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Wetland Monitoring and Assessment Program for the State of Illinois

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

BUREAU OF WATER

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Prepared by

Illinois Environmental Protection Agency

Bureau of Water

Surface Water Section and Watershed Management Section

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Illinois Environmental Protection Agency

September 2007

I. Executive Summary

The Illinois Environmental Protection Agency (Illinois EPA) currently operates monitoring and assessment programs designed to meet the requirements of sections 305(b) and 303(d) of the Clean Water Act for rivers and streams, inland lakes, Lake Michigan and ground waters. There is currently no comparable monitoring and assessment program for the State's wetland resources, even though wetlands are considered waters of the state. In October 2005, the Illinois EPA received a grant from USEPA Region 5 to develop a plan for a wetland monitoring and assessment program, in preparation for future implementation. Realizing there was expertise within the State, and with the desire to construct a program which would meet needs of as many interests as possible, the Illinois EPA convened a Wetland Technical Working Group comprised of individuals from Federal, State, and local agencies and entities with wetland knowledge and experience.

The resulting plan for a wetland monitoring and assessment program builds upon the existing wetland monitoring efforts of the Illinois Department of Natural Resources' Critical Trends Assessment Program, conducted by Illinois Natural History Survey. Through the addition of some monitoring components and the development of a Wetland Index of Biotic Integrity as an assessment tool, the resulting program provide will meet Clean Water Act requirements and will provide valuable and needed information to a number of agencies and entities in the State.

An initial component critical to the success of this program is the completion of an update to the National Wetland Inventory for Illinois. Virtually all parties and interests represented on the Wetland Technical Working Group were in agreement that an update to the NWI for Illinois was the most important first step of this program.

This document describes the development and the components of the Statewide Wetland Monitoring and Assessment Program for Illinois. The Illinois EPA would like to express its appreciation and thanks to all of the individuals and agencies who were involved in the development of this plan.

II. Introduction

This document presents a brief description of a comprehensive statewide monitoring and assessment program for wetland water resources in the State of Illinois. This program will build upon existing information and ongoing wetland monitoring work in Illinois. This document describes a plan for a program which follows guidance and format provided in the USEPA document *Application of Elements of a State Water Monitoring and Asssessment Program for Wetlands* (available in Appendix 1 and at http://www.epa.gov/owow/wetlands/monitor/). A successful wetland monitoring and assessment program will provide water resource managers the information necessary to make more-informed decisions necessary to effectively protect, manage, and mitigate wetland resources in Illinois.

III. Monitoring Program Strategy

Illinois EPA began an effort to develop a comprehensive wetland monitoring and assessment program in 2005. As an initial activity, the Illinois EPA established and convened (January 12, 2006) a meeting of the Illinois Wetlands Technical Working Group (WTWG); a group comprised of representatives from various Federal, State, and local agencies, agricultural and development interests, environmental advocacy groups, legislative representatives, scientific and academic entities, and other interested private parties. From the WTWG, two subgroups were formed to focus on 1) Wetland Classification and Uses and 2) Wetland Monitoring and Assessment Protocols. These two subgroups met separately in April 2006 to begin discussion on their respective topics.

The Classification and Uses subgroup initially discussed various definitions for wetlands. Virtually all of the definitions considered included three components which defined wetland environments: hydrophytic vegetation, hydric soils, and saturation conditions.

The subgroup agreed that the definition currently used in the Illinois Interagency Wetland Policy Act of 1989 (available in Appendix 2 and at http://www.dnr.state.il.us/wetlands/ch6e.htm) was acceptable. That definition is: *Wetland means land that has a predominance of hydric soils (soils which are usually wet and where there is little or no free oxygen) and that is inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances does support, a prevalence of hydrophytic vegetation (plants typically found in wet habitats) typically adapted for life in saturated soil conditions.*

The subgroup then evaluated several different widely-used wetland classification systems and determined that most wetlands in Illinois could be placed into three general classes for monitoring and assessment purposes: forested wetlands, scrub-shrub wetlands, and emergent wetlands. A fourth class, aquatic bed wetlands, was also considered, but the WTWG subgroups determined that those wetland resources are currently monitored through the existing Illinois EPA stream (Ambient Water Quality Monitoring Network, AWQMN) and lake (Ambient Lake Monitoring Program, ALMP, and Volunteer Lake Monitoring Program, VLMP) monitoring activities. Consequently, aquatic bed wetlands do not need to be included in the wetland monitoring and assessment program.

The Monitoring and Assessment Protocols subgroup determined that a statewide program should initially focus on assessing and establishing characteristics and trends of Illinois wetland resources rather than meeting Clean Water Act (CWA) Section 305(b) and 303(d) program needs. The subgroup defined the measurements, observations, and indices required to make these assessments. An up-to-date inventory of wetland resources in the state was considered essential and is the first objective of the monitoring and assessment program. Once inventoried, a revised probabilistic-based assessment of the state's wetlands can be initiated and subsequently expanded as resources allow. It is certain that the wetland monitoring and assessment program will eventually be used for 305(b), 303(d) and Integrated Report purposes.

The two working subgroups continued to meet throughout 2006 and into 2007 and results of their work were presented to the parent WTWG on February 27, 2007.

An update of the wetland inventory for Illinois will require at least two years to complete; and the final monitoring and assessment program design cannot be completed until an accurate inventory is available. Ducks Unlimited, Inc., through the Great Lakes/Atlantic Regional office, submitted a proposal and has received approval of funding through the Illinois State Wildlife Grant program to complete an update of the wetland inventory for Illinois. This project will use 2005 and 2007 aerial photography to update the NWI for Illinois using Fish and Wildlife Service standards. The proposal document is presented in Appendix 3, a letter of support for this work from the Director of the Illinois Environmental Protection Agency is provided in Appendix 4, and the acceptance and funding notification letter is provided in Appendix 5.

A statewide monitoring network of reference wetlands is currently being established and will be expanded over the next several years to include at least 30 reference wetland sites throughout Illinois. These reference wetlands will include a gradient of levels of disturbance to the watersheds and wetland areas in order to provide a baseline from which assessments of wetland conditions can be made.

IV. Monitoring Objectives

The Illinois EPA currently monitors and derives assessments of designated use support for rivers and streams, lakes, and groundwater resources for Clean Water Act (CWA) goals and other purposes (Illinois EPA, 2002). Wetlands are another vital state water resource for which a comprehensive monitoring and assessment program is required. It is a goal of the Illinois EPA to eventually include wetland resources in the statewide assessments of water resources. Some of the specific goals of the wetland monitoring and assessment program are:

1. Establish a baseline of wetland resources and conditions from which to determine trends and changes in quantity and quality over time,
2. Determine reference conditions for the various classes of Illinois wetlands,

3. Develop and maintain a database which can provide guidance for management and compensatory mitigation decisions,
4. Provide information from which to evaluate wetland restoration, creation, mitigation, and protection programs or projects, as well as the effects of other conservation or regulatory programs, such as CWA Section 319 nonpoint source control efforts and Section 401 Water Quality Certification,
5. Incorporate wetlands into the State's 305(b) assessments and the Integrated Report, and
6. Provide necessary information required to develop applicable water quality standards.

Because of the limited available information on wetland resources in Illinois (both number of wetlands and information from historic assessments), it will require a number of years to develop a comprehensive database on wetland reference conditions and existing quantity and quality of wetlands in Illinois. Therefore, it might not be possible to determine statewide trends in quantity or individual trends in wetland quality for up to 10 years after a monitoring and assessment program is initiated. Evaluation of mitigation wetlands for compliance purposes is not included in the plan for a statewide monitoring and assessment program.

V. Monitoring Design

The wetland monitoring and assessment program is a cooperative effort between several state agencies, including the Illinois EPA, Illinois Department of Natural Resources (IDNR) and the Illinois Natural History Survey (INHS). Initially, the program will assess the status and trends of wetland resources throughout Illinois, including basic quantitative and qualitative evaluations. Over time, and as resources allow, the program will incorporate metrics, indices, and measurements which will support assessment determinations for 305(b) and 303(d) purposes.

The wetland monitoring and assessment program will be patterned after the existing IDNR Critical Trends Assessment Program's (CTAP) wetland monitoring efforts, which were initiated in 1997. The CTAP wetland monitoring efforts are conducted through the Illinois Natural History Survey (INHS). Currently, the CTAP monitors 226 wetland resources throughout the state on a 5-year rotational basis. The following table shows the number of wetlands currently monitored in each primary wetland class.

	Monitored (1997-2006)	
Class	Number	Percentage
Forested wetland	58	26
Scrub-shrub wetland	2	1
Emergent wetland	166	73

Sites for the CTAP wetland monitoring network were selected through a probabilistic design using the 1,765 Illinois Public Land Survey townships as the sampling units. Because not all townships were of equal size and configuration, townships were weighted by area to adjust for spatial differences prior to the random selection process. Townships were then selected in order from a randomly generated list of township sampling units.

Within each township unit, potential emergent wetland sampling sites were identified from the Illinois Wetlands Inventory database (Illinois Natural Resource Geospatial Data Clearinghouse, 1997, Suloway and Others, 1994) using the constraints that the wetland must encompass at least two acres and must be dominated by emergent palustrine vegetation. These selection criteria yielded 16,542 distinct wetlands in the state. These wetlands were randomly ranked within each individual township and the wetlands to be monitored within each selected township were identified sequentially from this list.

The selection of forested wetlands was a little different. The CTAP Land Cover of Illinois database (Illinois Department of Natural Resources, 1996) categorizes each pixel of land into various cover categories, including five forested land categories. For each randomly selected township, all pixels categorized as forest cover and which were also 1) part of a forest area at least 20 acres in size and 2) surrounded by a forest buffer of four pixels, were selected as potential monitoring sites. These potential sites were then randomly ranked for evaluation as forest monitoring sites. Fifty-eight of the final forest monitoring sites were determined to be forest wetlands, as represented in the previous table.

In each step of the site selection process (townships and wetland sites), some units selected were found to be impractical because of inadequate resource characteristics (such as unsuitable habitat or inadequate access) or denial of permission from a landowner. In each case, a replacement site was selected by proceeding sequentially down the list of randomly ranked wetlands and townships.

Details on the CTAP including site selection procedures and monitoring protocols can be found in Appendix 6 and at http://ctap.inhs.uiuc.edu/mp/monitoring.asp. Figure 1 shows the wetlands sampled through the CTAP program as of 2006.

With input provided by the WTWG, CTAP will be adding approximately 30 wetland reference sites to the wetland monitoring network over the next few years. These reference sites are high quality natural areas which represent the best potential characteristics, quality, and function of the various wetland types. In addition, the statewide network of sampling sites will be evaluated with respect to level of disturbance and a determination will be made as to whether or not there is an adequate representation of a gradient from which effects of human-induced disturbance can be evaluated. These two data sets should provide information which can be used to determine reference conditions for various levels of disturbance.

Because some types of wetlands are scarce in Illinois, it might be necessary or desirable to supplement the randomly selected monitoring sites with additional sites selected to represent some particular types of wetlands or resources, such as scrub-shrub wetlands, fens, or seeps.

Table 1 shows the assemblages and indicators to be monitored for each wetland type to assess the support of the Aquatic Life designated use. For wetlands, Aquatic Life is defined as "floral and faunal organisms that live in or depend upon the wetland water resource as a vital component of their function or survival." Aquatic bed wetlands (streams, ponds, lakes, lake shore, and open waters) are assessed for status and trends, 305(b), and 303(d) purposes through existing streams and lakes monitoring activities and are therefore not included in the wetland monitoring program. All wetland types are currently monitored for physical habitat, plant community, birds, and terrestrial insects through CTAP. As the program expands, monitoring for aquatic insects, reptiles and amphibians, and water chemistry will be added to the suite of information collected for most or all wetland types as resources allow. It is not anticipated that algae, fish or mammals will be monitored and/or assessed to determine aquatic life use support. Details on the core and supplemental indicators to be monitored are provided in Section D.

