water boatmen (Corixidae) and the tiny pygmy backswimmer (added to the list of leathery winged taxa), are illustrated along with several of the less common water bugs (Order Hemiptera). Please note that the Coleoptera (beetles) are represented by both adult and larval forms (both live in or near the water).
-

Identifying Damselflies and Dragonflies to Family level

The Odonates are divided into two suborders, the Zygoptera (damselflies) and Anisoptera (dragonflies). This taxonomic division is based primarily on adult features, but luckily the larvae also exhibit clear differences. The damselflies have three broad (side-view) tail filaments referred to as caudal lamellae (Fig 1 bottom), while dragonflies have short stiff pointed valves and cerci (Fig 2 bottom). The tail filaments of the damselflies are fragile and may be missing from your specimens, so in that case you have to go on the basis of general body form. After you have examined a number of representative specimens of both suborders you should not have any difficulty in separating dragonfly nymphs from damselflies.

Among the three families of damselflies found to occur in Wisconsin, two are common in wetlands, namely Coenagrionidae and Lestes. The third, Calopterygidae, is generally confined to stream banks. To separate Coenagrionidae from Lestes, compare the length and shape of the labium (the extendable mouth part that is used to capture prey). The labium in the Coenagrionidae is relatively short and broad, while the labium in Lestes is greatly elongated and narrowed (see Fig 1 top). Of the six families of dragonflies reported for Wisconsin, only three families commonly occur in wetlands. This includes Aeshnidae, Libellulidae, and Corduliidae. Nymphs of the later two families are extremely difficult to separate except when mature. Consequently, it is only necessary to separate out the Aeshnidae. Larvae of Aeshnidae may be separated from the Libellulidae and Corduliidae on the basis of having a flat mentum, while the other two families have a spoon-shaped mentum that wraps upwards covering part of the face (Fig 2 top). A fourth family of Anisoptera, the Gomphidae, also has a flat mentum and may occasionally occur in sandy bottoms of some wetlands. The general body shape of the Aeshnidae differs from that of the other possible wetland Odonates in having an elongated, tubular abdomen (see Figure 2 bottom).

Identifying Limnephilid Caddisflies in Wisconsin Wetlands

Most keys to immature (non-adult) aquatic insects are based on mature larva. Because we are collecting wetland biotic index samples during early spring (April-early May), the caddisfly specimens that we collect may be very small and relatively undeveloped. Consequently they may be difficult if not impossible to correctly identify to the family Limnephilidae (Trichoptera). This is one reason we have retained the otherwise redundant 3 caddisfly metrics in the WWMBI (abundance and percentage total caddisflies and abundance of limnephilids). Caddisflies and limnephilids in particular seem to be more prevalent in least disturbed, wooded, depression type wetlands. Whether the limnephilids are truly dependent on good water quality and low human disturbance or are abundant in primarily wooded wetlands because of the input of coarse woody debris (leaf litter) is uncertain. Most species of limnephilids prepare their protective cases from leaf or plant fragments. The removal of trees or other sources of woody debris related to human disturbance (agriculture production or urbanization) might reduce the supply of woody debris to the wetland and thereby possibly reduce the quality of the habitat for the caddisfly.

Hilsenhoff's Trichoptera key (pages 25-33 in Hilsenhoff 1995 publication) includes many families that do not or occur infrequently in wetlands. The most likely caddisfly families that you might encounter in your wetland samples include: Polycentropodidae, Phryganeidae, Leptoceridae, and Limnephilidae. Of these the Polycentropodidae and Phryganeidae differ from the Leptoceridae and Limnephilidae based on the presence or absence of darkened sclerotized plates on the middle thoracic segment (=mesonotum). The Polycentropodidae have mesonotums that are generally entirely membranous (i.e., lacking sclerotized areas – Figure 1). Six genera of Phryganididae have entirely membranous mesonotums (Figure 2), while a few genera have mesonotums with only very small plates (Figure 3). Limnephilidae and Leptoceridae have mesonotums mostly covered with sclerotized areas (Figure 4). However, one genus of Leptoceridae that may be found in wetlands (*Ceraclea*) has a mesonotum with a pair of very narrow (but distinctive) curved or v-shaped bars on the mesonotum (Figure 5). An additional clue to separating families is the presence or absence of a case. Polycentropodidae do not live in cases. The other three families build and live in cases, but consider the fact that they may crawl outside of their cases when exposed to the preservative. Therefore do not rely on the absence of a case as a means to identify a specimen as a Polycentropodidae. Aside from the relatively distinctive *Ceraclea*, other genera of Leptoceridae may be told apart from Limnephilidae on the basis of the relative length of their antennae (see Figure 6). Unfortunately, examination usually requires a higher power magnification (binocular scope best). The Leptoceridae have long antennae (length > 6 times width, while Limnephilidae have short antennae (< 3 times width). Although not presented in the keys provided, the cases of the mature Leptoceridae larvae are generally narrow, long and skinny relative to Limnephilidae cases, which generally are larger and more robust. Unfortunately, small (young) Limnephilidae larval cases may be very tiny and resemble cases of Leptoceridae. Consequently, you may have to simply lump small cased caddisflies as unknown caddisflies.

Among the other families of caddisflies known to occur in Wisconsin, most are restricted to lotic waters and therefore might turn up in springs, fens, and seeps. A few others might be associated with larger wind-swept shorelines of shallow water marshes. Of these, the most likely one to encounter in wetlands might be the Hydroptilidae (micro-caddisflies), which are very small and often overlooked (see descriptions in Hilsenhoff and McCafferty's publications).

Representative Polycentropodidae

*No sclerite on 2nd thoracic segment
And abdominal segment no. 9 entirely membranous
No cases*

Representative Phryganeidae

*No sclerite on 2nd thoracic segment
And abdominal segment no. 9 with sclerite
Cases may be missing*

Alternative Phryganeidae

Pair small sclerites on 2nd thoracic segment

Limnephilidae and Leptoceridae

*Large sclerites on 2nd thoracic segment
Cases may be missing
Length and location of
antennae important*

Alternative form of Leptoceridae (*Ceraclea*)

Pair of dark bars on 2nd thoracic segment

Identifying Beetles in Wisconsin Wetlands

Beetles (both adults and larva) are common inhabitants of Wisconsin wetlands. Beetles often contribute significantly to species richness and are occasionally dominant as a group (Order level). Both adult and larval beetles are relatively difficult to identify to family. Hilsenhoff's keys (pages 44-49 for adults and pages 49-54 larvae) or McCafferty's pictorial keys (pages 208-209 adults and pages 210-211 larvae) are recommended. Adult bugs are occasionally mistaken for adult beetles, but beetles can be told apart by the presence of hardened forewings (called elytra) that meet at the midline of the body. Bugs have leathery wings that overlap near the tips.

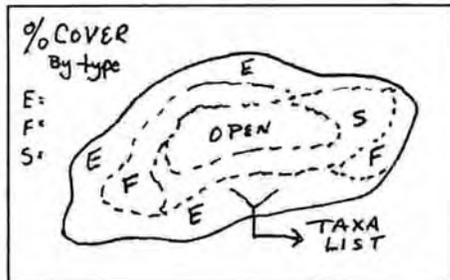
Of the 14 families of aquatic beetles represented in Wisconsin, only seven or eight occur regularly in wetland situations. These include the families Dytiscidae (Predaceous diving beetles), Gyrinidae (Whirligig beetles), Haliplidae (Crawling water beetles), Chrysomelidae (Leaf beetles), Curculionidae (Weevils), Hydrophilidae (Water scavenger beetles), and Scirtidae (Marsh beetles). The family Noteridae (Burrowing water beetles) also occurs in wetlands, but specimens are often mistaken for Dytiscids. Another beetle family, the Carabidae (Ground beetles) is not keyed in Hilsenhoff's book, but it does occur in wet-soil conditions. Most of the other families are lotic.

Among the adults, weevils, whirligig beetles, and leaf beetles are relatively distinctive and are easily identified to family. The crawling water beetles have large distinctive plates covering the base (underside) of the abdomen (see illustrations in keys). Separating adult diving beetles from water scavenger beetles is perhaps the most difficult step in identifying water beetles. Following McCafferty's key (page 208), the Dytiscids can be separated from the Hydrophilids on the basis of their streamlined (bullet-shaped) body together with unclubbed antennae. Other Hydrophilids have a body form that is less streamlined with swimming hairs on the hind legs (note, some Dytiscids have swimming hairs but they have very streamlined body form). Also consider that you might have a Noteridae (consult keys).

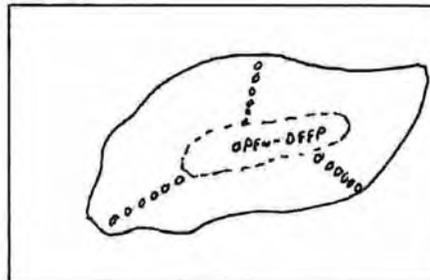
The situation with beetle larvae is even more complicated and is easier to refer directly to the keys provided in the books. Keep in mind that as you become more experienced and acquainted with the larvae, you will recognize certain families (even genera) on sight and will not have to key everything out. Some larvae are easily recognized, such as the distinctive and somewhat common marsh beetle (Scirtidae) and larval forms of Haliplidae. The common Dytiscids and Hydrophilidae have somewhat distinctive body forms that will become more familiar to you after you have looked at several dozen specimens.

