Lessons Learned By States\Tribes Through Bioassessment of Wetlands

State	Lessons Learned from biomonitoring	Contact
Delaware/ Maryland	**Amphibians** • The reduced species richness of amphibians, compared to macrophytes and macroinvertebrates, may limit the number and types of metrics that can be developed from this assemblage. • Adequate sampling for amphibians requires more trips and techniques than other assemblages. This is due to their mobility, multiple life history strategies, and variable breeding periods among species. Sampling for one life stage only is probably not as effective as sampling for adults and tadpoles in determining amphibian usage of a wetland.	Don W. Sparling Project and Amphibian Coordinator U. S. Geological Survey (USGS) Biological Resources Division Patuxent Wildlife Research Center 11510 American Holly Drive Laurel, MD 20708-4017 Phone: (301) 497-5723 Email: don_sparling@usgs.gov
Delaware/ Maryland	**General:** • Many of the wetlands in our bases were only a few years old when we started and may not have had ample time for ecological and anthropogenic factors to separate them along a physical gradient. • As a result, development of a reliable and ecologically meaningful gradient has been one of the most difficult parts of this project. • It would be very instructive to revisit these wetlands after 10 or 15 years and see how they have changed.	Don W. Sparling Project and Amphibian Coordinator U. S. Geological Survey (USGS) Biological Resources Division Patuxent Wildlife Research Center 11510 American Holly Drive Laurel, MD 20708-4017 Phone: (301) 497-5723 Email: don_sparling@usgs.gov

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Delaware/ Maryland	**Macroinvertebrates** • Picking, sorting, and identifying aquatic insects was one of the most laborious aspects of the study. Investigators wishing to use invertebrates in their bioassessments should allocate sufficient resources to accomplish the task. • Invertebrate species presence, and especially abundance, are seasonally quite variable. June to early July before the drying of mid- to late summer begins seems to be the best months for finding the greatest diversity and abundance of macroinvertebrates.	T. Peter Lowe Coordinator for Macroinvertebrates USGS, Patuxent Wildlife Research Center 11510 American Holly Dr. Laurel, MD 20708-4017 Office: (301) 497-5705 Email: Peter_Lowe@usgs.gov
Delaware/ Maryland	**Macrophytes** • There can be considerable differences between mid- and late summer in the ability to easily record and identify plants. This is especially true for graminoids, which are primarily identified by fruiting body characteristics. In addition, many legumes, composites, warm season grasses are present in late summer but not apparent in spring. • The inclusion of incidental species added appreciably to the number of species identified in a particular wetland. We are evaluating whether this inclusion has an effect on the resulting metrics. • Deep water areas (greater than 45 cm) have a much lower species richness than shallower zones and do not need to be sampled at the same level of intensity at the same site. • Permanent transects are preferred if data collection can continue over several years. This will allow for the annual and seasonal changes that occur over time due to shifts in hydrology.	Norman Melvin Coordinator for Macrophytes U.S. Department of Agriculture Wetland Science Institute 11400 American Holly Dr. Laurel, MD 20708-4014 Office (301) 497-5933 Email: Norman_Melvin@usgs.gov

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Florida	**Classification\Reference Condition:** • Periphyton, macroinvertebrate, and macrophyte communities in WCA 2A change substantially from reference conditions at approximately seven to eight km downstream of canal discharges into WCA 2A. • Data analysis has shown that biological populations at the two stations (E5 and (F5) nearest to the three initial reference sites (U1-U3) are very similar in terms of biological community structure. This suggests that these areas, despite slight phosphorus enrichment, still support reference condition biota. The somewhat higher phosphorus regime at the next stations (E4 and F4 and beyond) is associated with greater biological changes. Experimental field dosing studies (mesocosms) conducted by SFWMD ESRD show that the addition of phosphorus causes changes in periphyton assemblages consistent with those observed in the transect study. The WCA 2A transect periphyton data for each site and date have been analyzed using the entire taxonomic assemblage encountered and using lists of pollution-sensitive and pollution-tolerant species based on available literature and experimental phosphorus addition studies (the mesocosms) in WCA 2A. Macroinvertebrate data have been analyzed using the Florida Index and the macroinvertebrate component of the Lake Condition Index (LCI), measures of the numbers of pollution-sensitive taxa in a sample that are routinely used by FDEP in bioassessments of streams and lakes. The use of these methods with the WCA 2A transect data has demonstrated a clear signal of biological disturbance along the nutrient gradient in WCA 2A. FDEP is using this information as well as information from other studies conducted in the Florida Everglades to develop a numeric phosphorus criterion for the Everglades Protection Area.	Russ Frydenborg Florida DEP Environmental Assessment Section 2600 Blairstone Rd. Tallahassee, FL 32399-2400 Email: russel.frydenborg@dep.state.fl.us Phone: (850) 921-9821 Mark Brown Center for Wetlands University of Florida Phelps Lab – P.O. Box 116350 Gainesville, FL 32611-6350 Email: mtb@ufl.edu Phone: (352) 392-2309 Systems Ecology, Environmental Engineering Services, University of Florida