An updated inventory of the State's wetland resources is needed to accurately determine how well a monitoring and assessment program represents and characterizes the resource. Updating the inventory for Illinois is a high priority for all of the agencies involved with wetlands issues. As previously discussed, Ducks Unlimited has secured funding through the Illinois Department of Natural Resources for a State Wildlife Grant to fund an update of the Illinois NWI using 2005 and 2007 aerial photography (see appendices 3-5).

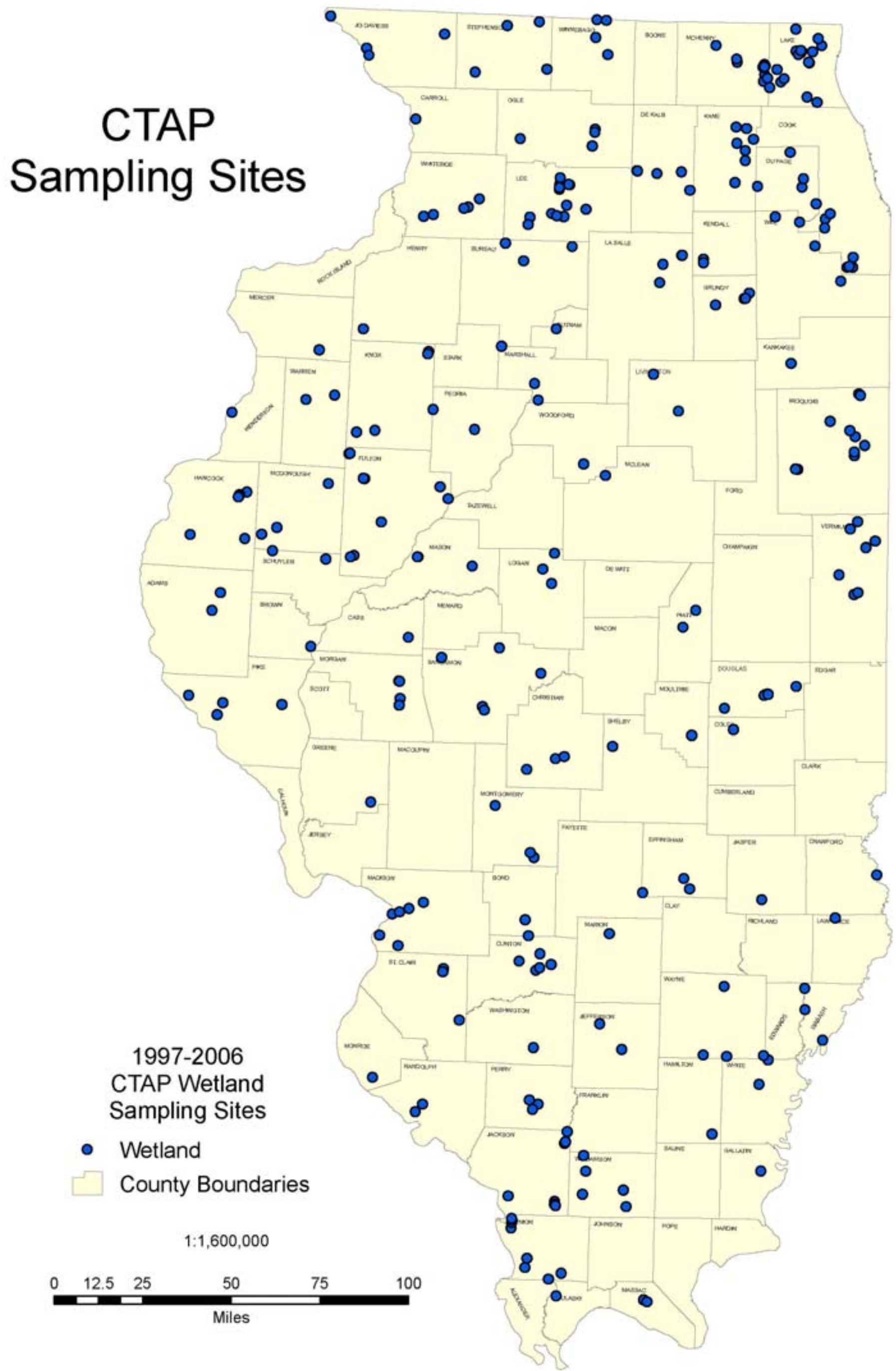

Figure 1. Wetlands monitored through the Critical Trends Assessment Program from 1997-2006.

Table 1. Assemblages and indicators to be monitored and assessed to determine wetland support of the Aquatic Life* designated use.

	Core Indicators				Supplemental Indicators			Dismissed Indicators		
Wetland Class	**Physical Habitat**	**Vascular Plants**	**Birds**	**Terrestrial Insects**	**Aquatic Macro Inverte-brates**	**Reptiles and Amphibians**	**Water Chemistry**	**Algae**	**Fish**	**Mammals**
FORESTED										
Floodplain	1	1	1	1	3	3	3	NA	NA	NA
Swamp	1	1	1	2	3	3	3	NA	NA	NA
SCRUB-SHRUB	1	1	1	2	3	3	3	NA	NA	NA
EMERGENT										
Marsh	1	1	1	1	3	3	3	NA	NA	NA
Wet meadow	1	1	1	1	3	3	3	NA	NA	NA
Wet prairie	1	1	1	1	3	3	3	NA	NA	NA
Fen	1	1	1	1	3	3	3	NA	NA	NA
Bog	1	1	1	1	3	3	3	NA	NA	NA

*Aquatic Life – "Floral and Faunal organisms that live in or depend upon the wetland water resource as a vital component of their function or survival".

1. Currently monitored by the Illinois Natural History Survey as a component of the Critical Trends Assessment Program.
2. High priority component to be added to current Critical Trends Assessment Program monitoring activities.
3. Low priority component to be added to the Critical Trends Assessment Program monitoring activities.

NA - Monitoring of this assemblage is not required or is of limited benefit for the purpose of assessing the support of the Aquatic Life designated use, as defined for wetlands.

Note: Aquatic Bed wetlands (streams, ponds, lake shore, and open waters) are not included in this table. These resources are monitored and assessed through the Illinois Environmental Protection Agency's Ambient Water Quality Monitoring Network, the Ambient Lake Monitoring Program and Volunteer Lake Monitoring Program.

VI. Core and Supplemental Indicators (and Methods)

As previously mentioned, there is currently limited information on wetland resources for most of Illinois. This statewide monitoring and assessment effort will significantly increase the amount of information on wetland characteristics and conditions. However, compilation of such a data set will require a number of years to achieve. The USEPA advocates a three-tiered approach to wetland assessment, including GIS- and remote-sensing based inventories (Level 1), rapid assessments (Level 2), and intensive site assessments (Level 3). Because wetlands have not been evaluated in this manner before in Illinois, it is anticipated that this effort will eventually include all three levels of assessment for most wetland sites in order to compile the information needed for the goals stated. Initially, Illinois EPA plans on developing two of the three assessment levels – remote sensing inventory (Level 1) and intensive site assessment (Level 3). Since data already exists in varying stages to support these two levels they will be undertaken first, which will then support the development of a rapid assessment protocol (Level 2) in the future. All methodologies will conform to accepted sampling design as per USEPA guidelines.

GIS/Remote Sensing Based Inventory (Level 1)

Most of the Level 1 inventory objectives will be accomplished through the update of the National Wetland Inventory database for Illinois to be done by Ducks Unlimited, Inc. It is the desire of the Illinois EPA to have the inventory update and Level 1 wetlands assessment done by September 30, 2009. Level 1 assessments will be utilized to assess wetland status and trends, selecting sites for restoration and monitoring projects, and for integrated reporting for CWA 305(b)/303(d) reports.

Intensive Site Assessment (Level 3)

Illinois plans on addressing Level 3 assessments by use of a multimetric wetland Index of Biological Integrity (IBI) specifically developed for Illinois wetlands, as endorsed by USEPA (Appendix 7). This wetland IBI will be similar in depth and scope to that of the wetland indices based developed by Minnesota and Ohio and follow the widely used framework laid out by Peet et al. (1998). The Illinois Natural History Survey (INHS) has submitted a proposal to USEPA, Region V to fund the development of the Illinois wetland IBI (Appendix 8) and the project is enthusiastically supported by the Chief of the Bureau of Water at the Illinois EPA (Appendix 9).

The Illinois wetland IBI will use a multimetric vegetation index as the core indicator of the multivariable index. This primary index will be supported by several proposed supplemental indicators (see list below). These supplemental indicators would be used to support the vegetative core indicator on a site by site basis dependent upon predetermined criteria. The applicability/suitability of these supplemental indicators would need to be investigated in more detail before they were incorporated into multivariable wetland IBI in addition to the vegetation component. Level 3 assessments will be utilized in standards development (including Tiered Aquatic Life Uses, or TALUs), mitigations performance criteria development/monitoring, and for integrated reporting for CWA 305(b)/303(d) reports.

The collection and development of a base data set necessary to develop a wetland IBI is already well underway in Illinois. As previously stated, the CTAP includes a wetland monitoring program which is conducted by the Department of Natural Resources and the Illinois Natural History Survey. This program provides an excellent basis from which to develop a larger and more comprehensive monitoring and assessment program/protocol for Illinois. A more detailed description of CTAP monitoring protocol and methodology (Illinois Natural History Survey, 2002) can be found in Appendix 6 and at http://ctap.inhs.uiuc.edu/mp/pdf/mp.htm As stated above, it is certain that additional, supplemental indicators and measurements will be added to this program (see list below for examples). The Monitoring and Assessment Protocols subgroup will determined which measurements, variables, and indices are most appropriate for the wetland monitoring and assessment program in Illinois.

<u>Proposed Core and Supplemental Indicators for use in a Wetland IBI in Illinois</u>

a. *<u>Core Indicators</u>*
    i. Vegetation
    ii. Floristic Quality Index (FQI)
    iii. Species coverage
    iv. Species richness (ground, tree, & shrub layers)
    v. Presence/Absence of threatened and endangered species

b. *<u>Supplemental Indicators</u> (Current)*
    i. Birds
        a. Diversity & density of applicable bird species
        b. Presence/Absence of threatened and endangered bird species
    ii. Insects
        a. Species richness (terrestrial)
    iii. Physical parameters

c. *<u>Supplemental Indicators</u> (Future)*
    i. Reptiles & amphibians (richness)
    ii. Aquatic macroinvertebrates (richness)
    iii. Water chemistry

VII. Quality Assurance

In accordance with USEPA and Illinois EPA policies and procedures, a comprehensive Quality Assurance Project Plan (QAPP) will be developed for the wetlands monitoring and assessment program as the program expands beyond the current protocols and methodologies currently used by CTAP. This document will include all aspects of the monitoring program including program design, site selection, data collection, data analyses, and assessment methodology. The QAPP will be written during and finalized after the specific monitoring and assessment protocols are developed by the subgroups. Detailed descriptions and records of proper sample collection, processing, shipping, and analyses will be maintained by field, laboratory, and Illinois EPA, Bureau of Water database personnel. It is understood that significant resources will be required to ensure adequate quality assurance of field, laboratory, database, and data processing activities.

VIII. Data Management

The Illinois EPA will work closely with partnering agencies to manage and store wetland data. To the extent possible and practicable, the data will be entered into the STORET database. Assessment determinations will also be stored in the USEPA's Assessement Database, or an equivalent database which allows for data analysis, manipulation, and easy access. Because the wetland program will be a joint effort of multiple state agencies, careful planning and consideration will need to be given to data storage and data transfer among various systems and databases. Various agencies will have different uses for the data from this effort and will likely transfer information into agency-specific data bases and programs. It is vital that a single quality-assured data base be designated as the parent data base to be used to supply information to all agencies. This is required in to avoid differences and discrepancies among multiple data sets.