OVERVIEW OF COLLECTING AND PROCESSING PLANT DATA FOR CALCULATING PLANT BIOTIC INDEX SCORES

Field Collections:



General subjective survey



Quantitative transect surveys

Laboratory Processing:

Compute relative importance values for all taxa present in the transect surveys on the basis of relative frequency of occurrence and relative cover. Compute individual metric scores for seven taxonomic groups based on their respective importance values. Compute total taxa metric score based on combination of plants observed in the general survey and transect survey. Compute deep water adjustment metric based on combination of importance value of total pondweeds present in transect surveys and the overall percent cover of floating-leafed vegetation

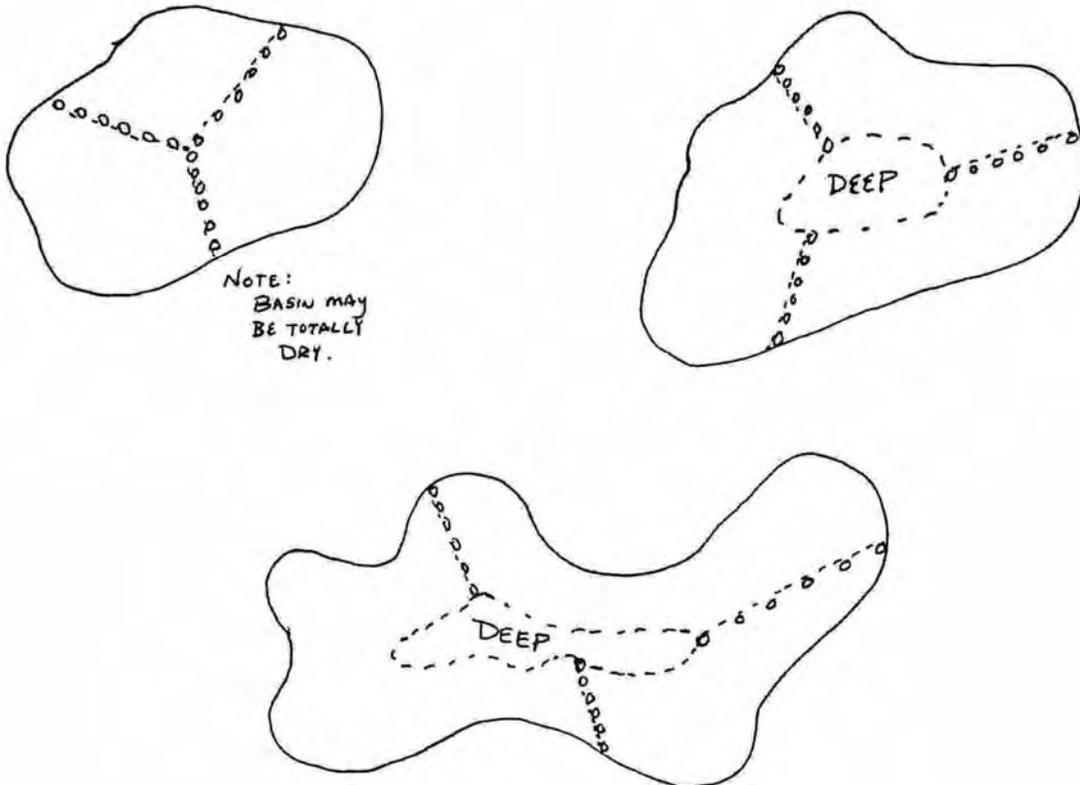
METRICS IN WISCONSIN WETLAND PLANT BIOTIC INDEX (DRAFT VERSION)

- Total Taxa Count Decreases with disturbance
- Carex spp. Importance (Ivs) Decreases
- Reed Canary Grass Importance Increases
- Cat-tails Importance Increases
- Duckweeds Importance Increases
- Bluejoint Grass Importance Decreases
- Good (7 genera) Importance Decreases
- -----
- Deep water Community adjustment for longer duration basins:
- Pondweeds Importance Optimum (peak)
- Floating-leafed Percent Decreases

Plant Transect Survey Technique

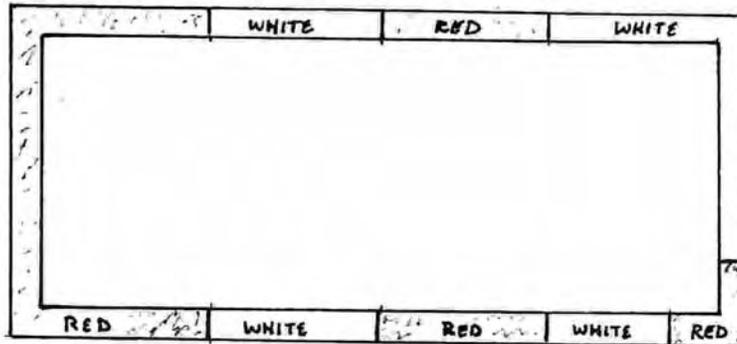
Our survey technique is based on Daubenmire's 1959 paper in the Journal Northwest Science Vol. 33, No. 1, pages 43-64 titled "A canopy-coverage method of vegetational analysis". For those of you interested in the rationale for using a transect technique with a relatively small area sampler, please consult the text of his article. We have modified his technique somewhat (e.g., we use fewer than the recommended number of quadrats) to conserve time.

We calculate relative Importance Values (IVs) as the average of relative frequency occurrence and relative percent cover in eighteen 20 by 50 cm quadrats. Six quadrats are collected at approximately equa-distantly spaced locations along three transects in each basin. The transects are positioned to roughly trisect the basin from the center of the basin to shore (or if dry, to where the shoreline was during spring snowmelt). In large basins, the transects may be positioned parallel to one another at various intervals such that a particular region of the basin may be examined and evaluated. Uniformly spaced quads ensures gathering samples along the entire depth gradient from shore to about 60 cm (or 2 feet). Three examples of the layout of transects are shown below. Try to position transects through 'typical' areas (i.e., don't intentionally look for rarer plant types). Start at the deep end and eye-ball the position of the remaining 5 quads along the transect line (note – you don't need to use an actual line). By the deep end, we mean the 60 cm depth interval (approximately the maximum wadeable depth). However, in basins with a deep water component, record the visible plant community in that zone also.



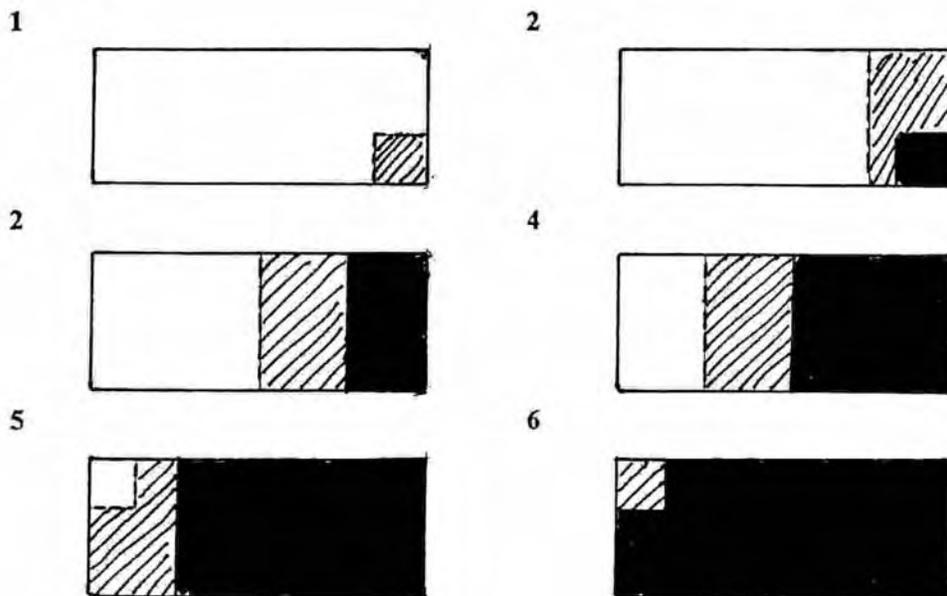
CANOPY-COVERAGE (PERCENT COVER) METHOD. Continued.....

Daubenmire Rectangle 20 by 50 cm inside dimensions.



Class Code	Percentage Range covered	Percentage Midpoint
1	0-5 ($\leq 5\%$)	2.5%
2	5-25 ($\leq 25\%$)	15%
3	25-50 ($\leq 50\%$)	37.5%
4	50-75 ($\leq 75\%$)	62.5%
5	75-95 ($\leq 95\%$)	85%
6	95-100 ($\leq 100\%$)	97.5%

Examples:



FIELD SHEETS

Examples shown include a 3-page form. You may wish to design your own form(s), adding or subtracting various data inputs. As a minimum, you should include either GPS coordinates or detailed T-R-Sec-Q/QQ and a map so that people can match up your data with the proper basin in future years. Data recorded on page 3 are essential to compute Importance Values and the plant biotic index scores.

Page 1. General Information – Basin description, location, map (relative to known landmarks such as roads and towns, etc.), riparian cover, plant cover type, bottom composition, and limited water quality characterization.

Page 2. Finer detail map of wetland basin outlining shape, general plant distribution, location of transects. This page is designed to record the overall occurrence of all taxa observed during the course of conducting the evaluation, including taxa observed while conducting the transect surveys and while walking about the perimeter of the basin. This information, supplemented with lab identification of unknown vouchers, can be used to compute Floristic Quality Index values. Space is provided for listing the 10 most dominant plant taxa (emergent, submersed, and floating-leafed); additional taxa can be added at the bottom of the page as needed. Unknowns should be described in whatever detail is necessary or accompanied by a sketch such that you can match up the data with voucher specimens in lab. For example, use unknown # 1 (alternate leaves with tiny blue flower or finely dissected submersed # 2 with fan shaped leaflets add sketch). The “Rating” scores for estimating plant dominance refer to overall distribution in the entire basin (or portion being evaluated in the case of very large basins). The numbers 1-6 are highly subjective and may vary from one individual to another. The numbers are not used in the computation of plant biotic index scores, so it is not critical if you should forget to record all numbers. It is more important to record the presence of all taxa in the basin (without spending an inordinant amount of time doing so). The ‘dominance’ data recorded on this page are of historical value and will be valuable for monitoring changes in basin plant community composition over time. The data represent a very coarse ‘snapshot’ of the overall plant community. For guidance, reserve the use of 5s and 6s for those cases where a taxon or taxa (5s) are obviously the dominant plants in the basin and cover more than 50% of the total available vegetated area. In situations where the total plant cover in a basin may be relatively sparse and yet a particular taxon (or taxa) may clearly be dominant, I would recommend classifying those taxa as only abundant (4) or common (3) – unvegetated areas would actually represent the ‘dominant’. ‘Rare’ (1) would represent those taxa that only appear at one or two locations in the basin (generally not found in the transects). ‘Occasional’ (2) would represent taxa that appear more frequently (may be absent from transect quads) but are not altogether common. ‘Common’ (3) refers to taxa that appear relatively frequently (or may be somewhat abundant in a very small area of the basin) throughout the vegetated area of the basin, but never make a major contribution to the total abundance in the basin. ‘Abundant’ (4) refers to those taxa that may compete with the dominant taxa on occasion, but overall are ‘secondary’ plants that are generally numerous and important throughout the basin.

Page 3. Plant Transect Data form. This form is used to record taxa occurrence and percent cover among the 18 quadrats along the 3 transects for each basin. The resulting data are used to compute importance values that are the basis for assigning plant biotic index scores. Water depths are recorded at each site (up to 60 cm or about 2 feet maximum). Depth is not critical to record, so it is all right if you forget to bring a meter or yard stick. The method of estimating percent cover will be presented separately. The data for taxa beyond the wadeable depth (i.e., 'deep') is usually ignored in computing importance values in most basins. However, if the basin has experienced a recent and substantial rise in water level, the data from the 'deep' stations may be incorporated into the calculation. Irrespective of whether a basin has undergone a recent increase in water level, the taxa present in the 'deep' stations would be used in the FQI (?).