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Massachusetts	**General:** Through the three pilot projects, the Massachusetts CZM project team has been able to learn from each application. As a result, the team has made several small, incremental revisions to many components of the protocols, including adjustments to sampling methods and shifts in the attributes and metrics examined. Each application has also generated results that indicate decreasing biological integrity with increasing land use stressors. New efforts to engage volunteers through intensive classroom and field training have shown that, with proper training and coordination, many of these assessment tools are available to groups and organizations interested in pursuing wetlands bioassessment.	Bruce K. Carlisle Massachusetts Coastal Zone Management 100 Cambridge Street Boston, MA 02202 Phone: (617) 626-1200
Minnesota	**Invertebrates:** The invertebrate community in wetlands respond differently than those used for stream IBIs. Stream IBIs are based on invertebrates which typically employ well-oxygenated riffle communities, where pollution or disturbances promote an increase of taxa that tolerate lower oxygen conditions. In wetlands, many of the aquatic invertebrates are well adapted to the natural, diurnal fluctuations of oxygen and would be expected to be "pollution tolerant" but indeed may not be.	Mark Gernes Minnesota Pollution Control Agency (MPCA) Environmental Outcomes Division 520 Lafayette Road St. Paul, MN 55155 Phone: (651) 297-3363 Email: mark.gernes@pca.state.mn.us

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Minnesota	**Vegetation** ! IBIs show great promise for future applications in wetlands biological assessment as they are biologically rich and sensitive to a variety of human disturbances. ! Sampling method adaptability (vegetation) is needed in many wetlands that receive significant quantities of water during storm events. These wetlands frequently have poorly developed emergent fringe plant communities due to extreme water level fluctuations.	Mark Gernes Minnesota Pollution Control Agency (MPCA) Environmental Outcomes Division 520 Lafayette Road St. Paul, MN 55155 Phone: (651) 297-3363 Email: mark.gernes@pca.state.mn.us
Montana	**Classification\Reference Condition:** • We concluded that multivariate analysis was a useful tool for developing a wetland classification system and that hydrogeomorphology and ecoregions were practical approaches to classifying wetlands for the development of biocriteria. • We determined that both the multimetric and multivariate techniques were valuable for developing wetland biocriteria. • Two wetland types in the arid west (including Montana) are difficult to classify. Wetlands such as potholes are highly complex and difficult to classify due to both spatial and temporal variability. For these wetlands, the hydrology, water chemistry and biology can change dramatically throughout a season or from year to year as a result of climatic change. For example, the biological community of a wetland often changes due to an increase in salinity or a decrease in water content caused by drought.	Randall S. Apfelbeck Montana Department of Environmental Quality 2209 Phoenix Avenue P.O. Box 200901 Helena, MT 59620-0901 Phone: (406) 444-2709 Email: rapfelbeck@state.mt.us

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Montana	**Diatoms and Macroinvertebrates:** • We found that diatoms and macroinvertebrates were most useful for evaluating the biological integrity of perennial wetlands with open water environments that had relatively stable water levels and were not excessively alkaline or saline. • In most cases, the multimetric and multivariate approaches that we used to assess the macroinvertebrate and diatom communities both identified the same wetlands as impaired.	Randall S. Apfelbeck Montana Department of Environmental Quality 2209 Phoenix Avenue P.O. Box 200901 Helena, MT 59620-0901 Phone: (406) 444-2709 Email: rapfelbeck@state.mt.us
Montana	**Vegetation:** • Montana focused on vegetation biocriteria because they believed wetland vegetation was easier to assess than macroinvertebrates or diatoms for depressional wetlands that are seasonally dry.	Randall S. Apfelbeck Montana Department of Environmental Quality 2209 Phoenix Avenue P.O. Box 200901 Helena, MT 59620-0901 Phone: (406) 444-2709 Email: rapfelbeck@state.mt.us
North Dakota	**Classification\Reference Condition:** • The first two years of the program focused solely on "least impaired" or reference condition wetlands. While beneficial in testing sampling methods, the lack of a disturbance gradient in the study design did allow for the testing of attributes and the selection of metrics. Therefore, beginning in 1997 the NDDH chose wetlands across a disturbance gradient, including both reference wetlands and degraded wetlands. • The NDDH has also found it beneficial to stratify wetlands based on ecoregion and wetland class. This minimizes the amount of variation in the biological assemblage and allows more sensitivity in the response of the metrics to the disturbance gradient. Current IBI development efforts are focusing on temporary and seasonal depressional wetlands within the Northern Glaciated Plains and Northwestern Glaciated Plains ecoregions.	Mike Ell North Dakota Department of Health Division of Water Quality 1200 Missouri Avenue P.O. Box 5520 Bismarck, ND 04333 Phone: (701) 328–5214 Email: mell@state.nd.us