IX. Data Analysis / Assessment

Assessment of Illinois wetland resources will be based primarily on a wetland Index of Biological Integrity (IBI) for Illinois wetlands, which will focus on plant communities. The IBI will be supplemented with data on bird and insect communities as well as water chemistry. The wetland IBI will provide a measure of overall habitat condition and integrity within and across natural divisions. The wetland IBI will be developed from wetland monitoring data acquired through the CTAP over the past 11 years. The wetland IBI will be developed using reference wetlands and a disturbance gradient associated with changes in surrounding landuse and direct human disturbance. The wetland IBI will be used for assessment purposes in a manner similar to how the fish IBI and macroinvertebrate IBI is currently used.

X. Reporting

Data from the wetland monitoring and assessment program will be reported in several ways. First, as mentioned in section F, the data and information from the monitoring and assessment efforts will be stored in the USEPA's STORET database and assessments will be stored in USEPA's Assessment Database. In addition, the Illinois EPA, in cooperation with other state agencies, will produce a report describing the condition of the State's wetlands at least every three to five years. With time and the accumulation of additional information necessary to make informed decisions, the monitoring and assessment program will become incorporated into the State's Integrated Report, which is the Illinois EPA's primary monitoring report to USEPA. Due to the cooperative effort among various state agencies, it is probable that much of the data collected through this program will be stored in several other agency's databases. Periodic update reports and the inclusion of wetland data in easily accessible databases should provide water resource managers with the data and information needed to better protect, manage, and evaluate the State's wetland resources.

XI. Programmatic Evaluation

Evaluation of the Illinois EPA wetland monitoring program will be incorporated into the periodic review of all of the Agency's water resource assessment programs. This review process typically entails an internal review of these programs in conjunction with USEPA Region 5, including evaluation of and planning for improvements and changes in the programs. Cooperating state agencies will be actively involved in the wetland component.

XII. General Support and Infrastructure Planning

Illinois EPA does not currently have resources committed or planned to support a statewide wetland monitoring and assessment program. The implementation of a wetland program is expected to be implemented gradually as resources allow and as the commitment of financial and logistical resources can be attained or transitioned in support of this effort. The full implementation of a statewide probabalistic program is several years away. The program will be implemented initially by using CTAP as a basis and incorporating other active monitoring sites and locations where there may be environmental concerns or risks to the wetland or where risks, finances, or personnel availability provide impetus for monitoring of a particular resource or area. Several other wetland programs operated by other State and local agencies, including the Illinois

Department of Transportation, the Illinois Department of Natural Resources and several counties can potentially contribute to this effort. The wetland program will be incorporated into the planning and operational structure of Illinois EPA surface water resource programs as resources allow.

XIII. Timeline for Development of Wetland Monitoring and Assessment Protocols

Fall 2005	- Begin Illinois EPA efforts to develop wetland monitoring and Assessment protocols
Spring 2006	- Wetland Technical Working Group meeting, January 2006
	- Classifications and Uses Subgroup and Monitoring and Assessment Protocols subgroup meetings, April 2006
Fall 2006	- Joint subgroup meeting, August 31, 2006
	- Additional Monitoring and Assessment Protocols Subgroup meetings, September, October 2006
	- WTWG meeting, November 2006
Winter 2006	- Draft Monitoring and Assessment Plan and QAPP, January 2007
	- Final Classification and Use structure for wetlands
	- Final Monitoring and Assessment Protocols for wetlands
Summer 2007	- Final Monitoring and Assessment Plan
Fall 2007	- Pilot test of methods and indicators
	- Database design and integration with other agency systems (Fall 2007 – Fall 2008)
Fall 2008	Identification of initial set of reference sites
Summer 2009	Completion of Wetland Inventory Update?

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APPENDIX 1

Application of Elements of a State Water Monitoring and Assessment Program for Wetlands

Application of

Elements of a State Water Monitoring and Assessment Program For Wetlands

April 2006

Wetlands Division
Office of Wetlands, Oceans and Watersheds
U.S. Environmental Protection Agency

Available on the web

http://www.epa.gov/owow/wetlands/monitor/

Introduction

This document was prepared to help EPA and State program managers plan and implement a wetland monitoring and assessment program within the context of the March 2003 EPA document, *Elements of a State Water Monitoring and Assessment Program* (EPA 841-B-03-003). It provides clarification and further information on how the original *Elements* document applies to wetlands. That document recommended ten basic elements of a state water monitoring and assessment program, and serves as a tool to help EPA and the States determine whether a monitoring program meets the requirements of Clean Water Act Section 106(e)(1).

Over the past few years States have made significant progress in developing and implementing monitoring programs that characterize state waters and have contributed to an improved understanding of the condition of wadeable streams nationwide. In developing monitoring programs a number of states have explicitly addressed wetlands assessment. The purpose of this document is to provide specific information on the elements of wetlands monitoring programs for states that are in earlier stages of developing these programs and to promote interstate consistency in reporting progress toward increasing wetland quantity and towards the longer-term goal of improving the quality of the nation's wetlands.

A monitoring and assessment program that is built using these elements will be able to provide managers the information necessary to report on the condition of State wetlands. That information, in turn, can be used to prioritize wetland management activities such as protection, restoration and compensatory mitigation. State implementation of these elements will be an iterative process that is completed over several years. Progress made on one element of activity will influence and advance work being conducted on the other elements.

Organization of this Document

We duplicate the descriptions of each of the 10 elements that make up the Elements of a State Water Monitoring and Assessment Program, and then follow with a description of how to apply that element to wetlands.

The Recommended Elements of a State Program

A) Monitoring Program Strategy

The State has a comprehensive monitoring program strategy that serves its water quality management needs and addresses all State waters, including streams, rivers, lakes, the Great Lakes, reservoirs, estuaries, coastal areas, wetlands, and groundwater. The strategy should contain or reference a description of how the State plans to address each of the remaining nine elements. The monitoring program strategy is a long-term implementation plan and should include a timeline, not to exceed ten years, for completing implementation of the strategy. EPA believes that state monitoring programs can be upgraded to include all of the elements described below by 2014. It is important that the strategy be comprehensive in scope and identify the technical issues and resource needs that are currently impediments to an adequate monitoring program.

EPA recommends that appropriate staff from multiple agencies devise the State's overall water monitoring strategy and integrate wetland monitoring and assessment into it. While the State can develop a separate monitoring strategy for wetlands, it should be coordinated with and referenced in the broader State water monitoring strategy. For example, States that operate under a water monitoring strategy that was finalized during or before 2006 are encouraged to include a description of wetland monitoring and assessment activity in the next scheduled revision of their overall water monitoring strategy. Over time, such program integration will foster the coordination and prioritization of monitoring activities across the various types of waterbodies.

B) Monitoring Objectives

The State has identified monitoring objectives critical to the design of a monitoring program that is efficient and effective in generating data that serve management decision needs. EPA expects the State to develop a strategy and implement a monitoring program that reflects a full range of State water quality management objectives including, but not limited to, Clean Water Act goals.

Likewise, progress made in developing a comprehensive wetland monitoring program will serve many local and State program needs. Some of those wetland program goals include the following:

(1) Establish a baseline of wetland condition and/or report changes in condition in a State's Clean Water Act (CWA) Section 305(b) report or Integrated Report;

(2) Evaluate the environmental consequences of a federal action or group of actions, including the effectiveness of compensatory wetland mitigation, under the provisions of CWA Section 404/401 and the National Environmental Policy Act (NEPA);

(3) Evaluate the performance of wetland restoration projects, including CWA Section 319 nonpoint source pollution control projects;

(4) Evaluate the cumulative effects of wetland loss and/or restoration, and develop watershed plans for the recovery of impaired waterbodies that are listed pursuant to CWA Section 303(d) and;

(5) Refine or create wetland specific water quality standards pursuant to CWA Section 303, including development of appropriate reference conditions.

These objectives should be considered during strategy development along with other state or local objectives. When setting program objectives, EPA expects that the States will focus on measuring both the individual and cumulative environmental effects of management actions so that improvements can be made in those actions over time. Wetland monitoring and assessment should be conducted with the expectation that the information gathered will be used to help support and document the effectiveness of environmental protection and restoration activity.

Each individual objective controls the nature of wetland sampling design, the selection of assessment indicators and sampling methods, field deployment, quality assurance, data analysis, data management, reporting, and the cost of wetland monitoring activity. However, practitioners should avoid the pitfall of assuming that the data quality needs associated with each of the listed objectives are the same. For example, some wetland planning decisions will not need the same high resolution information as is needed for the promulgation of water quality standards that are specific to wetlands.

The remainder of the Strategy should describe the State's approach for achieving the identified objectives including how the State plans to address program gaps or weaknesses.

C) Monitoring Design

The State has an approach and rationale for selection of monitoring designs and sample sites that best serve its monitoring objectives. The State monitoring program will likely integrate several monitoring designs (e.g., fixed station, intensive and screening-level monitoring, rotating basin, judgmental and probability design) to meet the full range of decision needs. The State monitoring design should include a probability-based network for making statistically valid inferences about the condition of all State water types over time. EPA encourages the State to use the most efficient combination of monitoring designs to meet its objectives.

A State should describe in its strategy the monitoring designs that will be used to achieve their wetland management objectives. Below we describe three generally accepted sampling designs for the monitoring and assessment of wetlands.

1. The first is a census that entails examining every unit in the population of interest. Some CWA Section 404 "advance identification actions" (ADID) and "special area management plans" (SAMP) employ this approach to identify significant wetlands in need of specific regulatory attention.

2. The second approach is used for studying an extensive resource, such as all wetlands within a watershed or region. It relies on probability sampling. Studies based on statistical samples rather than complete coverage are referred to as sample surveys.

   Implementing a sample survey involves three primary steps: (1) Creating a list of all units of the target population from which to select the sample; (2) selecting a spatially-distributed, random sample of units from that list; and (3) collecting data from the selected units. The premise behind sample surveys is the ability to characterize and report the overall cumulative condition of wetlands on a broad scale, such as watersheds and regions, without sampling each wetland. The results of sample surveys also allow a State agency to prioritize areas where more targeted sampling efforts are needed to meet a particular objective. Developing a probability-based sampling design is a rigorous task. EPA can provide technical assistance in designing this type of a monitoring program and in analyzing the resulting data.

3. The third approach relies on best professional judgment to target sampling within specific wetlands for purposes of comparison. A common use of targeting sampling is to characterize wetland condition and function along a gradient of human disturbance in order to establish reference wetland condition. Many rapid assessment methods use this design approach. Improvements to the assessment methods are then made using supplemental data gathered through the use of a probability-based sampling approach.

Also, a State strategy should identify the type of wetland classification system and mapping system they intend to use as part of their sampling design. They should also describe how they intend to complete or update the wetland inventory maps needed to conduct monitoring and assessment activity. States are encouraged to closely coordinate with EPA Regional staff on this matter in order to keep apprised of related work being conducted by the Federal Geographic Data Committee (FGDC). More information about the FGDC can be found at: *http://www.fgdc.gov/*.

<u>Characterization of wetland reference condition</u>

The characterization of wetland reference condition is an important step in the design of a wetland monitoring and assessment program. The ecological understanding that is derived from the characterization of reference sites can be extrapolated to other sites to meet a specified set of assessment objectives. In a practical sense, that extrapolation is achieved through the development, verification and use of wetland assessment methods. Steps to characterize reference condition include:

- Prioritize watersheds or other geographical areas to be surveyed to meet a given wetland monitoring and assessment objective.

- Identify specific wetland classes within prioritized watersheds targeted for assessment, and identify the domain (sample frame) for each selected type. Consider the hydrogeologic or ecoregion setting, wetland inventory, wetland hydrogeomorphic (HGM) and Cowardin classification and the overall wetland landscape profile. A wetland landscape profile represents the abundance, by class, of wetlands that occur in a geographical area.

- Select and verify indicators that are used to assess wetland condition, relative to wetland beneficial use and function. Verification can be achieved based on a preponderance of scientific information (i.e., "weight of evidence") that is systematically gathered at wetland reference sites.

- Establish a reference network that: (a) Reflects a gradient of human-induced disturbance, and includes both least-impacted sites and other sites, and (b) can be sampled to verify the accuracy of wetland assessment methods. Long-term sampling conducted within the reference network will provide information needed to characterize wetland variability over time and space.