FIELD SHEET - WETLAND BIOTIC INDEX STUDY - WDNR (1998)

(Lillie, revised 7-6-1998 in ponds.wpp)

(If Found, Please return to R. LILLIE, RESEARCH, 1350 FEMRITE DRIVE, MONONA, WI 53716; phone 608-221-6338)

Wetland Name SAMPLE Code (W1, L1, B1, etc.) L-105

County COLUMBIA Date: 21 AUG 2001 Time: 1200

Lat. 43° 27' 015" Lg. 89° 60' 00" or TN 9N RG 7E Sec 27 Qtr/qtr NE/NW

Collections By R. LILLIE

Field Measurements:

Air Temp (F/C) 85

Water Temp (F/C) 20

Clarity (in./cm) TO BOTTOM

Mx. Depth (in./cm) 40

algal bloom? NONE

duckweed abundant? < 5 %

duckweed sp. _____

Photograph taken?

Description:

Apparent

Color Code

Dark-stain

Light-stain

Turbid/brn

Turbid/grn

Clear-green

Clear-blue

Biological Samples:

Zooplankton collected?

Diatoms (summer: sediments)?

Plants (vouchers collected?)

Field Assessment Forms:

Rapid Assessment Form?

No

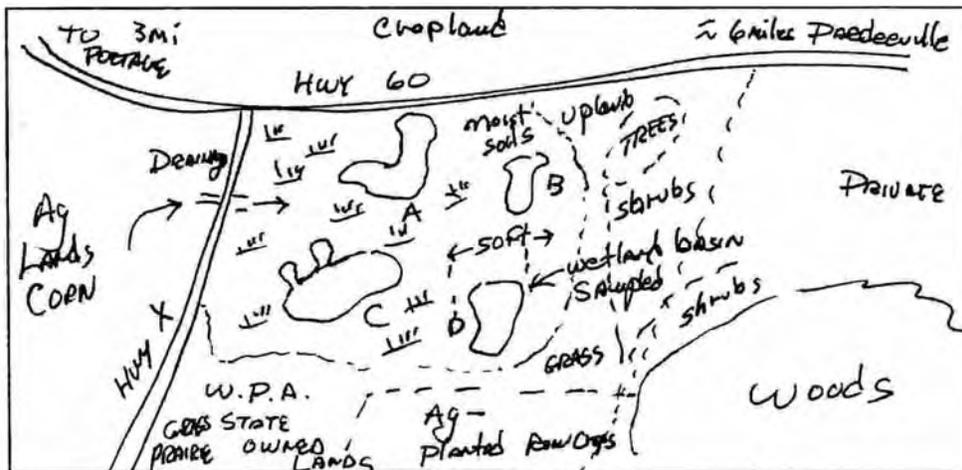


Figure 1 General cover map and shoreline details

Shade Cover % 0
100 ft buffer zone

Riparian Cover

0 % Woods

15 % Shrubs

25 % Grassland

60 % Wetland

0 % Urban

10 % Agriculture

General Measurements:

Cover by Type

15 % Emergents

50 % Submergents

75 % Floating-leaf

25 % Open water

Dominant Bottom Type

Peaty, Organic, Roots,

Mud, silt-sand, Leafpack

Other: _____

Wildlife observations:

Other Notes:

lots B.W. Teal

Turtles, Frogs

Indirect runoff from Ag-field

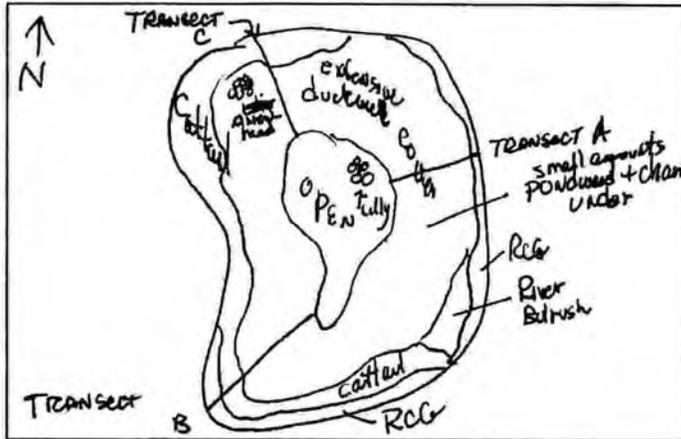
to south due to bit. Some

shade in early morning. (near 10:00)

FIELD SHEET – WETLAND BIOTIC INDEX – PLANT SURVEYS PAGE 2

Basin Name SAMPLE Code L105 County COLUMBIA
 Date 21 Aug 2001 Collected By: R. LILLIE

Map sketch: (Include location of transects)



Dominance Codes:	
1	= Rare
2	= Occasional
3	= Common
4	= Abundant
5	= Co-dominant
6	= Clearly Dominant

Plant Taxa Lists:

Emergents

- | CODE - Taxon Name |
|---|
| 4 (1) <u>Cattails</u> |
| 4 (2) <u>R.C. Grass</u> |
| 3 (3) <u>River Bulrush</u> |
| 1 (4) <u>Bluejoint</u> |
| 2 (5) <u>arrowhead</u> |
| 1 (6) <u>spikeweed</u> |
| 2 (7) <u>rice-cut grass</u> |
| 1 (8) <u>unknown alt. leaf</u> ^{no flower} |
| (9) |
| (10) |
| (11) |
| (12) |
| (13) |
| (14) |
| (15) |
| (16) |
| (17) |
| (18) |
| (19) |
| (20) |

Submergents

- | CODE - Taxon Name |
|---|
| 3 (1) <u>pendant narrow-leaved pondweed</u> |
| 4 (2) <u>Chara</u> |
| 2 (3) <u>bladderwort (yellow)</u> |
| (4) |
| (5) |
| (6) |
| (7) |
| (8) |
| (9) |
| (10) |
| (11) |
| (12) |
| (13) |
| (14) |
| (15) |
| (16) |
| (17) |
| (18) |
| (19) |
| (20) |

Floating-leafed

- | CODE - Taxon Name |
|--------------------------------|
| 6 (1) <u>Lemna minor</u> |
| 2 (2) <u>Lemna trisulca</u> |
| 1 (3) <u>white water lilly</u> |
| 2 (4) <u>wolflia</u> |
| (5) |
| (6) |
| (7) |
| (8) |
| (9) |
| (10) |
| (11) |
| (12) |
| (13) |
| (14) |
| (15) |
| (16) |
| (17) |
| (18) |
| (19) |
| (20) |

Describe Unknowns by leaf form, leaf orientation, size, flower color, and collect voucher for later identification.

FIELD SHEET - WETLAND BIOTIC INDEX

PLANT TRANSECT DATA (Revised 08/08/01) Page 3 of 3

Basin Name SAMPLE Code L105 County COLUMBIA
 Location TRI-TRANSECTS Date 21 AUG 2001 Collected By: R. LILLIE

Percent Cover Codes: (1) = 0-5%; (2) = 5-25%; (3) = 25-50%; (4) = 50-75%; (5) = 75-95%; (6) = 95-100%

Taxa List	Transect One.....							Transect Two.....							Transect Three.....						
	A1	A2	A3	A4	A5	A6	AD	B1	B2	B3	B4	B5	B6	BD	C1	C2	C3	C4	C5	C6	CD
Depth (cm)	3	11	21	29	38	57	760	5	15	20	31	47	58	760	6	12	23	30	41	52	760
Cattail	6	6	2	.	.	.	.	2	6	.	.	.	.	.	1	6	.	.	.	.	.
RC GRASS	.	2	.	.	.	.	.	6	1	.	.	.	.	.	6	.	.	.	.	.	.
UNKNOWN GRASS	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sakerush	2	.	.	.	.	.	.	3	.	.	.	.	.	.	1	.	.	.	.	.	.
Arrowhead	.	2	1	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	.	.
Galium? unidentified Alt-leaved Forb	1	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.
und. narrow-leaf Pondweed	.	.	3	3	4	3	.	.	.	1	1	3	4	.	.	.	.	2	3	1	.
Chara	.	.	1	4	4	1	.	.	.	2	1	3	4	.	.	.	.	.	1	4	.
Bladderwort	.	2	1	.	.	.	.	.	.	1	.	1	.	.	.	.	1	.	.	.	.
lesser duckweed	.	1	3	.	6	6	.	.	2	3	6	6	6	.	.	2	1	6	5	4	.
Wolffia	.	2	.	.	.	.	.	.	1	.	.	.	1	.	.	1	.	.	.	.	.
Note: deep water white water lily	.	.	.	.	.	.	2	.	.	.	.	.	1	.	.	.	.	.	.	.	.

CONTINUED ? | Yes, see next sheet.

CALCULATING PLANT BIOTIC INDEX SCORES

The following steps require input data from transect survey field sheets (i.e., taxon richness, and Importance Values) and the General Field form (overall percent coverage for Floating-leafed plants).

Step 1 – Total Taxa Metric (Richness or the number of different taxa present; taxa not necessarily identified to species or even to genera in some cases). Tally all taxa on transect survey form and supplement with any additional taxa among the emergent, submergent, and floating-leafed taxa on page two of field forms. Refer to Scoring System sheet to assign scores based on the total richness.

Total ____ Score = ____

Step 2 – Relative Importance Values. (see previous sheet for instructions on how to calculate Ivs). It is essential to compute the relative frequency of occurrence and relative cover for all taxa.

IV Score =

Record Ivs for Carex spp.	____		____	
RC-grass	____*		____*	
Cat-tail	____*		____*	
Duckweeds	____		____	
Bluejoint grass	____		____	
“Good” taxa list	____		____	

and Pondweeds Ivs = ____ (use below in step 3)

Step 3 – Water Duration Adjustment. The plant biotic index has an inherent bias favoring (produces higher scores) shorter duration basins with more complex plant communities. To compensate for this bias, two additional metrics are examined that account for plant structure in basins of long water duration (i.e., basins with water persistence that borders on permanent – public waterbodies or lakes). This includes a metric based on the total percent cover of floating-leafed forms (from page 1 estimates of the entire basin) and the IV of all pondweeds (generally restricted to long duration basins). Note: the average of these two scores is applied, not both.

Percent (%) of floating-leafed plants ____% Score = ____

Pondweed Ivs from transect surveys ____ Score = ____

Average the two scores to derive the final deep-water adjustment = ____
(Note: some number between 1 – 5)

Step 4 – Calculate the Final Plant Biotic Index as the Sum of the scores in steps 1-3 =

* If total taxa count ≤ '1' and no emergents are present (or consists only of one annual) a 'zero' scores as '0' points rather than '5'. This modification is intended to account for the situation where the basin is in such sad shape that not even RCG or Cat-tail can get a foothold.