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Ohio	**Classification\Reference Condition:** • Classification is definitely an iterative process. Investigators should definitely consider a Hydrogeomorphic (HGM) classification scheme if one has been developed for their region of interest, at least as a starting point. However, the experience in Ohio suggests that grosser classes based on dominant vegetation (emergent, scrub-shrub, forested, etc.) may work also. • A goal of a cost-effective Biocriteria program is to have the fewest classes that provide the most cost-effective feedback. With vegetation, data from Ohio is suggesting somewhat diverse wetland types may be "clumpable," since even though their floras are different at the species level, the quality/responsiveness of their unique floras to human disturbance is equivalent. This is also a concern in states with high degrees of wetland loss where two few wetlands of a particular HGM class remain to analyze as a separate class.	Mick Micacchion (amphibians, rapid assessment method) Wetland Ecologist Ohio Environmental Protection Agency Division of Surface Water 122 South Front Street P.O. Box 1049 Columbus, Ohio 43216-1049 Phone: (614) 644-2327 Email: mick.micacchion@epa.state.oh.us

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Ohio	**Macroinvertebrates and Amphibians:** • Funnel traps consistently collected an average of ten more macroinvertebrate taxa than qualitative sampling using dip-nets. Funnel traps were much more effective in sampling amphibians and fish than sampling with dip nets. • Qualitative sampling collected somewhat more Mollusca and Chironomidae taxa than funnel traps. • Funnel traps collected more leech taxa, Hemiptera taxa, Coleoptera taxa, Odonata taxa, and Crustacea taxa than qualitative sampling. • Hester-Dendy artificial substrate samplers were ineffective for sampling most wetland macroinvertebrates except oligochaetes, Chironomidae, and Mollusca. • A 24-hour sampling period for funnel traps is preferred as it allows for the collection of nocturnal species that are infrequently collected by daytime sampling methods. • Finally, it is recommended that initially the sampling method should "over"-stratify in both the vertical and horizontal dimensions until it can be determined which strata and communities are responding best to human disturbance. Ohio has found that the herb and shrub (subcanopy layers) seem to respond the best, although some intermediate tree size classes (e.g., 10 to 25 cm dbh) also appear to be responsive. Overstratifying horizontally may also make sense at the reference development stage; however, ultimately the decision whether to split or clump communities depends on whether this is necessary to detect the disturbances. "Homogenizing" community types by placing a releve or transect across them (e.g., aquatic bed to emergent to shrub zone) can be appropriate if splitting doesn't matter to detect the disturbance. The caveat of course is that you can't separate the data set later if you detect something of interest in one of the clumped communities.	Mike Gray (macroinvertebrates, amphibians) Aquatic entomologist Ohio Environmental Protection Agency Division of Surface Water Ecological Assessment Unit 4675 Homer-Ohio Lane Groveport, OH 43125 Phone: (614) 836-8773 Email: mike.gray@epa.state.oh.us

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Ohio	**Vascular Plants:** • **Floristic Quality Assessment Indexes:** Ohio EPA has found that the FQAI score and subscores of the FQAI, e.g., percent coverage of plants with Coefficients of Conservatism of 0, 1, or 2, is a very successful attribute and metric for detecting disturbance in wetlands. • **Field and Lab Methods:** After experimenting with both transect/quadrat and releve-style plot methods, Ohio has adopted a plot-based method that allows for a qualitative stratification of wetland by dominant vegetation communities. This method appears to be flexible and adaptable to unique site conditions, provides dominance data for all species in all strata, provides data that is intercomparable with other common methods, is relatively easy to learn, and is relatively fast and cost effective (up to 2 to 3 plots can be completed in a day). • Whatever sampling method is adopted it is essential that dominance and density information (cover, basal area of trees, stems per unit area, relative cover, relative density, importance values, etc.) be collected. Many of the most successful attributes Ohio has found in developing a vegetation IBI are based on cover data of the herb and shrub layers and density data of the shrub and tree layers. • Definitely consider using cover classes in general and a class scheme that works on a doubling principle to aid in consistent inter-investigator usage, e.g., see Peet et al. 1998. Then use the mid points of the class for your analysis. This seemed to really help with consistent usage and smoothing out the roughness in cover data.	John J. Mack (plants, rapid assessment method) Wetland Ecologist Ohio Environmental Protection Agency Division of Surface Water 122 South Front Street P.O. Box 1049 Columbus, Ohio 43216-1049 Phone: (614) 644-3076 Email: john.mack@epa.state.oh.us