D) Core and Supplemental Indicators (and Methods)
Note: EPA has training modules and websites containing detailed information on monitoring design, assessment indicators and methods. For further information, please visit: http://www.epa.gov/waterscience/criteria/wetlands/.

Because limited resources affect the design of water quality monitoring programs, the State should use a tiered approach to monitoring that includes a core set of indicators selected to represent each applicable designated use, plus supplemental indicators selected according to site-specific or project-specific decision criteria.

The development of wetland assessment methods, and in particular a rapid wetland assessment method, is a prerequisite to accomplishing many program objectives. Figure 1 (next page) shows a conceptual model that identifies the core indicators and metrics used in wetlands assessment. The indicators and metrics reflect the ecological factors (or attributes) that define wetlands (i.e., hydrology, soils and biota) and how those factors respond to human-induced disturbance (i.e., stressors). Indicators of wetland condition can be based either on the response of a wetland to stressors or on the stressors themselves.

In particular, environmental indicators are used in making determinations of whether wetland function is changed or lost to the point of affecting wetland condition. In turn, the condition of wetlands affects their capacity to support a beneficial use (e.g., aquatic life use support, including wildlife habitat). The choice of indicators (and associated metrics) depends on the purpose of monitoring and level of accuracy needed for decision-making. For example, a set of core indicators can be used to characterize wetland condition in terms of ecological integrity. Supplemental indicators can then be used to characterize a wetland's special significance as critical or outstanding wildlife habitat. Wetland indicators, and their associated metrics, are often portrayed in wetland assessment methods as an organized set of assessment questions.

Figure 1

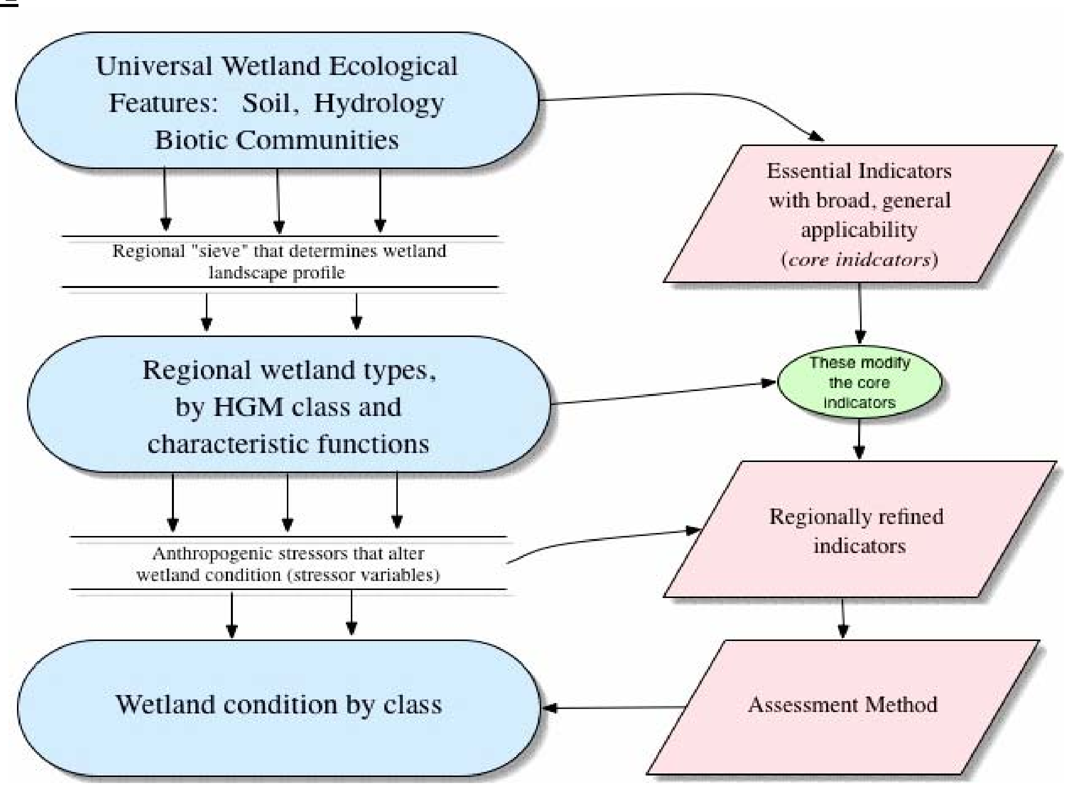

Table 1 (next page) presents three types of wetland assessment methods that can be developed to support program objectives. The method selected will depend on the availability of resources for project deployment and the desired level of rigor needed for project reporting and decision-making.

Work may begin on the development and verification of any of the three types of assessment methods, but should reflect identified monitoring objectives. For example, rapid wetland assessment methods (Level 2) that are developed using best professional judgment can be tested using results from more intensive wetland monitoring activity (Level 3). Results from both Level 2 and Level 3 assessments can be used to enhance the utility or test the efficacy of landscape scale (Level 1) assessments. The three types of assessment are generally described as:

Level 1 - Landscape Assessment

These assessments rely almost entirely on Geographic Information Systems (GIS) and remote sensing data to obtain information about watershed conditions and the distribution and abundance of wetland types in the watershed. Wetland (acreage) trends analysis that is conducted by the U.S. Fish and Wildlife Service's National Wetland Inventory (NWI) is a Level 1 type of assessment.

Also, wetland landscape profiles and landscape development indices are used in ”Level 1" assessments. Landscape development indices (LDI) involve the characterization of lands that surround assessed wetlands, including their buffer. Metrics used in the LDI approach, such as road density, percent forest cover, land use category, and presence of drainage ditches, can provide preliminary information on wetland condition within a watershed. Field-based monitoring efforts (Level 2 and 3) can be targeted within parts of a watershed and to specific wetlands in need of more rigorous assessment.

Table 1

3-Level Technical Approach

	Products/Applications
Level 1 - Landscape Assessment: Use GIS and remote sensing to gain a landscape view of watershed and wetland condition. Typical assessment indicators include wetland coverage (NWI), land use and land cover	•Targeting restoration and monitoring •Landscape condition assessment •Status and trends •Integrated reporting CWA 305(b)/303(d)
Level 2 – Rapid Wetland Assessment: Evaluate the general condition of individual wetlands using relatively simple field indicators. Assessment is often based on the characterization of stressors know to limit wetland functions e.g., road crossings, tile drainage, ditching.	•401/404 permit decisions •Integrated reporting •Watershed planning •Implementation monitoring of restoration projects, including nonpoint source BMPs,and Farm Bill programs
Level 3 – Intensive Site Assessment Produce quantitative data with known certainty of wetland condition within an assessment area, used to refine rapid wetland assessment methods and diagnose the causes of wetland degradation. Assessment is typically accomplished using indices of biological integrity or hydrogeomorphic function.	•WQS development, including use designation • Integrated reporting •Compensatory mitigation performance standards •Verify levels 1 and 2 methods

Level 2 - Rapid Assessment

Rapid assessments use relatively simple metrics for collecting data at specific wetland sites. These methods should provide a single rating or score that shows where a wetland falls on the continuum ranging from full ecological integrity (or least impacted condition) to highly degraded (poor condition).

A “rapid” method should take two people no more than four hours of field time, and one half day of office preparation and data analysis to reach a condition score. Once verified with “Level 3” site intensive assessments, rapid assessment methods can be used for regulatory decision making, local land and water use planning, and the assessment of ambient wetland condition.

Level 3 - Intensive Site Assessment

This is a more rigorous, field-based method that provides higher resolution information on the condition of wetlands within an assessment area, often employing wetland bioassessment procedures (i.e., indices of biological integrity “IBI”) or HGM functional assessment methods.

The robust metrics used in “Level 3” assessments produce information that can be used to (a) refine rapid assessment methods based on a characterization of reference condition, (b) diagnose the causes of wetland degradation, (c) develop design and performance standards for wetland restoration, including compensatory wetland mitigation, and (d) support the development of water quality standards that are protective of wetlands.

E) Quality Assurance

Wetlands monitoring programs will include Quality Management Plans and Quality Assurance Project Plans (QAPP), maintained and peer reviewed in accordance with EPA Policy to ensure the scientific validity of monitoring and laboratory activities. These plans are used to prevent the introduction of both random and systematic errors into data analysis and reporting. They ensure the scientific validity of sampling, laboratory, and data analysis and reporting activities.

QAPPs should reflect the level of data quality appropriate for specific uses of data (e.g., reporting status and trends, prioritizing restoration activity and assessing the performance of compensatory mitigation projects). In particular, States should be careful not to assume that a QAPP developed for the monitoring and assessment of streams, lakes or estuaries is directly suitable for wetlands.

For example, new State wetland monitoring programs will likely conduct a significant amount of testing on assessment indicators and methods. Some of that testing work will be accomplished during the actual implementation of wetland survey projects. For that situation, the overall project QAPP would have to explain how acquired sampling data would be used to independently verify the efficacy of methods used in the survey, as well as to document the statistical certainty of survey results.

In general, a QAPP can be thought of as a guide, a work plan, or a wetland sampling plan used to ensure scientific validity and provide consistency between field crews, sampling seasons, and differing sample sites. It can keep a project team on task so that they will produce timely and defensible results.

F) Data Management

The State uses an accessible electronic data system for water quality, toxicity, sediment chemistry, habitat, and biological data (following appropriate metadata and State/Federal geo-locational standards) with timely data entry and public access.

The State should also have the capability of managing available geospatial data for wetlands for use in Geographical Information System (GIS) applications (e.g., "Level 1" wetland assessment). Monitoring and assessment should be conducted with the intent that collected data and analyzed data will be archived to allow for its use in future studies. The selection of a data management system should be planned in the initial phases of a monitoring project and program.

EPA encourages States to enter wetland monitoring data into EPA's central water quality data warehouse (See: *http://www.epa.gov/storet/*). The "STORET" data warehouse is used by State environmental agencies, EPA, other federal agencies, universities, and others for the exchange of data of known quality. Over time, all wetland survey data gathered by the States should be entered into the warehouse. For States that do not currently enter their data into the water quality data warehouse, monitoring strategies should indicate that entry will be accomplished as quickly as possible. The entry of data gathered from a reference wetland network is a reasonable first step toward accomplishment of that goal.

The EPA is committed to working with States to provide training and technical support in the use of the STORET data warehouse. That partnership will help improve data sharing and reduce the cost of wetland monitoring by minimizing duplicative sampling among states. For example, neighboring states that share ecoregions and similar wetland classes may be able to use existing, stored data to assess wetland reference condition and thereby build a common set of wetland assessment methods.

In addition, the State should store its wetland assessment information in an accessible electronic database. EPA strongly recommends that all States use either the Assessment Database (ADB) or an equivalent database. The ADB is a relational database application for tracking water quality assessment information, including use attainment, and causes and sources of impairment. It is the basis of Clean Water Act Section 305(b)/Integrated Reporting.

The ADB supports three principal functions:

- Improve the quality and consistency of water quality reporting;
- Reduce the burden of preparing reports under Clean Water Sections 305(b), 303(d), 314, and 319 of the Clean Water Act (CWA); and
- Improve water quality data analysis.

As such, it serves as an analytical tool for States in the process of developing water quality standards that are specific to wetlands. For more information about the ADB, visit *http://www.epa.gov/waters/adb/index.htm*.

G) Data Analysis/Assessment

Data analysis procedures include the design and use of field data sheets and the specification of statistical/graphical analysis methods. The documentation of procedures, prior to environmental sampling, ensures monitoring and assessment data are produced and analyzed in a timely and cost effective manner. It also ensures that the rigor of wetland sampling and analysis is conducted in a manner that is commensurate with that needed for a particular type of decision-making. For example, the quality of assessment results needed for general wetland resource planning may differ from the quality needed for water quality criteria development.