EXAMPLE OF CALCULATING IMPORTANCE VALUES

Basin 'Sample'

Taxon	Quad 1	Quad 2	Quad 3	Quad 4	Quad 5	Quad 6	Quad 7	Quad 8	Quad 9	Quad 10	Quad 11	Quad 12	Quad 13	Quad 14	Quad 15	Quad 16	Quad 17	Quad 18	Freq. Occ.	Total Cover*
Taxon A	6	3	1	0	3	6	5	2	1	0	0	2	4	4	1	0	0	3	13	550
Taxon B	3	1	1	0	1	1	0	0	3	0	1	3	1	0	0	0	0	0	9	127
Taxon C	0	2	5	2	0	0	0	0	3	2	3	0	0	0	6	4	0	0	8	365
Taxon D	2	1	0	0	1	2	2	1	0	0	0	1	1	0	0	0	5	5	0	142
Taxon E	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2	5

- Based on the sum of Daubenmire's midpoint percentage values for recorded values 1-6, where for example a '3' represents 37.5% and a '6' represents 97.5%. This is where an Excel computer spreadsheet comes in handy to automatically convert your data input values (i.e., 1-6) into the proper percentage values that they represent prior to making the calculation.

The computed data are shown in the following table:

Taxon List	Absolute Frequency	Relative Frequency	Total Cover	Absolute Cover	Relative Cover	Importance Values
Taxon A	0.722	0.317	550	0.308	0.464	0.391
Taxon B	0.500	0.220	127	0.071	0.107	0.164
Taxon C	0.444	0.195	365	0.203	0.306	0.251
Taxon D	0.500	0.220	142	0.079	0.119	0.170
Taxon E	0.111	0.049	5	0.003	0.005	0.027
Sums	2.277	1.001**	1189	0.664	1.001**	1.003**

** these sums, which should approximate 1.00, should be performed as a check on your math. The small differences in this example represent inconsequential rounding errors.

If, in the above example, taxon A = Carex, taxon B = Cat-tail, taxon C = pondweeds, taxon D = duckweeds, and taxon E = arrowhead, and there were six additional taxa outside the transect quads, and total floating-leaved cover was 10%, then the Plant Biotic Index for the basin would be:

Total Taxa Metric = 5 + 6 = 11 with a score of 3; Carex IV of 0.391 scores '5'; RC-grass absent scores '5'; Cat-tail IV of 0.164 scores '1'; Duckweeds IV of 0.170 scores '3'; Bluejoint-grass absent scores as '1'; the "Good" taxa metric IV including the combined Ivs of Carex, Potamogeton, and Arrowhead equals 0.669 which scores as '5'; and the deep water adjustment metric would include pondweeds IV of 0.251 and percent floating-leaved value of less than 10% which would score as $(5+3)/2 = 4$. The sum of all scores produces a biotic index score of 27, which would result in a **VERY GOOD** rating.

METRICS SCORES FOR THE WETLAND PLANT BIOTIC INDEX

Taxon	Attribute	Response	Score=0	Score=1	Score=3	Score=5	Adjustments
Total Taxa	Abundance	Decrease	0-1	2-8	9-16	>16	?
Carex spp.	Importance Value (=IV)	Decrease	0	< 0.1	0.1 - 0.36	> 0.36	None
Reed Canary Grass	IV	Increase	> 0.5	> 0.05 - 0.5	> 0 - 0.05	0*	None
Cat-tail	IV	Increase	> 0.25	0.03 - 0.25	> 0 - 0.03	0*	None
Duckweed	IV	Increase	> 0.6	0.2 - 0.6	> 0 - 0.2	0	None
Bluejoint Grass	IV	Decrease	-	0	> 0 - 0.05	> 0.05	None
Good* Taxa	IV	Decrease	0	> 0 - 0.3	0.3 - 0.6	> 0.6	None

Deep Water Community Adjustments (1 to 5 maximum based on Pond IV & Floating-leaf / 2)

Taxon	Attribute	Response	Score=0	Score=1	Score=3	Score=5	Adjustments
Pondweeds	IV	Optimum	-	0	> 0 - 0.12	0.12 - 0.4	None
Floating-leaf	Percent	Decrease	-	0	> 0 - 0.3 > and > 0.4	> 0.3	None

- ** "Good" includes all *Carex*, *Utricularia*, *Potamogeton*, *Calamagrostis*, *Sagittaria*, *Polygonum*, and *Equisetum* species.
- ** Adjustment If total taxa \leq "1" and no emergents are present (or consists only of annuals) a "zero" scores as "0" points!

Appendix 2.

Refresher Training Manual with Field and Laboratory Instructions

Welcome to Wetland IBI Training

Please:

- Close all other applications on your computer, including email
 - Mute phone when not speaking
 - Ask questions as they arise
 - Identify yourself by first name and location when you have a question
 - Wait until end of session to print out slides with annotations
-

OVERVIEW OF PRESENTATION

- Objective: Present step-by-step procedure to collect, analyze, compute, and interpret wetland biotic indices.
 - Part I: What, Where, When, and How to collect and process plant and bug samples and data.
 - Part II: Bug Taxonomic Identification refresher & tips
 - Part III: Field Level Plant Identification
 - Part IV: Floristic Quality Index considerations - vouchers
 - Part V: Discussion & Wrap-up.
-

WHERE?

- Types of Wetlands
 - Palustrine, depression, long-short temporary, seasonal, semi-permanent, and permanent without fish
 - Do not sample bogs, fens, seeps, springs, lacustrine, riverine, or wet-soils wetlands.



WHAT?

- BUGS
 - PLANTS
 - OTHER
-

WHEN?

- **BUGS**
 - Late April-early May
 - (minimizes emigration & immigration)

- **PLANTS**
 - Late July-August
 - (easier ID, seeds, etc.)



HOW?

- **BUGS**

- Collection design
- Field sweeps
- Lab Processing
- Identification
- Index calculations
- Interpretation

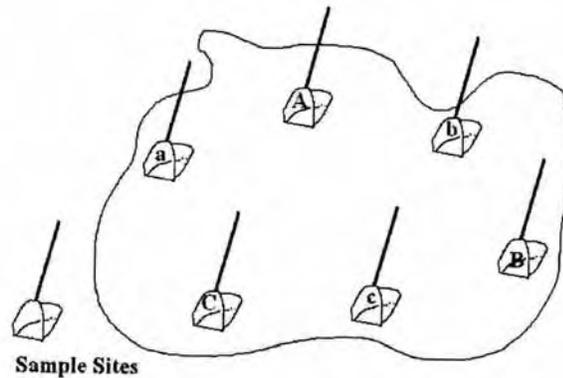
- **PLANTS**

- Collection design
 - Transect quadrats
 - Field Identifications
 - Data recording
 - Calculating Ivs
 - Index calculations
 - Interpretation
-

BUGS:

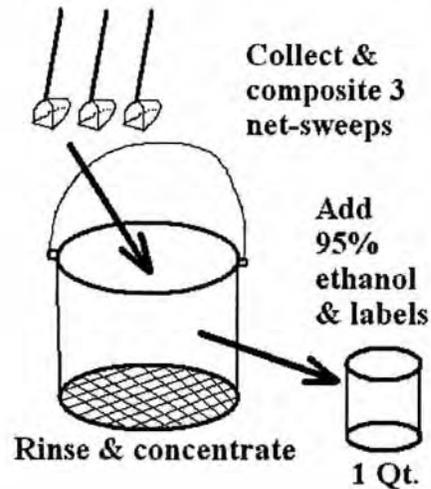
Where to sample within wetlands

- Sampling layouts
 - trisection
 - wadable
 - special this spring



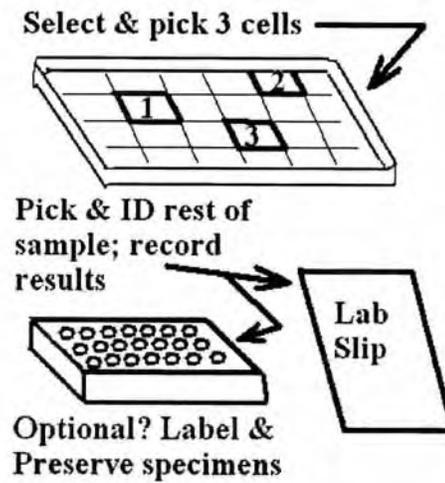
BUGS: Field collecting

- 3 net-sweeps 1m
- sieve & composite
- compact to 1 Quart
- Label inside & out
- Ethanol or isopropyl
- {Paired sampling this spring}
- Send 1 set to Madison



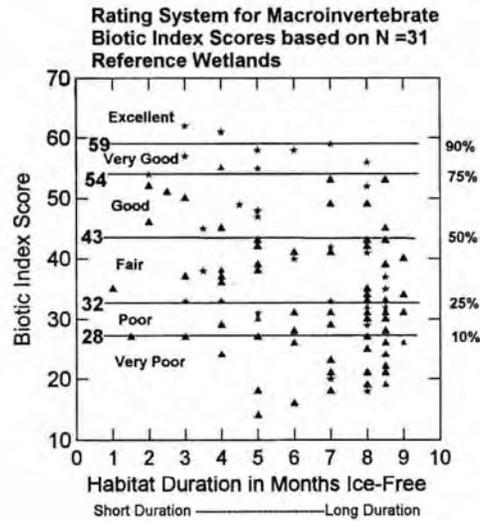
BUGS: Labwork

- Tray: Rinse & spread
- 3 random cells
- Pick & ID
- Rest of sample -
- labeling (options?)
- Lab sheet instructions
- Tallies



BUG INDEX CALCULATION

- Lab slip tallies
- Metric scoring table
- Record metric scores
- Hydroperiod Adjustments
- Sum for Final Index
- Classify?



Lillie Wetland Biotic Index Study

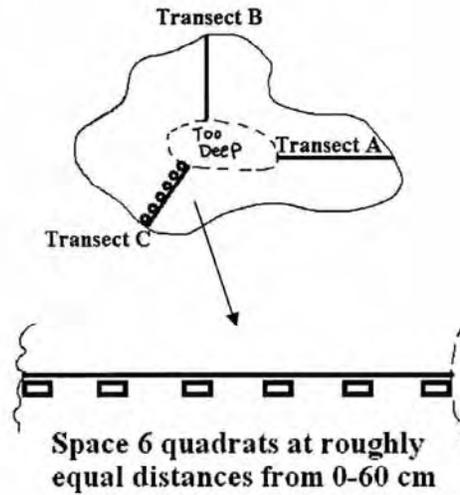
METRICS SCORES FOR THE WETLAND MACROINVERTEBRATE INDEX

Taxon	Attribute	Response	Score=0	Score=1	Score=3	Score=5	Adjustments
Mollusks	Abundance	Decrease	0	1-10	11-99	>99	None
Annelids	Abundance	Decrease	-	0-10	11-25	>25	None
Fairy Shrimp	Abundance	Decrease	-	0-8	9-25	>25	Duration
Non-Insects	Richness	Decrease	0	1-2	3-5	>5	Prairies?
Damselflies	Abundance	Decrease	0	1-2	3-15	> 15	Kettles?
Pigmy B.S.	Abundance	Increase	0	1-2 & >100	3-5 & 11-99	6-10	Duration
Boatmen	Abundance	Decrease	0	1-4	5-10	> 10	None
Limnephilid	Abundance	Decrease	0	1-10	11-50	> 50	?
Caddisflies	Abundance	Decrease	0	1-10	11-60	> 60	Duration?
Caddisflies	Percentage	Decrease	0	< 8%	8-15%	> 15%	Redundant?
Phantom M.	Abundance	Decrease	0	1-8	9-25	> 25	Duration
Mosquitoes	Abundance	Decrease	0	1-10	11-99	>100	Duration?
Soldier Flies	Abundance	Increase	-	> 25	8-24	< 7	Duration
Total Invert	Abundance	Decrease	< 150	150-500	500-1500	> 1500	None*
Total Taxa	Richness	Decrease	< 5	6-11	12-19	> 19	K vs. P?