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Ohio	**Vouchers and QAQC:** • Based on Ohio's experience voucher as much as you can for later confirmation in the lab and deposit vouchers in local and regional herbariums. Definitely, collect all Cyperaceae, Poaceae and Juncaceae and also consider collecting shrubs genuses and families (Salix, Viburnum, Vaccinium, Rosa, Alder, etc.) Polygonum spp., Aster spp., Viola spp., and Cryptograms.	John J. Mack (plants, rapid assessment method) Wetland Ecologist Ohio Environmental Protection Agency Division of Surface Water 122 South Front Street P.O. Box 1049 Columbus, Ohio 43216-1049 Phone: (614) 644-3076 Email: john.mack@epa.state.oh.us
Oregon	**General:** • Random or systematic sampling, whether within a region or within a site, is not always appropriate for use in identifying good biological indicators or developing rapid models for assessing wetland condition and function. • Systematic, repeatable, rapid procedures can be developed for assessing some of the disturbance gradients. This is a necessary precursor to selecting reference sites that will yield the most useful data. • The biological metrics investigated or used should be appropriate to the study design and measurement protocols. • Data suitable for identifying biological indicators of wetland condition can be collected simultaneously with data collected for calibration of HGM models. This does not necessarily require a great deal of additional training or field time. • Shared field experiences are a good forum for sharing wetland knowledge among agencies, and among agencies and consultants and citizens. Shared field experiences lead to participants feeling more vested in the process of developing models and multimetric indexes. This informal "buy-in" can lead to greater willingness of participants to use the methods that ultimately result.	Dana Field Oregon Division of State Lands 775 Summer St. NE Salem, OR 97310 Phone: (541) 378-3805 ext. 238 Email: Dana.Field@dsl.state.or.us Paul Adamus Adamus Resource Assessment, Inc. 6028 NW Burgundy Drive Corvallis, OR 97330 Phone: (541) 745-7092 Email: adamus7@attbi.com

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Wisconsin	**Macroinvertebrates:** • Water duration is an important factor shaping macroinvertebrate community composition and derived metrics that must be accounted for in metric scoring. • A coarse level of taxonomic resolution (order and family) appears to be satisfactory in developing wetland macroinvertebrate metrics. • Issues relating to redundancy among metrics, influences of water chemistry, differences among ecoregions, and seasonal variations need to be addressed in more detail. Undoubtedly, these factors need to be accounted for in establishing rating scores and/or in refining metrics for use in different areas or habitats. Basic differences exist in macroinvertebrate communities between wetlands representing wooded kettle depressions and prairie-type depressions. • The greatest difficulty was in selecting and assigning some measure of "human impact" to the study site wetlands. Further research will be required to quantify the degree of human impact in order to refine biological response metrics and indices. • The WWMI does not appear to be stable across dates, but it is not designed to be. Consequently, its use is restricted to early spring. Each macroinvertebrate index has its own set of advantages and disadvantages; further refinement is required to enable their successful application in the field.	Dick Lillie Wisconsin Department of Natural Resources Bureau of Integrated Science Services 1350 Femrite Drive Monona, WI 53716 Phone: (608) 221-6338 Email: LILLIR@dnr.state.wi.us
Wisconsin	**Plants:** • Some biases were apparent in the WWPBI as reference kettles scored consistently higher than prairie wetlands. • WWPBI scores in restored prairie wetlands were better than in many natural wetlands, suggesting that wetland restorations in Wisconsin may be adequate in terms of "restoring" the vegetative community (not true for macroinvertebrate response). • The WWPBI shows some promise in its performance and, because of its taxonomic simplicity, it could be applied by nonbotanist.	Dick Lillie Wisconsin Department of Natural Resources Bureau of Integrated Science Services 1350 Femrite Drive Monona, WI 53716 Phone: (608) 221-6338 Email: LILLIR@dnr.state.wi.us