States should document or reference their wetland data analysis and assessment procedures in their Strategy and relate them to the objectives identified under "Element B - Monitoring Objectives." The strategy also should describe the data analysis procedures that will be used to characterize a wetland or wetlands relative to an established reference condition.

H) Reporting

The State produces timely and complete water quality and wetland condition reports. EPA expects that wetland monitoring and assessment will be conducted to specifically inform wetland management decisions. The intended user group, format, style and peer review requirements of project reports should be identified in the initial phases of a monitoring and assessment project.

The EPA encourages all States to enter wetland assessment results produced from ambient monitoring surveys into EPA's Assessment Database (ADB), as mentioned in "Element F." Information entry may include an interpretation of those results and narrative describing how the reported information will be used to inform wetland management decisions.

All available wetland assessment information should be included in the State CWA Section 305(b)/Integrated Report. That report, which draws upon information from the Clean Lakes Program, nonpoint source program, CWA Section 303(d) listed waters and other assessments, is the primary State monitoring program report to EPA. Integrated Reporting guidance is available at *http://www.epa.gov/owow/tmdl/2006IRG/*.

The EPA also is interested in partnering with the States to integrate wetland monitoring and assessment information with CWA Section 404/401 permit tracking systems. Several such systems are currently under development by the U.S. Army Corps of Engineers and the States.

I) Programmatic Evaluation

The State, in consultation with its EPA Region, conducts periodic reviews of each aspect of the monitoring program to determine how well the program serves its water quality decision needs for all State waters, including all waterbody types. The internal audits will identify gaps in information production that can be filled as a program matures. Program evaluation may consist of a periodic program review by a technical or policy advisory committee. During periodic review, the EPA expects that States will document how wetland monitoring and assessment information is used to produce beneficial environmental outcomes (e.g., prioritize wetland protection and restoration to aid recovery of impaired waterbodies, develop design and performance measures for compensatory wetland mitigation projects). The review also provides an opportunity to identify contingencies that will allow wetland monitoring and assessment activity to continue in the event of a funding shortfall.

J) General Support and Infrastructure Planning

The State identifies current and future monitoring resources needed to fully implement its monitoring program strategy including those components that are not yet in place. The start-up of a wetland monitoring and assessment program will likely occur at geographical locations where there are wetlands at risk, discretionary dollars, interested people and existing data. Work at those locations should take into account the logistics and budget resource needs relative to project staffing, training, field operations (e.g., access to private properties), laboratory needs and
office operations (e.g., access to existing information, data management and analysis). The actual costs of such projects should be documented in terms of both money and time. Such budget documentation forms the basis for future funding requests and project plans.

All needs should be assessed and discussed with EPA Regional staff during the preparation of proposals for CWA Section 104(b)(3) grants, 106 grants and/or Performance Partnership Grants.

APPENDIX 2

Illinois Wetland Policy Act of 1989

THE ILLINOIS INTERAGENCY WETLAND POLICY ACT OF 1989

CHAPTER 20. EXECUTIVE BRANCH
DEPARTMENT OF NATURAL RESOURCES
ACT 830. INTERAGENCY WETLAND POLICY ACT OF 1989 (Complete Act)

Current through P.A. 90-25, apv. 6/23/97

ARTICLE I. GENERAL PROVISIONS

830/1-1. Short Title

1-1. Short Title. This Act shall be known and may be cited as the "Interagency Wetland Policy Act of 1989".

(Source P.A. 86-157, Art. I, 1-1, eff. Aug. 12, 1989. Formerly Ill.Rev.Stat.1991, ch. 96 1/2 , 9701-1.)

830/1-2. Legislative declaration

1-2. Legislative declaration. The General Assembly finds and determines that:

(a) In 1818, Illinois contained an estimated 8.2 million acres of wetlands. Based upon preliminary results of the Illinois portion of the National Wetlands Inventory, less than nine percent of the original acres remain.

(b) With the significant loss in acreage, a corresponding loss in the functional values and benefits that wetlands provide has occurred.

(c) Continued loss of Illinois' wetlands may deprive the people of this State of some or all of the benefits which they provide, including:

(1) reducing flood damages by absorbing, storing and conveying peak flows from storms;
(2) improving water quality by serving as sedimentation and filtering basins and as natural biological treatment areas;
(3) providing breeding, nesting, forage and protective habitat for approximately 40 percent of the State's threatened and endangered plants and animals, in addition to other forms of fish, wildlife, waterfowl and shorebirds;
(4) protecting underground water resources and helping to recharge rivers, streams and local or regional underground water supplies;
(5) serving as recreational areas for hunting, fishing, boating, hiking, bird watching, photography and other uses;
(6) providing open space and aesthetic values, particularly in rapidly developing areas;
(7) providing unique educational and research opportunities because of their high diversity of plants and animals, their support for a high incidence of threatened and endangered species, and their function as a natural buffer for rivers, lakes and streams;
(8) supplying nutrients in freshwater food cycles and serving as nursery areas and sanctuaries for young fish; and
(9) helping to protect shorelines from the forces of water erosion.

(Source P.A. 86-157, Art. I, 1-2, eff. Aug. 12, 1989. Formerly Ill.Rev.Stat.1991, ch. 96 1/2 , 9701-2.)

830/1-3. Application

1-3. Application. The General Assembly recognizes the environmental, economic and social values of the State's remaining wetlands and directs that State agencies shall preserve, enhance, and create wetlands where possible and avoid adverse impacts to wetlands from:

(a) State and State pass-through funded construction activities. This Act does not apply to construction activities costing less than $10,000, in which non-public contributions are at least 25 percent of the total cost. This Act does not apply to cleanup of contaminated sites authorized, funded or approved pursuant to:

(1) the federal Comprehensive Environmental Response Compensation and Liability Act of 1980 (P.L. 96-510), as amended; [42 U.S.C.A. º 9602]

(2) the leaking underground storage tank program, as established in Subtitle I of the Hazardous and Solid Waste Amendments of 1984 (P.L. 98-616), as amended, [42 U.S.C.A. º 6901 et seq.] of the Resource Conservation and Recovery Act of 1976 (P.L. 94-580); [42 U.S.C.A. º 6901 et seq.]

(3) the State remedial action program established under Section 4 of the Environmental Protection Act, as amended, [415 ILCS 5/4] or any other Section of this Act or regulations promulgated thereunder which pertain to the above exempted federal cleanup programs.

This Act does not apply to projects receiving loan assistance provided to local government units under the provisions of the Illinois Water Pollution Control Revolving Fund, that are subject to review under the National Environmental Policy Act of 1969 (NEPA) [42 U.S.C.A. º 4321 et seq.] or the state equivalent, pursuant to rules governing the Illinois Water Pollution Control Revolving Fund.

(b) State supported land management activities;

(c) State and State supported technical assistance programs; and

(d) Other State activities that result in adverse impacts to wetlands.

Educational materials produced with State support, shall be consistent with the policies contained within this Act.

(Source P.A. 86-157, Art. I, 1-3, eff. Aug. 12, 1989. Formerly Ill.Rev.Stat.1991, ch. 96 1/2 , 9701-3.)

830/1-4. State goal

1-4. State goal. It shall be the goal of the State that there be no overall net loss of the State's existing wetland acres or their functional value due to State supported activities. Further, State agencies shall preserve, enhance and create wetlands where necessary in order to increase the quality and quantity of the State's wetland resource base.

(Source: P.A. 86-157, Art. I, 1-4, eff. Aug. 12, 1989. Formerly Ill.Rev.Stat.1991, ch. 96 1/2 , 9701-4.)

830/1-5. Goal implementation

1-5. Goal implementation. The goal is implemented through a State Wetland Mitigation Policy and the development of Agency Action Plans.

(Source: P.A. 86-157, Art. I, 1-5, eff. Aug. 12, 1989. Formerly Ill.Rev.Stat.1991, ch. 96 1/2 , 9701-5.)

830/1-6. Definitions

1-6. Definitions. As used in this Act:

(a) "Wetland" means land that has a predominance of hydric soils (soils which are usually wet and where there is little or no free oxygen) and that is inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances does support, a prevalence of hydrophytic vegetation (plants typically found in wet habitats) typically adapted for life in saturated soil conditions. Areas which are restored or created as the result of mitigation or planned construction projects and which function as a wetland are included within this definition even when all three wetland parameters are not present.

(b) "Adverse wetland impacts" means any land management and construction or related project activity which directly or indirectly reduces the size of a wetland or impairs a wetland's functional value, as described in subsection (c) of Section 1-2 of this Act, or the hydraulic and hydrologic characteristics of a wetland.

(c) "Director" means the Director of Natural Resources.

(d) "Department" with reference to this Act means the Department of Natural Resources.

(e) "Committee" means the Interagency Wetlands Committee created by this Act.

(f) "Mitigation" includes avoiding, minimizing or compensating for adverse wetland impacts. This includes:

(1) Avoiding the impact altogether by not taking a certain action or parts of an action;
(2) Minimizing the impact by limiting the magnitude of the action; and
(3) Compensating for the impact by replacing or providing substitute wetland resources or environments.

(g) "Agency Action Plan" means a plan developed by an individual agency to implement this Act.

(h) "Wetland Compensation Plan" means a plan developed for each individual construction project that details how the responsible agency will compensate for actions which will result in adverse wetland impacts.

(i) "Conservation Organization" means an organization, legally established under Illinois Law, for the purpose of managing and protecting natural resources.

(j) "Necessary" means in a manner consistent with the intent of this Act.

(Source: P.A. 86-157, Art. I, 1-6, eff. Aug. 12, 1989. Amended by P.A. 89-445, 9A-13, eff. Feb. 7, 1996. Formerly Ill.Rev.Stat.1991, ch. 96 1/2 , 9701-6.)

ARTICLE II. AGENCY COORDINATION

830/2-1. Interagency Wetlands Committee

2-1. Interagency Wetlands Committee. An Interagency Wetlands Committee, chaired by the Director of Natural Resources or his representative, is established. The Directors of the following agencies, or their representative, shall serve as members of the Committee:

Capitol Development Board,
Department of Agriculture,
Department of Commerce and Community Affairs,
Environmental Protection Agency,
Department of Transportation, and
Historic Preservation Agency.
The Interagency Wetlands Committee shall also include 2 additional persons with relevant expertise designated by the Director of Natural Resources.
The Interagency Wetlands Committee shall advise the Director in the administration of this Act. This will include:

(a) Developing rules and regulations for the implementation and administration of this Act.
(b) Establishing guidelines for developing individual Agency Action Plans.
(c) Developing and adopting technical procedures for the consistent identification, delineation and evaluation of existing wetlands and quantification of their functional values and the evaluation of wetland restoration or creation projects.
(d) Developing a research program for wetland function, restoration and creation.
(e) Preparing reports, including:

(1) A biennial report to the Governor and the General Assembly on the impact of State supported activities on wetlands.
(2) A comprehensive report on the status of the State's wetland resources, including recommendations for additional programs by January 15, 1991.

(f) Development of educational materials to promote the protection of wetlands.

(Source: P.A. 86-157, Art. II, 2-1, eff. Aug. 12, 1989. Amended by P.A. 89-445, 9B-6, eff. Feb. 7, 1996. Formerly Ill.Rev.Stat.1991, ch. 96 1/2 , 9702-1.

830/2-2. Agency Action Plans

2-2. Agency Action Plans. Within one year following passage of this Act each State agency serving on the Interagency Wetlands Committee shall prepare an Agency Action Plan, which shall be used as the agency's procedural plan for the implementation of this Act. Guidelines for Agency Action Plans shall be developed by the Department and reviewed by the Committee within 6 months of the effective date of this Act.

(a) Minimum elements of each Agency Action Plan will include:

(1) Provisions for both a consultation process with the Department and conflict resolution process through the Governor's office;
(2) Procedures for the development of a Wetland Compensation Plan;
(3) Procedures to scientifically monitor the success of wetland restoration/creation projects.
(4) Procedures to minimize the destruction of wetlands caused or encouraged by State supported construction, land management, technical assistance, educational and other activities;
(5) Procedures to increase the quantity and quality of wetlands as a standard component of agency activities including incentives for the creation of wetlands in the agency's regulation of activities for

which wetland compensation plans are not required by this Act;
(6) Procedures to coordinate the responsibilities contained within this Act with other State programs;
(7) Procedures to ensure that historic and archaeological resources will not be negatively impacted by this Act; and
(8) An acquisition policy related to implementation of this Act.