* May need to incorporate an adjustment based on a dominance type metric?

PLANTS: Layouts

- Trisection or other
- 60 cm cutoff
- Transects - position of six quadrats

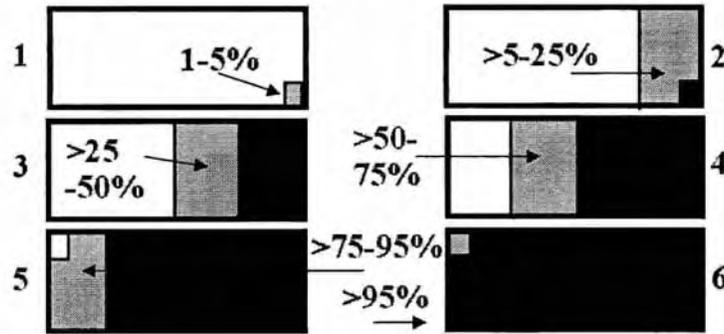
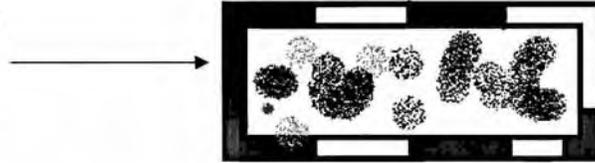


PLANTS:Fieldwork

- General cover type
 - Plant dominants
 - Transects
 - Depth (?)
 - Plant ID taxonomy
 - Occurrence
 - Percent Cover
 - Unknowns/vouchers
 - **Dominance Codes:**
 - **1 = Rare**
 - **2 = Occasional**
 - **3 = Common**
 - **4 = Abundant**
 - **5 = Co-dominant**
 - **6 = Clearly Dominant**
-

CANOPY COVERAGE

- Daubenmire Rectangle
- 20 X 50 cm



PLANT: Importance Values

- Manual
 - Absolute freq & cover
 - Relative freq & cover
 - Avg = IV
- Excel Spreadsheet
 - Data entry
 - Output columns
 - Sample

SAMPLE IV CALCULATION

- **STEPS**
- Absolute frequency
- Relative frequency
- Absolute cover
- Relative cover
- Importance Values

**FIELD SHEET – WETLAND BIOTIC INDEX
PLANT TRANSECT DATA (Revised 08/08/01) Page 3 of 3**

Basin Name Example Short Code SP1 County North

Location TN-RG-Sec Date April 15, 2002 Collected By: S.A.L.

Percent Cover Codes: (1)= 0-5%; (2)= 5-25%; (3)= 25-50%; (4)= 50-75%; (5)= 75-95%; (6)= 95-100%

	Transect One.....					
Taxa List	A1	A2	A3	A4	A5	A6
Depth(cm)	7	14	25	31	43	58
Pondweed	—	—	1	4	6	6
Carex sp	6	3	—	—	—	—
Smartweed	2	1	—	—	—	—
Duckweed	6	6	4	3	1	

METRICS SCORES FOR THE WETLAND PLANT BIOTIC INDEX

Taxon	Attribute	Response	Score=0	Score=1	Score=3	Score=5	Adjustments
Total Taxa	Abundance	Decrease	0-1	2-8	9-16	>16	?
Carex spp.	Importance Value (=IV)	Decrease	0	< 0.1	0.1 - 0.36	> 0.36	None
Reed Canary Grass	IV	Increase	> 0.5	> 0.05 - 0.5	> 0 - 0.05	0*	None
Cat-tail	IV	Increase	> 0.25	0.03 - 0.25	> 0 - 0.03	0*	None
Duckweed	IV	Increase	> 0.6	0.2 - 0.6	> 0 - 0.2	0	None
Bluejoint Grass	IV	Decrease	-	0	> 0 - 0.05	> 0.05	None
Good* Taxa	IV	Decrease	0	> 0 - 0.3	0.3 - 0.6	> 0.6	None

Deep Water Community Adjustments (1 to 5 maximum based on Pond IV & Floating-leaf / 2)

Taxon	Attribute	Response	Score=0	Score=1	Score=3	Score=5	Adjustments
Pondweeds	IV	Optimum	-	0	>0 - 0.12 and > 0.4	0.12 - 0.4	None
Floating-leaf	Percent	Decrease	-	0	> 0 - 0.3	> 0.3	None

- * **“Good”** includes all *Carex*, *Utricularia*, *Potamogeton*, *Calamagrostis*, *Sagittaria*, *Polygonum*, and *Equisetum* species.
- ** **Adjustment** If total taxa \leq “1” and no emergents are present (or consists only of annuals) a “zero” scores as “0” points!

PLANTS: Index calculation

- Score metrics (Table)
- Compute PBI
- Classify & Interpret

- Note: Comparisons
with Bug Biotic Index
-- need not agree!!
- (different responses)

BUG IDENTIFICATIONS

10 Taxa you need to recognize

- NON-INSECTS
 - Snails & Clams
 - Worms
 - Fairy Shrimp
 - INSECTS
 - Damselflies
 - Pigmy Backswimmers
 - Water Boatmen
 - Caddisflies (Limnephilids)
 - Phantom Midges
 - Mosquitoes
 - Soldier Flies
-

Odonata:Zygoptera =Damselflies

- Extendable mouthparts for grasping prey
 - 3 caudal lamellae (tail parts)
 - generally long, slim, skinny compared with dragonflies
 - Two common families separated by shape of labium (mouthpart)
-

ODONATES: Family Level I.D.s

- **Use length & shape of labium (extendable mouthpart) --**
 - **Damselflies Lestes vs. Coenagrionidae**
 - **Dragonflies - 3 common families, Aeshnids (flat labium) vs. Cordulids and Libellulids (spoon-shaped labium)**

Note: ID of genera difficult in early spring because larvae generally not well developed.

Pigmy Backswimmers

- **Tiny - 3 mm range**
- **Legs folded, not visible**
- **Color varied from cream or tan to dark black**
- **Easily mistaken for plant seeds**
- **This is a smaller cousin of the larger backswimmers or Notonectids - both are Hemipterans or true bugs**
- **Common in weed beds**

CORIXIDAE: Water Boatmen

- **Fast swimmers, ranging in size from 6 to 15 mm.**
 - **9 genera in Wisconsin, difficult to separate (*Hesperocorixa* large, other taxa smaller.**
 - **Active fliers**
 - **Easy to I.D. as a group.**
 - **3 genera common throughout state.**
 - **Most taxa are herbivorous, but prey on small animals.**
 - **Increased abundance in moderately disturbed wetlands.**
-

TRICHOPTERA: = Caddisflies

- **Adults moth-like in appearance**
 - **Larva with or without cases**
 - **Long fleshy body with 3 pairs thoracic legs; often with stringy thread-like gills on abdomen**
 - **Of 19 families in WI, only expect 4-5 typically in wetlands**
 - **Combination of presence of sclerotized plates on dorsum of thoracic segments characteristic**
 - **Small size of larvae in spring makes ID difficult!**
-

Caddisflies Part 2 - Family ID

- **Hydroptilids - very tiny < 5 mm in purse-like cases**
- **See key McCafferty pg 242-43**
 - Dorsal segment 2 with well developed plates?**
 - **No - then Phryganeidae or Polycentropodidae (no cases)**
 - **Yes - then Limnephilidae or Leptoceridae (next slide)**
 - Abdominal segment 1 humped with striped head?**
 - **Yes - Phryganeidae**
 - **No - Polycentropodidae (also has curved body with anal prolegs)**

Caddisflies Part 3 - Family ID

- **Limnephilidae and Leptoceridae have well developed plates on thoracic segment 2**
 - **2nd thoracic segment with pair of distinctive dark bars?**
 - Yes - Leptoceridae (1 genus)
 - No - continue...
 - **Long antenna (hard to see)?**
 - Yes - Leptoceridae (7 genera)
 - No - continue
 - **Dorsal spacing tubercule on abdominal segment 1 with cases of vegetation?**
 - Yes - Limnephilidae (several genera)
 - No - other families?
-

DIPTERA: Chaoboridae = Phantom Midges

- **10-15 mm, thin, semi-transparent bodies**
 - **Distinctive prehensile antenna**
 - **3 genera easily separated by key**
 - **Occurrence sensitive to fish predation; widespread**
 - **Chaobrids are important predators of zooplankton**
 - **More active at night**
 - **Pupae! Differ from mosquitoes by having pointed respiratory horn (see also midge pupa).**
-

DIPTERA: CULICIDAE = Mosquitoes

- **Thoracic segments fused, bulbous, distinctive head**
 - **Common everywhere without fish**
 - **9 genera difficult to separate without key (don't?)**
 - **Look-alike Dixid midges relatively rare and have prolegs on 1st 2 abdominal segments**
 - **2 genera overwinter as larvae, but other genera exhibit fast development following spring snow-melt**
 - **Pupa! See open respiratory horn**
-

DIPTERA: Stratiomyidae = Soldier Flies

- **Straight dark body with distinctive truncate head, no legs**
 - **Usually last segment with dense plumose coronet**
 - **9 genera but too difficult to try to separate (lump)**
 - **larva crawl about just under the water's surface**
 - **Tend to be associated with lots of aquatic vegetation**
 - **Sizes vary from less than 5 mm to large, over 20 mm or more**
-

MOLLUSKS

Includes Gastropods and Pelecypods
(Snails, bivalves or clams, including
fingernail clams)

- **Small sphaerids may be mistaken for clam shrimp -see clam shrimp**
- **Three (4th possible) morphs of snails used (more possible within morphs)**
 - shell opening to right
 - shell opening to left
 - shell coiled, flat (orbs)
- **See Thorp & Covich's book for additional illustrations and key**
- **record all taxa found**

WORMS?: Includes earthworms, large oligochaetes, nematodes (Nematoda), and flatworms (Turbellaria)

- **Hodgepodge of non-insect phyla**
 - **Any worm-like organism other than leeches**
 - **Never very common in samples, but tend to be associated with undisturbed wetlands with plenty of organic substrates**
-

Non-Cladoceran Branchipods (Anostraca = Fairy Shrimp)