(b) Agency Action Plans may also include:
(1) procedures for the development and management of a Wetland Compensation Account; and
(2) procedures to expedite the review of certain classes of projects.

(c) Agency Action Plans shall be submitted to the Governor and the General Assembly after review and approval by the Department. (Source: P.A. 86-157, Art. II, 2-2, eff. Aug. 12, 1989. Formerly Ill.Rev.Stat.1991, ch. 96 1/2 , 9702-2.)

ARTICLE III. STATE WETLAND MITIGATION POLICY

830/3-1. State Wetland Mitigation Policy

3-1. State Wetland Mitigation Policy. This Act implements the State Wetland Mitigation Policy, which directs that each State agency shall preserve wetlands as a priority of action when they develop construction or land management plans. When an agency can establish that no other feasible alternative exists and adverse wetland impacts are unavoidable, adverse impacts are to be compensated for through the development and implementation of a Department approved Wetland Compensation Plan.

The policy requires progressive levels of compensation based upon the level of impact to the existing wetland and the location of compensation wetlands. Priority shall be given to locating compensation wetlands close to the wetland area impacted.

Proposed State and State-supported construction activities which may impact wetlands identified on the Illinois Natural Areas Inventory, under public ownership or which provide habitat for State or federally threatened or endangered species will continue to require direct consultation with the Department and compliance with the Endangered Species Protection Act of 1986. [520 ILCS 10/1 et seq.]

(Source: P.A. 86-157, Art. III, 3-1, eff. Aug. 12, 1989. Formerly Ill.Rev.Stat.1991, ch. 96 1/2 , 9703-1.)

830/3-2. Ownership and management

3-2. Ownership and management. Wetlands, whether purchased, restored or created as the result of this Act shall be protected through either easements or fee simple transfer to either a public conservation agency or private conservation organization which will protect and manage the area.

(Source: P.A. 86-157, Art. III, 3-2, eff. Aug. 12, 1989. Formerly Ill.Rev.Stat.1991, ch. 96 1/2 , 9703-2.)

830/3-3. Wetland Compensation Account

3-3. Wetland Compensation Account. Each State agency is hereby authorized to establish a Wetland Compensation Account to reconcile debits and credits established as the result of Wetland Compensation Plans.

Management of a Wetland Compensation Account, if established, is the responsibility of the individual State agency. The Department shall review each agency's Compensation Account to confirm that all debits and credits are accounted for and balanced.

(Source: P.A. 86-157, Art. III, 3-3, eff. Aug. 12, 1989. Formerly Ill.Rev.Stat.1991, ch. 96 1/2 , 9703-3.)

830/3-4. Impact evaluation

3-4. Impact evaluation. For each project action involving a wetland, State agencies shall follow a multi-step process to avoid and minimize adverse wetland impacts as the preferred course of action. An agency must document that no other feasible alternative exists before adverse impacts are considered.

In order of priority, these steps shall include:

(1) The avoidance of adverse wetland impacts;
(2) Minimal alteration with compensation on the site of the proposed project;
(3) Significant alteration with compensation on the site of the proposed project;
(4) Wetland destruction with compensation on the site of the proposed project;
(5) Wetland destruction with compensation off the site of the proposed project but within the same drainage basin; and
(6) Wetland destruction with compensation both off the site of the proposed project and out of the drainage basin.
(Source: P.A. 86-157, Art. III, 3-4, eff. Aug. 12, 1989. Formerly Ill.Rev.Stat.1991, ch. 96 1/2 , 9703-4.)

830/3-5. Value

3-5. Value. Value shall include:

Value for each compensation plan shall be established by the agency developing the compensation plan in consultation with the Department.

(Source: P.A. 86-157, Art. III, 3-5, eff. Aug. 12, 1989. Formerly Ill.Rev.Stat.1991, ch. 96 1/2 , 9703-5.)

830/3-6. Compensation ratios

3-6. Compensation ratios. Wetland Compensation Plans must adhere to a schedule of increasing compensation ratios based upon the amount of adverse wetland impact and the location of compensation projects.

(a) Compensation ratios are required to:

(1) Ensure that wetland systems are not destroyed without careful evaluation of other alternatives; and

(2) Discourage destruction of wetland resources in rapidly developing areas of Illinois and their replacement within other regions of the State.

(b) Compensation ratios shall be established and shall be progressively higher to reflect the priority actions identified in Section 3-4.

The lowest compensation ratio shall be for minimal alteration and compensation on-site. The highest compensation ratio shall be for destruction and compensation outside the impacted wetland's drainage basin.

Progressively higher compensation ratios shall strongly encourage agencies to avoid or minimize adverse wetland impacts and to compensate on-site.

(c) Compensation may be accomplished through a combination of creation of new wetlands, restoration of degraded wetlands, acquisition of existing wetlands, or research. Compensation shall be accomplished using the best available technology.

(d) The Department, through the Interagency Wetlands Committee, shall review the compensation ratios to determine their adequacy and appropriateness, and shall report the results of this review in the biennial report required in Section 2-1.

(e) When adverse wetland impacts occur, the Wetland Compensation Plan must include the creation of at least one-for-one replacement of new wetlands of comparable functional type and size, before restoration, acquisition or research alternatives are considered.

One provision of a Wetland Compensation Plan may include funding for needed research on wetland functions, restoration or creation. Credit for research funding requires approval of the Department upon consultation of the Committee.

(Source: P.A. 86-157, Art. III, 3-6, eff. Aug. 12, 1989. Formerly Ill.Rev.Stat.1991, ch. 96 1/2 , 9703-6.)

ARTICLE IV. ADMINISTRATION

830/4-1. Administration

4-1. Administration. The Department shall administer this Act and shall formulate rules and regulations necessary for its implementation.

(Source: P.A. 86-157, Art. IV, 4-1, eff. Aug. 12, 1989. Formerly Ill.Rev.Stat.1991, ch. 96 1/2 , 9704-1.)

APPENDIX 3

2007 Illinois State Wildlife Grant Proposal: Updating the National Wetlands Inventory for the State of Illinois. Submitted by Ducks Unlimited, Inc.

2007 Illinois State Wildlife Grant Pre-Proposal

Updating the National Wetlands Inventory for the State of Illinois

Ducks Unlimited

TITLE:

Updating the National Wetlands Inventory (NWI) for the State of Illinois

BRIEF PROJECT DESCRIPTION:

The National Wetland Inventory (NWI) is currently being used in the state of Illinois for developing state wildlife plans and research efforts to support those plans. However, the NWI was created from aerial photography from the 1980's. Based upon current field studies, there have been some major changes in wetlands since the 1980s. This project will use current aerial photography (2005 and 2007) to update the NWI for the state of Illinois using Fish and Wildlife Service standards.

TYPE OF PROJECT AND MATCH RATE:

Implementation Project

Match requirement is 50%

BUDGET:

Ducks Unlimited (DU) is requesting $172,000 from the State Wildlife Grant for this project. DU has received a grant from the U.S. EPA Great Lakes National Program Office to support part of the project. The State of Illinois (IL EPA, IL DNR, IL DOT, INHS, and ISGS ???? – did I miss anyone?) and DU will supply the non-federal match for this project.

TASK	MATCHING FUNDS[2]	FEDERAL FUNDS[1]	SWG FUNDS	TOTAL
Update NWI for the state of Illinois	$15,000	$12,518	$142,000	$169,518
Field Verification and Assessment	$157,000	$0	$30,000	$187,000
TOTAL	**$172,000**	**$12,518**	**$172,000**	**$356,518**

1) DU has received a grant from the U.S. EPA Great Lakes National Program Office for this project.
2) DU has $15,000 in match for the NWI update process and the State of Illinois will provide the match for the Field Verification.

CONTACT INFORMATION:

Robb Macleod
Ducks Unlimited
331 Metty Drive, Suite 4
Ann Arbor, MI 48103
734-623-2000
rmacleod@ducks.org

NEED:

Wetlands provide habitat for over 900 different species of birds, amphibians, mammals, insects, and plants. Many of these plants and animals are threatened or endangered, and rely on wetlands for survival. Knowing the location of wetlands in Illinois is critical to any strategic conservation planning effort for wildlife. In addition, having a wetlands layer in a Geographic Information System (GIS) is invaluable when applying wildlife habitat models to large geographic areas. The U.S. Fish and Wildlife Service's (FWS) National Wetlands Inventory (NWI) is available for the State of Illinois in GIS format. However, the inventory was accomplished using photos from the early to mid 1980s. Recent field studies utilizing the NWI data have indicated many changes in wetland occurrence and type since the 1980s. These changes could potentially have a major impact on wildlife conservation planning efforts in Illinois.

User Surveys from the FWS have documented over 100 different applications for the NWI data. The applications were varied and included uses such as: comprehensive resource management plans, environmental assessments, facility and corridor placement, contingency plans for environmental emergencies, natural resource inventories, and habitat surveys. An updated NWI data set will allow the State of Illinois to utilize current and accurate wetlands information in their comprehensive wildlife conservation plan and strategy. The updated NWI will assist the plan by identifying current wetlands, converted wetlands, and newly created or omitted wetlands. The current wetlands layer can be used in wildlife habitat models, restoration targeting scenarios, and for easement and mitigation sites. The converted wetland can be used for identifying potential restoration sites and status and trends of wetlands for the State.

RELATIONSHIP TO THE PLAN:

This project addresses the Wetlands Campaign, Action 3 (Fill information gaps and develop conservation actions to address stresses), Subaction b (updated inventory of wetland habitat in Illinois).

OBJECTIVES:

The objective of this project is to develop an updated National Wetlands Inventory (NWI) layer in Geographic Information System (GIS) format that is consistent and accurate for the State of Illinois. The specific tasks to meet the objective are:

- Assemble original NWI data and current aerial photos
- Update and track the status of the NWI based on the current aerial photos
- Run quality assurance and quality control tests on the NWI update
- Field verify the NWI update
- Produce final reports and documents

APPROACH:

The first step in the NWI updating process for the State of Illinois is to gather all of the data needed to perform the update. The original NWI data will be exported from the USGS NWI Master Geodatabase (MGD) and imported into DU's Geodatabase (DU MGD). The aerial photos that will be used for the updating process will be the Statewide Spring 2005 photos and the NAIP Summer 2007 photos if available. If the 2007 NAIP photography is not available, the 2004 and 2006 NAIP photos will be used. Ancillary data sets that may be used in the update are digital elevation models and hydric soils.

One of the challenges in updating the NWI is to design a system that tracks the historic wetland information so that wetland trends and potential restoration sites (wetlands that have been converted) can be identified. DU will accomplish this by adding attributes to the current database that identifies the converted and partially converted wetlands. The updating process will involve displaying the original NWI layer on top of the aerial photos on a section-by-section basis. The photos will be interpreted as to whether the wetland still exists, if it has changed class, has been spatially modified, or remains in the same condition as the original. A photo interpretation key and the existing NWI data will be used to assist the interpreter in determining the wetland condition and class. Any wetlands that were either missed by the original NWI or have been created will be digitized and attributed. All existing wetlands that do not spatially register with the photos will be modified to match the photo.

Once the photo interpreter has completed the NWI update for a county, the version will undergo quality assurance/quality control (QA/QC) before the database administrator posts the version to the DU MGD. The first QA/QC process involves having a different interpreter visually verify 10% of the county for any errors. The second process is to run

DU's 14-step attribute verification tool that checks for any errors in the additional attributes that were added in the DU MGD. The third step is to run the USGS NWI attribute and verification tool to check for NWI attribute errors and spatial errors. The counties must pass the USGS attribute and verification tool in order for the USGS to accept the update back into the USGS MDG. Once the QA/QC and the accuracy assessment are completed for an area of the NWI update, the DU MGD will be sent to the USGS for posting to the USGS MGD

The NWI field verification will be an assessment of the wetland status (converted, still existing, additional) and wetland class (open water, emergent, aquatic bed, etc.). The goal of the field assessment is to sample 1% of the wetlands stratified based on the wetland class and status. A field inspection will be conducted by driving to each site, recording the wetland status and type, and taking a digital photo of the wetland. A final report will be created documenting the methods and reporting the results of the update.