- **Generally limited to fishless ponds with short hydroperiods**
 - **Rapid development in spring results in variation in sizes from 7-100 mm**
 - **Distinctive pair of bulbous eyes**
 - **11-19 pairs of thoracic legs**
 - **Swims with legs up**
 - **Demonstrates tolerance to salinity (some taxa); generally tolerant to low DO**
 - **Key by Dodson & Frey in Thorp & Covich book**
-

Other Common Non-Insects

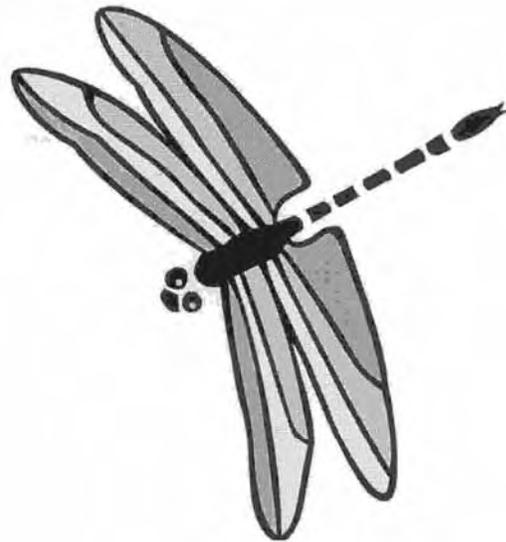
- **Amphipods**
(Scuds)
- **Isopods**
(Sowbugs)
- **Hydracarina**
(Mites)
- **Collembola**
(Springtails)

Clam Shrimp (Conchostraca) & Seed Shrimp (Ostracoda)

- **Seed Shrimp**
 - very tiny,
< 1.5 mm
 - some
colored
blue
- **Clam Shrimp**
 - 1-4 mm
 - appear
round
like eggs
 - Compare
with
clams

OTHER IMPORTANT AQUATIC INSECTS

- Mayflies
- Dragonflies
- Beetles
 - Primarily 5 families
- Common Midges
- Biting Midges
- Crane Flies



EPHEMEROPTERA = Mayflies

- **Most have three tails**
 - **Only 2-3 families
common in wetlands**
 - **Caenid (squarebacks)
small, 5-15 mm - very
common amongst
plants**
 - **Baetidae (Callibaetis)
some able to stand
drought.**
-

Odonates: Anisoptera = Dragonflies

- **Generally larger more robust than damselflies**
- **Different terminal appendages**

DIPTERA: Others including Midges

- **Common midges (Chironomidae)**
are among the most abundant organisms occurring in wetlands
 - **Note: proleg and shape; many different sizes.**
Often concealed within tubes constructed of organic detritus
- **Biting midges (Ceratopogonidae)**
 - **Generally long, thin, pencil shaped**
 - **swim in snake-like motion**
 - **less common than common midges, easily overlooked**

Other Hemiptera (Bugs)

- **Many are semi-aquatic forms**
- **Fast swimmers or skaters**
- **Not shown are:**
 - **water scorpions**
 - **creeping water bugs**
 - **giant water bugs**
 - **shore bugs**
 - **short-legged striders**
 - **marsh treaders**
 - **velvet water bugs**
 - **water treaders**
 - **others**

COLEOPTERA: = Beetles (Larvae & Adults)

- **Beetle Larvae**
 - variety shapes & sizes
 - many predators
- **Aquatic Beetle adult forms**
 - body shape
 - mobility (live)
 - See McCafferty's key pg 208-209

Thanks for attending

Good Luck with Sampling!

**Send in your site maps and driving
directions to Tom Bernthal**

berntt@dnr.state.wi.us

608-266-3033

Appendix 3.

Narrative Summaries of Each Site with Photographs and FQI Scores, Including Summary and Evaluation of the FQI and WWPBI

Floristic Quality Assessment of 17 Wetland Sites in Wisconsin

28 August 2002

A report from:

Emmet J. Judziewicz
True Heritage Botanical Services
1180 Dodds Drive, Apt. 4
Plover, WI 54467

To:

Thomas Bernthal
Bureau of Fisheries Management and Habitat Protection
Wisconsin Department of Natural Resources
Madison, WI 53706

POLK COUNTY: Standing Cedars Wetlands.

Location: T32N-R19W, Sec. 29, on west side of 280th Street about 2 miles north of the St. Croix County line. GPS location: 45°14'26"N, 92°44'21"W.

Surveys: 4 July 2002 (35 minutes), 14 August 2002 (25 minutes plus 15 minutes for Wetland Biotic Index sampling).

Size of site: about 100 x 60 meters (0.45 ha).

Context of site: Within a matrix of old and currently used agricultural land to the east (on level terrain), and rugged oak forest along and within coulees of the St. Croix River to the west.

Description of site: Open natural glacial pothole wetland. Immediately surrounded by disturbed second-growth forest of willow, box elder, green ash, cottonwood, and prickly ash. The site was probably utilized by livestock sometime in the past. Standing water was present on both visits (decreasing from about 60% to 50% of the total area). The dominant plant species surrounding the pond was reed canary grass (*Phalaris arundinacea*). Emergent aquatic macrophytes included *Sagittaria graminea* and *Schoenoplectus acutus*. Common duckweed (*Lemna turionifera*) was a dominant floating aquatic.

Survey results: The surveys found 20 native species and an FQI of 17.2. The August visit increased the FQI by 1.0. The very low FQI is typical of a small natural pond with a history of “grazing” and massive invasion by reed canary grass.



POLK COUNTY: WPA (Waterfowl Production Area) Wetlands.

Location: T32N-R17W, Sec. 33, on south side of County Hwy. A, 0.2 miles east of its junction with County Hwy. CC. GPS location: 45°13'26"N, 92°28'32"W.

Surveys: 4 July 2002 (45 minutes), 14 August 2002 (20 minutes plus 15 minutes for Wetland Biotic Index sampling).

Size of site: about 150 x 125 meters (1.3 ha).

Context of site: Within a matrix of formerly and currently used agricultural land on rolling terrain.

Description of site: Open, apparently natural (not dredged?) glacial pothole wetland. Immediately surrounded by fields except for a thin fringe of box elder, green ash, and willow on the south side. Site managed for waterfowl production. Wild rice may have been planted.

Standing water was present on both visits and was apparently deep, at least 1 meter over most of the pond, which occupied 90-95% of the wetland. The dominant plant species surrounding the pond was a fringe of reed canary grass (*Phalaris arundinacea*). Emergents aquatic macrophytes were sparse.

Survey results: The surveys found 42 native species and an FQI of 22.8. The August visit left the FQI unchanged (no increase). The low FQI is typical of a pond with a narrow wetland fringe dominated by massive growths of reed canary grass. Where reed canary was not dominant there were tiny, somewhat rich pockets of native forbs that probably increased the FQI of the site by several points.



POLK COUNTY: Tatro Wetlands.

Location: T33N-R15W, Sec. 15, on west side of County Hwy. D, 2 miles NW of the village of Clayton. GPS location: 45°20'59"N, 92°11'51"W.

Surveys: 4 July 2002 (25 minutes), 14 August 2002 (20 minutes plus 20 minutes for Wetland Biotic Index sampling).

Size of site: about 60 x 60 meters (0.3 ha).

Context of site: Within a matrix of actively used agricultural land on level terrain.

Description of site: Open wetland; sign noted that it was a "restoration site" so probably has seen dredging/scraping. Standing water was present on both visits (decreasing from about 60% to 40% of the total area). The dominant plant species surrounding the pond were reed canary grass (*Phalaris arundinacea*), cattails (*Typha latifolia*), and woolgrass (*Scirpus cyperinus*). The pond had abundant submerged aquatics including bladderwort (*Utricularia*) and a weedy pondweed (*Stuckenia pectinata*). Where reed canary was not dominant there were tiny, somewhat richer pockets of native forbs that probably increased the FQI of the site by several points.

Survey results: The surveys found 35 native species and an FQI of 20.1. The August visit increased the FQI by 4.3. The very low FQI is typical of a small "restored" wetland that is partially dominated by the invasive reed canary grass.



ONEIDA COUNTY: Site 1, IBI Wetland (Forest Pond)

Location: T35N-R9E, Sec. 12. GPS location: 45°32'27"N, 89°18'31"W.

Surveys: 1 July 2002 (15 minutes), 14 August 2002 (5 minutes plus 10 minutes for Wetland Biotic Index sampling).

Size of site: about 22 x 22 meters (0.05 ha).

Context of site: Within a matrix of rolling, managed second-growth sugar maple – hemlock forest.

Description of site: Tiny, shaded glacial pothole wetland in forest. The site is seasonally wet, but no standing water was present during the 1 July 2002 survey. The dominant plant species was the sedge *Carex tuckermanii*.

Survey results: The surveys found 26 native species and an FQI of 26.5. The August visit increased the FQI by 1.3. The average co-efficient of conservatism was 5.2, the 3rd highest of all 17 sites visited. The moderately low FQI is typical of a tiny, shaded vernal woodland pond vegetated by native species, and probably does not reflect the pond's importance to other biota such as herps.



ONEIDA COUNTY: Site 2, IBI Wetland (Home Depot Wetland).

Location: T36N-R9E, Sec. 5. GPS location: 45°37'59"N, 89°23'25"W. On the south side of Business US Hwy. 8, at the west side of the entrance to the Home Depot store.

Surveys: 1 July 2002 (20 minutes), 14 August 2002 (10 minutes plus 15 minutes for Wetland Biotic Index sampling).

Size of site: about 32 x 32 meters (0.10 ha).

Context of site: To the east and north are highways and commercially developed sites within the city of Rhinelander. To the southwest is a red pine plantation and small copse of box elder. There is a storm drain inlet leading into the site from the north (across US 8) and the site's outlet is to the west.

Description of site: Small pothole apparently partly natural but also partly the result of construction activities. Seasonally wet, the area was about 75% standing water during the 1 July 2002 survey, decreased to 65% on 14 August. Dominant plants were the exotics reed canary grass (*Phalaris arundinacea*) and hybrid cattail (*Typha x glauca*). The native water-plantain (*Alisma triviale*) was emergent in dense beds in standing water.

Survey results: The surveys found 43 native species and a moderately low FQI of 25.8. The August visit increased the FQI by 1.8. The site also had 8 species of exotic plants including purple loosestrife and both buckthorns as well as reed canary grass. In many ways this was one of the most puzzling sites visited. The site is tiny, highly urbanized, full of the worst exotics, and perhaps scraped, yet a large number of native species are managing to hang on – so far. They will probably drop out in a few years as cattails and reed canary grass become dominant. An uncommon sedge (*Carex arcta*) was noted during the June survey.



ONEIDA COUNTY: Site 3, IBI Wetland (Pelican Ranch Road and Hwy. 8)

Location: T36N-R9E, Sec. 23. GPS location: 45°35'59"N, 89°20'21"W. At the southeast corner of US Hwy. 8 and Pelican Ranch Road.