Cooperators on this project include U.S. EPA Great Lakes National Program Office, Natural Resource Conservation Service, Illinois Environmental Protection Agency, Illinois Department of Natural Resources, Illinois Natural History Survey, Illinois State Geological Survey, and Ducks Unlimited – DID I MISS ANYONE?. The NWI update process will be performed by Ducks Unlimited. The field verification will be methods will be developed by the Illinois Natural History Survey and conducted by all cooperators.

ANTICIPATED OUTCOMES AND BENEFITS:

The anticipated outcome of this project is an accurate and updated wetland inventory for the State of Illinois based on the U.S. Fish and Wildlife's NWI data. An additional outcome is an inventory of converted wetlands and the ability to track wetlands into the future. The wetland inventory can be used to identify priority habitats and for developing habitat models for species of greatest need of conservation in Illinois. The converted wetland inventory can be used to identify and prioritize areas for restoration efforts directed towards those species of greatest need. The ability to track the wetlands into the future will be invaluable for future wetland inventory efforts and to identify trends in Illinois's wetlands.

The species of greatest need of conservation in Illinois include species from mussels, fishes, amphibians, reptiles, birds, and mammals. At some point in their life cycle, all of these species require or use wetlands. An updated wetlands layer for Illinois is critical for developing habitat models for these species, prioritizing restoration and conservation efforts, and developing strategic planning efforts for conservation.

<u>APPENDIX 4</u>

Letter of Support from Illinois Environmental Protection Agency Director Scott for Updating the National Wetland Inventory Proposal by Ducks Unlimited, Inc.

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

1021 NORTH GRAND AVENUE EAST, P.O. BOX 19276, SPRINGFIELD, ILLINOIS 62794-9276 – (217) 782-3397
JAMES R. THOMPSON CENTER, 100 WEST RANDOLPH, SUITE 11-300, CHICAGO, IL 60601 – (312) 814-6026

ROD R. BLAGOJEVICH, GOVERNOR DOUGLAS P. SCOTT, DIRECTOR

217/782-3397

MAY - 7 2007

Mr. James Renn
Illinois Department of Natural Resources
Office of Resource Conservation
One Natural Resource Way
Springfield, IL 62702

Re: Updating the National Wetland Inventory (NWI) - State Wildlife Grant Application

Dear Mr. Renn:

I am writing to you in support of the attached grant application, "Updating the National Wetlands Inventory (NWI) for the State of Illinois," developed by Ducks Unlimited, Inc. Mr. Gregg Good of my staff has worked with the applicant, Mr. Robb Macleod, to prepare it.

As you may know, staff in our Bureau of Water has been developing a "Plan for a Statewide Wetland Monitoring and Assessment Program." This plan, being developed over this past year under agreement with USEPA Region V, is nearing completion, and has had the input and support of the numerous agencies and organizations mentioned in the Ducks Unlimited, Inc., project application (e.g., IDNR, INHS, IDOT, NRCS, ISGS, GLNPO, Ducks Unlimited, Inc.). What was clear in discussions during development of the plan was the need to update Illinois' NWI, first generated over 25 years ago.

The Ducks Unlimited, Inc. project proposal creates a new NWI using 2005 and 2007 aerial photography, and will meet all U.S. Fish and Wildlife Service national mapping standards. Cost of the project is extremely reasonable; even so, other USEPA Region V states (e.g., Michigan, Ohio), and Region V Wetlands Program staff, have been very happy with the work Ducks Unlimited, Inc. has performed to date. Finally, this project specifically addresses your Illinois Wildlife Action Plan, Wetlands Campaign, Action 3, Sub-action B, which discusses the explicit need to update the inventory of this State's wetland resources.

I fully endorse the implementation of this project proposal. Please know that Ducks Unlimited, Inc. and your organization will have my staff's full support towards its implementation.

Should you have any questions or comments concerning the application or the project, please feel free to contact Gregg Good of my staff at 217/782-3362, or Gregg.Good@illinois.gov.

Very truly yours,

Douglas P. Scott
Director

DPS:GG:djp/wagduwesland

ROCKFORD – 4302 North Main Street, Rockford, IL 61103 – (815) 987-7760 • DES PLAINES – 9511 W. Harrison St., Des Plaines, IL 60016 – (847) 294-4000
ELGIN – 595 South State, Elgin, IL 60123 – (847) 608-3131 • PEORIA – 5415 N. University St., Peoria, IL 61614 – (309) 693-5463
BUREAU OF LAND - PEORIA – 7620 N. University St., Peoria, IL 61614 – (309) 693-5462 • CHAMPAIGN – 2125 South First Street, Champaign, IL 61820 – (217) 278-5800
SPRINGFIELD – 4500 S. Sixth Street Rd., Springfield, IL 62706 – (217) 786-6892 COLLINSVILLE – 2009 Mall Street, Collinsville, IL 62234 – (618) 346-5120
MARION – 2309 W. Main St., Suite 116, Marion, IL 62959 – (618) 993-7200

Project Title: Updating the National Wetlands Inventory (NWI) for the State of Illinois

Applicant Information

Applicant (Grantee if awarded)		**Project Manager** (Contact Person other than Applicant)	
Prefix	Mr.	**Prefix**	
First Name	Robb	**First Name**	
Last Name	Macleod	**Last Name**	
Organization	Ducks Unlimited, Inc.	**Organization**	
Address1	1220 Eisenhower Place	**Address1**	
Address2		**Address2**	
City	Ann Arbor	**City**	
State	MI	**State**	
ZIP Code	48108	**ZIP Code**	
Telephone	734-623-2000	**Telephone**	
Fax	734-623-2035	**Fax**	
Email	rmacleod@ducks.org	**Email**	

Project Information

Project Title: Updating the National Wetlands Inventory (NWI) for the State of Illinois

Project Description

The National Wetland Inventory (NWI) is currently being used in the state of Illinois for developing state wildlife plans and research efforts to support those plans. However, the NWI was created from aerial photography from the 1980s. Based upon recent field studies, there have been some major changes in wetlands since the 1980s. This project will use current aerial photography (2005 and 2007) to update the NWI for the state of Illinois using Fish and Wildlife Service NWI Mapping standards.

Type of Project

(•) Implementation ( ) Planning

(Match Rates Implementation: 50% Federal : 50% Non-Federal | 75% Federal : 25% Non-Federal)

Dollars Requested

Dollars Requested	Total Federal	Total Non-Federal	Total Cost of Project
1st Year Funding	137600	137600	275200
2nd Year Funding	34400	34400	68800
3rd Year Funding	0	0	0
Totals:	172000	172000	344000

Need:

Wetlands provide habitat for over 900 different species of birds, amphibians, mammals, insects, and plants. Many of these plants and animals are threatened or endangered, and rely on wetlands for survival. Knowing the location and type of wetlands in Illinois is critical to any strategic conservation planning effort for wildlife. In addition, having a wetlands layer in a Geographic Information System (GIS) is invaluable when applying wildlife habitat models to large geographic areas. The U.S. Fish and Wildlife Service's (FWS) National Wetlands Inventory (NWI) is available for the State of Illinois in GIS format. However, the inventory was accomplished using photos from the early to mid 1980s. Recent field studies utilizing the NWI data have indicated many changes in wetland occurrence and type since the 1980s. Documenting changes to and the current status of wetlands could potentially have a major impact on wildlife conservation planning efforts in Illinois. User Surveys from the FWS have documented over 100 different applications of the NWI data. The applications were varied and included uses such as: comprehensive resource management plans, environmental assessments, facility and corridor placement, contingency plans for environmental emergencies, natural resource inventories, and habitat surveys. An updated NWI data set will allow the State of Illinois to utilize current and accurate wetlands information in their comprehensive wildlife conservation plan and strategy. The updated NWI will assist the plan by identifying current wetlands, converted wetlands, and newly created or omitted wetlands. The updated wetlands layer can be used in wildlife habitat models, restoration targeting scenarios, and for easement and mitigation sites. The converted wetland information can be used for identifying potential restoration sites and status and trends of wetlands for the State.

Objectives:

This project addresses the Illinois Wildlife Action Plan, Wetlands Campaign, Action 3 (Fill information gaps and develop conservation actions to address stresses), Subaction b (updated inventory of wetland habitat in Illinois). The objective of this project is to develop an updated National Wetlands Inventory (NWI) layer in Geographic Information System (GIS) format that is consistent and accurate for the State of Illinois and meets the current wetland mapping standards of the FWS. The specific tasks to meet the objective are: assemble original NWI data and current aerial photos; update and track the status of the NWI based on the current aerial photos; run quality assurance and quality control tests on the NWI update; field verify the NWI update; produce final reports and documents.

Approach:

The first step in the NWI updating process for the State of Illinois is to gather all of the data needed to perform the update. The original NWI data will be exported from the USGS NWI Master Geodatabase (MGD) and imported into DU's Geodatabase (DU MGD). The aerial photos that will be used for the updating process will be the Statewide Spring 2005 photos and the NAIP Summer 2007 photos if available. If the 2007 NAIP photography is not available, the 2004 and 2006 NAIP photos will be used. The updating process will involve displaying the original NWI layer on top of the aerial photos on a section-by-section basis. The photos will be interpreted as to whether the wetland still exists, if it has changed class, has been spatially modified, or remains in the same condition as the original. A photo interpretation key and the existing NWI data will be used to assist the interpreter in determining the wetland condition and class. Any wetlands that were either missed by the original NWI or have since been created will be digitized and attributed. All existing wetlands that do not spatially register with the photos will be modified to match the photo. Once the photo interpreter has completed the NWI update for a county, the update will undergo quality assurance/quality control (QA/QC). The first QA/QC process involves having a different interpreter visually verify 10% of the county. The second process is to run DU's 14-step attribute verification tool that checks for any errors in the attributes that were added in the DU MGD. The third step is to run the USGS NWI attribute and verification tool to check for NWI attribute errors and spatial errors. The counties must pass the USGS attribute and verification tool in order for the USGS to accept the update. Once the QA/QC and the accuracy assessment are completed for an area, the DU MGD will be sent to the USGS for posting to the USGS MGD The NWI field verification will be an assessment of the wetland status (converted, still existing, additional) and wetland class (open water, emergent, aquatic bed, etc.). The goal of the field assessment is to sample 1% of the wetlands, stratified on wetland class and status. The field verification methodology will be developed by the Illinois Natural History Survey and Ducks Unlimited. A final report will be created documenting the methods and reporting the results of the update. Primary Cooperators on this project include U.S. EPA Great Lakes National Program Office, Natural Resources Conservation Service, Illinois Environmental Protection Agency, Illinois Department of Natural Resources, Illinois Natural History Survey, Illinois State Geological Survey, Illinois Department of Transportation, and Ducks Unlimited. The NWI update process will be performed by Ducks Unlimited. The field verification methods will be developed by the Illinois Natural History Survey and Ducks Unlimited and conducted by all cooperators.