Surveys: 1 July 2002 (20 minutes), 14 August 2002 (15 minutes plus 15 minutes for Wetland Biotic Index sampling).

Size of site: about 40 x 40 meters (0.16 ha).

Context of site: There is an aspen forest on the east side. Otherwise, the site is surrounded by high grassy embankments (the exotic grass *Bromus inermis* covers the embankments) adjacent to Highways US 8, Old US 8, and Pelican Ranch Road. There are culverts draining the wetland on the north and west sides.

Description of site: An open, sunny sedge – bluejoint meadow nearly filled with standing water during the 1 July 2002 survey (but summer has been exceptionally wet). Standing water had decreased a bit (or the emergents grown more luxuriant) by 14 August 2002. Dominant plant species were the sedge *Carex lacustris* and the grass *Calamagrostis canadensis*. One exotic shrub was present, common buckthorn (*Rhamnus cartharticus*).

Survey results: The surveys found 27 native species and a moderate FQI of 27.4. The August visit increased the FQI by 2.2. Highway construction and maintenance has had significant impact on the site's hydrology, but the wetland is still dominated by native species. In fact the site had the highest average coefficient of conservatism (5.6) of any of the sites sampled. Perhaps exotics have a more difficult time invading a cold, acid wetland (leatherleaf is present) and that this helps maintain a relatively high FQI.



PLAINFIELD (WAUSHARA COUNTY): Site 1: Plainfield Lakes (Sherman Lake).

Location: T20N-R9E, Sec. 17. GPS location: 44°12'12"N, 89°27'53"W. On east side of Hwy. 73 about 2 miles east of village of Plainfield.

Surveys: 26 June 2002 (60 minutes), 16 August 2002 (30 minutes plus 25 minutes for Wetland Biotic Index sampling).

Size of site: about 400 x 300 meters (9 ha).

Context of site: Within a matrix of rolling, managed, sandy aspen, jack pine, and Hill's oak forest.

Description of site: Part of a State Natural Area that protects a rare community and several rare plant species, this 9-hectare pothole has a sandy-mucky bottom and widely fluctuating water levels. I visited this site in 2000 and found about 4-5 ha of open water. In 2001 there was less than 1 ha of open water. The site was about 75% covered by standing water during the 26 June 2002 survey, this increasing to 95% on 16 August when the levels were as high as I've ever seen in six visits over the last three summers. Dominant plants were sedges (*Schoenoplectus* spp., *Eleocharis* spp., *Carex* spp.) on the lake margins, floating aquatics (*Nymphaea*, *Nuphar*) and few emergents such as aquatic smartweed (*Polygonum amphibium*) in open water, and *Panicum acuminatum* and *Euthamia graminifolia* on the sandy, vegetationally zoned receding shoreline.

Survey results: The 2002 surveys found 52 native species and a moderately high FQI of 34.9. In addition, the site had 10 species of exotic plants, although none was dominant. The August visit increased the FQI by 2.8. The rather low FQI of this site was surprising given the fact that a number of rare plants were present and it is preserved as a State Natural Area. In my list of species I included four species that I had seen here in 2000 but not 2002: *Carex sychnocephala*, *Eleocharis compressa*, *E. quinquefolia*, and *E. olivacea*. My reasoning is that these species are doubtlessly present in the seed bank, "waiting" for low water levels. If these four native species are excluded from the survey based on their lack of emergence this year, the site's FQI would drop by 10% to 31.5.



PLAINFIELD (WAUSHARA COUNTY): LMR Site 2 (West Marsh).

Location: T18N-R10E, Sec. 22. GPS location: 44°01'29"N, 89°18'07"W. On the south side of Cumberland Lane, on the west side of Hwy. 22, about 3 miles south of Wautoma.

Surveys: 26 June 2002 (30 minutes), 16 August 2002 (20 minutes plus 20 minutes for Wetland Biotic Index sampling).

Size of site: About 100 meters in diameter (0.75 ha).

Context of site: Within a matrix of current and former agricultural fields and woodlots dominated by oak and aspen. In general the area is flat and poorly drained. A large deep, straight, north-south running drainage ditch is located a few meters west of the site and must have a significant impact on its hydrology.

Description of site: The dominant plants were tussock sedge (*Carex stricta*) with scattered to dense patches of shrubby willows, mostly *Salix petiolaris*. Open water – puddles from recent heavy rains – occupied about 10% of the site on both visits.

Survey results: The 2002 surveys found 37 native species and a moderate FQI of 31.7. The August visit increased the FQI by 1.8. Notably, in spite of nearby agricultural activities and the drainage ditch (the site was characterized as “moderately disturbed”), it had only one exotic species (bittersweet nightshade, *Solanum dulcamara*) and had numerous fairly conservative native species.



PLAINFIELD (WAUSHARA COUNTY): LMR Site 3 (East Marsh).

Location: T18N-R10E, Sec. 22. GPS location: 44°01'26"N, 89°18'01"W. On south side of Cumberland Lane; on west side of Hwy. 22 about 3 miles south of Wautoma.

Surveys: 26 June 2002 (40 minutes), 16 August 2002 (25 minutes plus 20 minutes for Wetland Biotic Index sampling).

Size of site: about 125 meters in diameter (1.25 ha).

Context of site: Within a matrix of current and former agricultural fields and woodlots dominated by oak and aspen. In general area is flat and poorly drained.

Description of site: The dominant plants were tussock sedge (*Carex stricta*), wiregrass sedge (*Carex oligosperma*), and bluejoint (*Calamagrostis canadensis*) with scattered to dense patches of shrubby willows, mostly *Salix petiolaris*. A 0.1 ha pond – apparently artificially dug as evidenced by old dredge spoils – occurs on the east edge of the site and its extent and level had not changed from 26 June to 16 August 2002.

Survey results: The site had both the highest number of native species (63) as well as the highest FQI (40.4) and 2nd highest co-efficient of conservatism (5.22) of any of the sites sampled. The August visit increased the FQI by 1.6. Notably, in spite of nearby agricultural activities and the dredged pond, the site had only two exotic species, neither common: reed canary grass (*Phalaris arundinacea*) and bittersweet nightshade (*Solanum dulcamara*) and had numerous fairly conservative native species. On the margins of the site was a tiny, somewhat richer pocket of native wetland forbs (including the beakrush *Rhynchospora capitellata*) that probably increased the FQI of the site by several points.



GREEN COUNTY: Brooklyn-Albany Road Wetland (Liberty Creek Sedge Meadow).

Location: T3N-R9E, Sec. 2. GPS location: 42°46'08"N, 89°24'30"W. On south side of Brooklyn-Albany Road ca. miles west of the Rock County line, just west of Liberty Creek.

Surveys: 27 June 2002 (70 minutes), 8 August 2002 (30 minutes plus 25 minutes for Wetland Biotic Index sampling).

Size of site: about 150 meters in diameter (1.75 ha).

Context of site: Within a matrix of current and former agricultural fields. In general the area is flat and poorly drained. Streams in immediate vicinity including Liberty Creek do not appear to have been ditched.

Description of site: An open sedge-grass meadow. During the 27 June 2002 survey, the dominant plants were tussock sedge (*Carex stricta*) and bluejoint (*Calamagrostis canadensis*). There were also scattered to dense patches of shrubby willows, mostly *Salix petiolaris*. No open water was evident on either visit.

Survey results: The 2002 surveys found 49 native species and a moderately high FQI of 34.1. The August visit increased the FQI by 0.5. Notably, in spite of nearby agricultural activities, the site had only one exotic species, reed canary grass (*Phalaris arundinacea*), and that was uncommon. The record of northern green orchid (*Platanthera huronensis*) was the first for Green County.



GREEN COUNTY: Tin Can Alley Wetland.

Location: T3N-R9E, Sec. 17. GPS location: 42°43'47"N, 89°27'59"W. On the east side of Tin Can Road just south of the Sugar River hike-bike trail.

Surveys: 27 June 2002 (35 minutes), 8 August 2002 (15 minutes plus 20 minutes for Wetland Biotic Index sampling).

Size of site: About 40 x 20 meters (0.06 ha).

Context of site: Within a matrix of current and former agricultural fields and floodplain woods in the floodplain of the Sugar and Little Sugar Rivers. In general the area is flat and poorly drained. Construction and maintenance of the former railroad and (east-west) and town road (north-south) appear to have impeded drainage and formed or deepened this wetland.

Description of site: A thick stand of reed canary grass (*Phalaris arundinacea*), common cattail (*Typha latifolia*), and bur-reed (*Sparganium eurycarpum*) with about one foot of standing water on 27 June 2002. The water had dried by 8 August 2002.

Survey results: The 2002 surveys found 30 native species and a moderately low FQI of 25.9. The August visit increased the FQI by 1.0. The site had two exotic species, the dominant reed canary grass (*Phalaris arundinacea*), and also *Solanum dulcamara*. The FQI was relatively low, reflecting the disturbed hydrological regime of the site and the dominance of an exotic species.



DANE COUNTY: Hope Road Wetlands (Bork).

Location: T7N-R11E, Sec. 20. GPS location: 43°03'11"12"N, 89°13'27"W. On south side of Brooklyn-Albany Road ca. miles west of the Rock County line, just west of Liberty Creek.

Surveys: 29 June 2002 (25 minutes), 2 August 2002 (45 minutes plus 20 minutes for Wetland Biotic Index sampling).

Size of site: about 100 x 150 meters (1.2 ha).

Context of site: Within a matrix of current and former agricultural fields. In general the area is flat and poorly drained, between drumlins to the NW and SE.

Description of site: The site is a cattail marsh dominated by hybrid (*Typha x glauca*) and native (*T. latifolia*) species. It may be partly artificially dug and is perhaps fertilized with run-off from adjacent agricultural fields. About 0.1 ha of the site is open water in June. This has dried to mud by August.

Survey results: The 2002 surveys found 29 native species and a very low FQI of 17.3. The August visit increased the FQI by 3.3. In addition to the exotic cattail, exotic reed canary grass (*Phalaris arundinacea*) was also present. The site was species-poor because of its disturbed nature and the dominance of cattails.



JEFFERSON COUNTY: Fayeveille Prairie Scrape.

Location: T8N-R14E, Sec. 19. GPS location: 43°08'46"N, 88°52'47"W. At the end of Prairie Lane, less than a mile west of the Crawfish River.

Surveys: 28 June 2002 (30 minutes), 2 August 2002 (25 minutes plus 15 minutes for Wetland Biotic Index sampling).

Size of site: About 20 x 20 meters (0.03 ha).

Context of site: Within a matrix of unplowed prairie (to the north) and former agricultural fields (to the south). In general the area is flat and poorly drained.

Description of site: The site is a tiny shallow pond that is the result of a recent bulldozer scrape. The pond is surrounded by cattails (the exotic hybrid *Typha x glauca* and native *T. latifolia*). Spikerushes and bulrushes of various species are the dominants. The pond had dried up by the August visit.

Survey results: The 2002 surveys found 26 native species and a very low FQI of 17.1. The August visit increased the FQI by 2.3. Five species of exotic plants are present including reed canary grass (*Phalaris arundinacea*) and purple loosestrife (*Lythrum salicaria*). The FQI is low as expected because of the artificial nature of this wetland.



JEFFERSON COUNTY: Diedrich-Alexander Wetland.

Location: T8N-R13, Sec. 35. GPS location: 43°07'27"N, 88°55'05"W.

Surveys: 28 June 2002 (25 minutes), 2 August 2002 (25 minutes plus 20 minutes for Wetland Biotic Index sampling).

Size of site: About 75 x 25 meters (0.15 ha).

Context of site: Within a matrix of current and former agricultural fields on rolling drumlinal terrain (to the east) and extensive wetlands including tamarack swamp (to the west). In general the area is flat and poorly drained.

Description of site: The site is at the eastern margin of an extensive wetland complex. The dominant plants are cattails (*Typha latifolia*) along with various tussock sedges such as *Carex stricta*. About 80% of the area surveyed was open water over muck. This was reduced to a few puddles by August.

Survey results: The 2002 surveys found 43 native species and a moderately low FQI of 27.6. The August visit increased the FQI by 4.8. Three species of exotic plants are present including reed canary grass (*Phalaris arundinacea*). On the margins of the site was a tiny, somewhat richer pocket of native wetland forbs that probably increased the FQI of the site by several points.



WASHINGTON COUNTY: WIBI SER Site 1 - Myra Wetland (Ozaukee County Land Trust) (OWLT)

Location: T11N-R20E, Sec. 16. GPS location: 43°24'51"N, 88°06'46"W.

Surveys: 29 June 2002 (35 minutes), 20 August 2002 (25 minutes plus 20 minutes for Wetland Biotic Index sampling).

Size of site: About 150 x 75 meters (0.9 ha).

Context of site: Within a matrix of active agricultural fields (planted to clover for hay) and suburban residences on rolling.

Description of site: The site is a pothole vegetated by a mix of sedges (*Carex lacustris*), grass (the native *Calamagrostis canadensis* and exotic *Phalaris arundinacea*), and shrubby willows (*Salix petiolaris* is commonest). There was standing water throughout much of the site during the 29 June 2002 survey; this was all gone by the 20 August visit.

Survey results: The 29 June 2002 survey found 39 native species and a moderately low FQI of 26.9. Five species of exotic plants are present. The August visit reduced the FQI by 0.2 to 26.7. The FQI is somewhat low, probably because of both invasion by reed canary grass, and nutrient-laden run-off from adjacent agriculture.



WASHINGTON COUNTY: WIBI SER Site 2 – Byer’s Pond

Location: T11N-R21E, Sec. 30. GPS location: 43°23’18”N, 88°01’51”W.

Surveys: 29 June 2002 (30 minutes), 20 August 2002 (25 minutes plus 20 minutes for Wetland Biotic Index sampling).

Size of site: About 200 x 30 meters (0.5 ha).

Context of site: The site is within a matrix of a woodlot of second-growth sugar maple, beech, basswood, and white ash on rolling morainal land adjacent to the UW-Milwaukee Field Station.

Description of site: The site is a shaded pothole supporting a vernal pond that on 29 June 2002 was almost entirely open water. The commonest emergents are occasional trees of green ash (*Fraxinus pennsylvanica*). Many old dead tree trunks, probably American elm, occur in the pond, and many herbaceous species occur only on the downed rotting trunks. Dominant aquatic macrophytes in the pond include yellow water buttercup (*Ranunculus flabellaris*), forked duckweed (*Lemna trisulca*), and eastern manna grass (*Glyceria septentrionalis*). On 20 August, there was no standing water.

Survey results: The 29 June 2002 survey found 20 native species and a very low FQI of 18.1. Three species of exotic plants are present including reed canary grass (*Phalaris arundinacea*) but none are dominant. The August visit decreased the FQI by 0.2 to 17.9. The FQI is very low, probably because site was at one time essentially a wooded swamp with few herbaceous species. It “opened up” when the American elm died.



WASHINGTON COUNTY: WIBI SER Site 3 – Seidler Farms on Hwy. 181

Location: T10N-R21E, Sec. 21. GPS location: 43°18'40"N, 88°00'18"W.

Surveys: 29 June 2002 (25 minutes), 20 August 2002 (25 minutes plus 20 minutes for Wetland Biotic Index sampling).

Size of site: About 60 x 50 meters (0.25 ha).

Context of site: The site is within a matrix of a woodlot of second-growth green ash and American elm. Hwy. 181 forms the site's eastern boundary. Surrounding the woodlot is residential and agricultural land.

Description of site: The site is a shaded pothole supporting a vernal pond that on 29 June 2002 was almost entirely open water. The commonest emergents are occasional trees of green ash (*Fraxinus pennsylvanica*) and the manna grass *Glyceria septentrionalis*. Many old dead tree trunks, probably American elm, occur in the pond. On 20 August the standing water was gone and reed canary grass, manna grass, and river bulrush (*Bulboschoenus fluviatilis*) were dominant.

Survey results: The 29 June 2002 survey found 22 native species and a very low FQI of 14.1. Five species of exotic plants are present but none are dominant. The August visit increased the FQI by 5.5 to 19.6. This was the largest increase in FQI in any site. The reason for this may be that species that were submerged in the June survey became evident when the waters dried over the summer. The FQI is low, but this is natural since the site was a vernal pond dominated by just a few emergent species (manna grass and bulrush).



Summary and Evaluation of the Floristic Quality Assessment and Index of Biotic Integrity (Based on Visits to 17 Wisconsin Wetlands, June-August 2002)

Emmet J. Judziewicz

True Heritage Botanical Services, 1180 Dodds Drive, Apt. 4, Plover, WI 54467

30 August 2002

An evaluation of the Floristic Quality Assessment and Index of Biotic Integrity of 17 selected Wisconsin wetlands was conducted from 26 June to 20 August 2002 and its results are summarized as:

- 1) An overall evaluation and summary of the utility of the Floristic Quality Assessment (FQA) and Index of Biotic Integrity (IBI) methods of survey (below).
- 2) An illustrated narrative for each site;
- 3) Three Excel Spreadsheets documenting the FQI of 17 Wisconsin Wetlands during late June surveys, August surveys, and combined June and August surveys (plus an 18th very high quality wetland of my choice).

1. Overall Evaluation of the Adequacy of the Floristic Quality Assessment (FQA) to Characterize the Integrity of the Plant Community at Wetland Sites

In general, a site's Floristic Quality Assessment (FQI) corresponded well to the site's natural area significance. Swink & Wilhelm (Flora of the Chicago Region, 4th ed., 1994: 18) note that FQI values of less than 20 denote a site with no significance whatever, while those of 35 or higher are at least marginally significant; while sites with FQA values of 50 or more probably deserve protection as natural areas. The 17 sites I surveyed had FQIs ranging from 17 to 40. Below 40, there were two sites with FQIs approaching 35, and one has already been designated as a State Natural Area (Sherman-Plainfield Lake).

One exception is that the FQA system does not work well for small, high-quality vernal ponds such as the two Ozaukee County sites (Byers and Seidler Ponds) and the Oneida County forest pond. Both Ozaukee sites had FQIs of less than 20, yet they were clearly fairly undisturbed and probably had important values for other biota such as herps and aquatic invertebrates that are not reflected in their low FQIs.... By contrast, a pond of similar size with a rich fen mat and numerous obligate calciphiles (and probably also a high quality fauna, too) such as "Site 18" (Ponsegrau Lake, Oconto County) had an FQI of over 80, or 4 times as high as the southern Wisconsin vernal ponds.

Some of the aspects of FQI that impressed me were the following:

Some species have coefficients of conservatism that appear to be inflated. Examples include but are not limited to *Campanula aparinoides* (7), *Lysimachia terrestris* (7), and *Triadenum fraseri* (8). Even in degraded sites one will often find one or a few individuals of these species. It would probably be useful at some point in the future to review FQI values for all of these native species.

The species that "suffer" most from a "late-season-only" survey are the more delicate species of sedges such as *Carex brunnescens* (C = 7), and *C. interior* (7). These species tend not to keep their perigynia for as long as some of the larger, coarser sedges, and moreover they tend to be more conservative taxa with higher Cs than the late season species. Also, late season-flowering species such as *Aster* and *Bidens* species generally tend to be coarser and weedier, with lower C values that decrease the FQI values at a site.

With regard to an optimum time for surveys, the following are summations of the values for the 17 sites visited:

	June	August	June + August	Increase by adding an August survey
Mean co-efficient of conservatism	4.41	4.30	4.31	- 2.5 %
Mean number of native species	28.9	33.9	36.2	+ 25.3%
Mean FQA value for site	23.5	24.9	25.6	+ 8.9 %

Small, rich pockets of “high-C” species tend increase the FQI of certain sites. These microsites generally occur on the margins of more extensive wetland where, by chance, larger coarse, often invasive species such as reed canary grass have failed to become dominant.

The late season (August) surveys found significantly more species (34) than the June surveys (29). This is probably due to the more numerous species that appear, flower, and fruit after water levels have dropped as the summer progresses – examples are the smartweeds (*Polygonum* species) and beggar-ticks (*Bidens* species).

In summary, a single visit to a site to obtain an FQI is probably sufficient. This visit could be scheduled any time from mid-June to the end of August. Two visits (early and late) will probably not, in general, increase the FQI by any more than about 10%. If the choice is between an early or late visit, a late visit is slightly preferable.

2. Summary of Observations on the Feasibility and Utility of the Sampling Methodology Employed in the Plant Biotic Index (Index of Biotic Integrity, IBI)

First of all, the results of IBI are not comparable to those of FQA because the entire site is not surveyed. In the August surveys, I found an aggregate total of 238 “species-records” in 17 sites in the IBI transects, while 577 species-records were found in the same 17 sites. So IBI picked up 238/577 or 41% of the species-records at a given site. On the other hand, IBI was clearly more quantitative in that an estimate of percent cover at each quadrat was recorded, plus a correlation with water depth and species-cover was recorded.

Because water levels vary from season to season and from year to year, it will be difficult to get even approximately comparable IBI transect data from the same site. Also, different transect routes will be run by different surveyors.

Another problem that I had with IBI was that, in practice, littoral zones tend to be abrupt, going from deep water to dry land in only a few meters. Or, there is no standing water at all late in the season. That necessitates transects with sampling intervals of only 1 or in some cases only 0.5 meters. Rare was the wetland with a long gradual gradient from deep water to shore so that transect intervals could be, say five meters in length.

That said, IBI is a useful, fast way to get quantitative data on the dominant vegetation at a given site. While a useful FQI value can be gotten from a single visit to a site, I think that two or three IBI visits – during periods of high, medium, and low water --- would be more useful.