Anticipated Outcomes and Benefits:

The anticipated outcome of this project is an accurate and current wetland inventory for the State of Illinois based on the original 1980's U.S. Fish and Wildlife's NWI data. This updated inventory will benefit many federal and state agencies as well as other conservation organizations. For example, the Illinois EPA is currently designing a wetlands monitoring and assessment program which will need an updated wetland inventory for program design and selection of monitoring sites. The IDNR's Critical

Trends Assessment Program (CTAP) has a wetland assessment program, but an updated wetland inventory will produce a more accurate determination of the state of wetlands in Illinois. An updated Illinois Wetland Inventory will go a long way to supporting the proposed work of CTAP, which will development of a Wetland - Index of Biotic Integrity for the entire State of Illinois. The Illinois Department of Transportation requires an accurate determination of wetland location to assess potential impacts and mitigation requirements associated with transportation projects and improvements. An additional outcome of this effort will be an inventory of converted wetlands and the ability to track changes to wetlands into the future. The wetland inventory can be used to identify priority habitats and for developing habitat models for species of greatest need of conservation in Illinois. The converted wetland inventory can be used to identify and prioritize areas for restoration efforts directed towards those species of greatest need. The ability to track the wetlands into the future will be invaluable for future wetland inventory efforts and to identify trends in Illinois's wetlands. The species of greatest need of conservation in Illinois include mussels, fishes, amphibians, reptiles, birds, and mammals. At some point in their life cycle, many of these species require or use wetlands. An updated wetlands inventory for Illinois is critical for developing habitat models for these species, prioritizing restoration and conservation efforts, and developing strategic planning efforts for conservation.

Signature of Principal Investigator:	
	Date:
Signature of department or unit head (if required):	
	Date:

APPENDIX 5

Letter of Funding Approval from the Illinois Department of Natural Resources for the Ducks Unlimited, Inc. National Wetlands Inventory update for Illinois

Illinois Department of
Natural Resources
One Natural Resources Way • Springfield, Illinois 62702-1271
http://dnr.state.il.us

Rod R. Blagojevich, Governor
Sam Flood, Acting Director

July 31, 2007

Mr. Robb Macleod
Ducks Unlimited, Inc.
1220 Eisenhower Place
Ann Arbor MI 48108

Received
AUG 3 2007

Dear Mr. Macleod,

Thank you for submitting your project pre-proposal entitled: "***Updating the National Wetlands Inventory (NWI) for the State of Illinois***" for consideration of State Wildlife Grant (SWG) Program funding.

Since the January 2007 request for pre-proposals, interest in the State Wildlife Grant Program in Illinois has been tremendous. The Illinois Department of Natural Resources (IDNR) has received a total of 48 pre-proposals requesting $6,817,170.in federal dollars. Illinois' allocated funding for the State Wildlife Grants for federal fiscal year 2007 totals $2,069,216 million.

Your project pre-proposal has been evaluated based on the established criteria identified in the IDNR's January 2006 Request For Pre-proposals and has been **APPROVED** for funding. All applicants of approved project pre-proposals will be requested to submit a **full Grant Proposal (GP)** and **Grant Segment (GS)** documentation.

To assist you with this process, a meeting for all SWG '07 project award recipients has been scheduled. The purpose of this meeting is to discuss federal aid requirements, fiscal requirements, reporting, project management, scheduling, and is mandatory for receipt of SWG federal funding.

Time and location information for the SWG'07 Project Recipients Meeting is identified below:

What:	**SWG'07 Project Recipients Meeting**
Where:	IDNR Headquarters Office One Natural Resources Way Springfield, IL 62702-1271 Lake Level - A&B Conference Rooms
When:	August 22, 2007 10:00 AM - 12:00 Noon

In preparation for the SWG '07 Project Recipients Meeting, please go to the SWG website (http://dnr.state.il.us/orc/wildlife resources/theplan/swggrant/login.asp) and review the posted Federal Aid forms required for completion of your application. In addition, federal aid grant writing guidelines are available from the U. S. Fish and Wildlife Service, Region 3 Office at: http://midwest.fws.gov/FederalAid/programs/guidelines.htm. (*1)

Please refer to the schedule on the State Wildlife Grant website (http://dnr.state.il.us/orc/wildlife resources/theplan/swggrant/login.asp) for completion dates of the full Grant Proposal and Grant Segment.

Your final Grant Proposal and Grant Agreement will be reviewed and approved by the IDNR and the U.S. Fish and Wildlife Service. Work may be initiated only upon written approval by the U.S. Fish and Wildlife Service and an executed agreement with the IDNR.

Questions regarding the preparation of your final Grant Proposal and Grant Segment, or the SWG'07 Project Recipients Meeting can be directed to:

Paul Vehlow, Office of Resource Conservation – Federal Aid Program Coordinator
Illinois Department of Natural Resources
One Natural Resources Way
Springfield, IL 62702-1271
phone: (217) 785-5922
email: pvehlow@dnrmail.state.il.us
Federal Aid Program Coordinator

Thanks again for your interest in the State Wildlife Grant Program and congratulations on the approval of your project pre-proposal.

Sincerely,

James Renn

Illinois Wildlife Action Plan Coordinator
IL Department of Natúral Resources
Office of Resource Conservation
One Natural Resources Way
Springfield, IL 62702-1271
217-785-5907
217-785-2438 fax
james.renn@illinois.gov

*1) A limited number of "hard copies" and CD's of the material found on the website will be available the day of the project recipient meeting. We encourage all successful applicants to use the website.

APPENDIX 6

Critical Trends Assessment Program Monitoring Protocols

Critical Trends Assessment Program
Monitoring Protocols

Illinois Natural History Survey
Office of the Chief
Technical Report 2002-2

CTAP Monitoring Protocols

From the Editor:

The Critical Trends Assessment Program (CTAP) is a long-term endeavor, which monitors the condition of forests, wetlands, grasslands, and streams throughout the state of Illinois. It assesses current and future trends in ecological condition on statewide, regional, and site-specific bases. This program, an endeavor of the Illinois Department of Natural Resources, is unique because it is the first-ever attempt at a statewide comprehensive assessment undertaken by a state natural resource organization. A total of 600 sites representing four habitats (150 of each; 30 sites per habitat per year) were randomly selected from across the state on both public and private land. Since 1997 the CTAP professional scientists of the Illinois Natural History Survey (INHS) have been conducting surveys at these sites.

In this document we present the CTAP standardized protocols for monitoring forests, wetlands, grasslands, and streams. In forests, wetlands, and grasslands data on herbaceous and woody vegetation, birds, and insects are collected. In streams, aquatic insects (EPT taxa: Ephemeroptera [mayflies], Plecoptera [stoneflies], and Trichoptera [caddisflies]) are the primary assemblage used. Each main section (terrestrial or aquatic) can stand as an independent document. This explains, in part, differences in format and repetition of information. The latter is more obvious in the terrestrial monitoring protocols. All groups, organizations, and individuals are welcome and encouraged to use these monitoring protocols. Following these protocols will benefit the user in several ways. For example, by collecting similar data, the user will be able to incorporate our data into her/his project. For additional information about our program and data, go to the following web page: http://ctap.inhs.uiuc.edu. Finally, this document should be cited as follows:

For **general** reference to the document:

Molano-Flores, B. 2002. Critical Trends Assessment Program Monitoring Protocols. Illinois Natural History Survey, Office of the Chief, Technical Report 2002-2, Champaign, IL. 38 pp, + Figures, Tables, and Appendix.

or

For each **section** of the document:

Author(s) section. 2002. Section title. in B. Molano-Flores (ed.) Critical Trends Assessment Program Monitoring Protocols. Illinois Natural History Survey, Office of the Chief Technical Report 2002-2, Champaign, IL. 38 pp, + Figures, Tables, and Appendix.

Document Contributors:

Several people have written, provided input, and reviewed this document. Below we provide a list of the people involved in the production of this document. To all of them thank you.

Document Editor: Brenda Molano-Flores

Section Authors:

Statistical Sampling Design: Jeff Brawn, Liane Sulaway, Ellen Brewer, Dan Niven, Chris Phillips, and William Ruesink

Initial study site selection: Mark Joselyn, Ellen Brewer, and Liane Sulaway

Habitat criteria for study sites: John Taft, Ken Robertson, Scott Robinson, Jeff Brawn, Chris Phillips, Dan Niven, R. Edward DeWalt, and Larry Page

Site evaluation, site selection, and documentation: Rhetta Jack, Steve Bailey, Connie Carroll, and Cynthia Dassler

Plant Sampling Protocols: Connie Carroll, Cynthia Dassler, James Ellis, Greg Spyreas, John Taft, and Kenneth Robertson

Bird Sampling Protocols: Dan Niven, Steve Bailey, Rhetta Jack, Jeff Brawn, and Scott Robinson

Terrestrial Insect Sampling Protocols: Chris Dietrich, Michelle Biyal, and Sue Gallo

Aquatic monitoring protocols and Appendix: R. Edward DeWalt

Table of Contents

I- Terrestrial monitoring protocols

1) Statistical Sampling Design

a) Sampling unit

In order to draw statistical inference about the status and trends of bio-indicators at the statewide level, a population of random, independent sampling units is needed. The population of 1765 Illinois Public Land Survey townships was chosen as the sampling units. The average size of these townships is 20,420 acres (SD = 6,612, range = 29,632). With the exception of townships along the edge of the state, along rivers, or along meridians, most townships are approximately square in shape and 6 miles on a side, and composed of 36 1-mile^2 "sections" (a township of this size would be 23,040 acres). Townships were chosen as the sampling unit because: 1) they are large enough to assure that suitable habitats for sampling will be found in most randomly selected townships; 2) there are enough townships to sample from; and 3) their common usage throughout the State makes them a convenient unit for GIS scientists to work with. Other grid systems were considered but rejected. For example, the EMAP hexagonal grid system used for some federal monitoring programs (such as the U.S. Forest Service's "Forest Health Monitoring" program) was rejected because the population of hexagonal polygons in the State was too small.

b) Township selection

For each habitat type to be monitored (forest, grassland, and wetland), the state's 1765 townships were randomly ranked. Ranking the townships during randomization allows us to avoid the bias of subjectively choosing which randomly selected townships to sample in a given year. Sampling proceeds sequentially down the list until an appropriate number of townships have been sampled (see below).

In order to make inferences about statewide environmental conditions, every location in the State should have an equal probability of being sampled. Therefore, to avoid bias toward sampling areas in larger townships, each township was weighted by its area during the randomization procedure.

Fig. 1a-c shows the location of the first 50 randomly selected townships. They are ranked from 1-50 and also include the unique township number. The goal is to monitor the townships ranked 1-30 in the first year, 31-60 the second year, etc. However, each year a few of the townships may have to be rejected because they do not have suitable habitat, reasonable access sites, and/or it is not possible to get permission to sample at the site. If this is the case, the scientists continue sequentially down the list until 30 acceptable townships are sampled.

c) Sample sizes

Statewide sampling will proceed on a five-year cycle. At least 30 new sites (townships) will be sampled in each of the four focal habitats every year for five years (i.e. sample without replacement), resulting in a total sample of approximately 150 townships per habitat. Although there will usually be more than one suitable location for sampling within each township, for any given habitat only one site will be sampled in each township. This will be done even though there may be multiple sampling locations (e.g. transects) at each site. The sole exception to the one site sampling per township will be made with bird sites in wetlands and grasslands. Additional sites may be monitored in a township (see Bird Sampling Protocols).

Time and resource constraints and the results of analyses of statistical power will ultimately determine the exact number of townships to be sampled. After the first five years the sampling cycle will be repeated: in the sixth year townships visited in year one (i.e., 1997) will be revisited, with the possible addition of some new townships. These townships may be needed to replace sites that are no longer suitable and/or are no longer accessible. In addition, without the addition of new sites the monitoring program may only detect changes due to natural successional processes rather than continually gaining new input into the general conditions of natural resources across the State.

2) Initial study site selection

Before CTAP biologists begin their field work each year, potentially suitable habitat for sampling locations must be identified from within each randomly selected township. This section describes the methods used to objectively identify these habitats and select potential study sites. Detailed GIS field maps are produced for each township to be evaluated and sampled. These maps show the distribution of land cover types and the location of potential study sites. Although multiple sites may be suitable in each township, only one location is sampled. This location is the lowest ranked acceptable site on which permission to sample is granted by the landowner. The sole exception to the one site sampling per township will be made with bird sites in wetlands and grasslands. Additional sites may be monitored in a township (see Bird Sampling Protocols).

a) Forest

The CTAP Land Cover of Illinois database (Illinois Department of Natural Resources, 1995) categorizes each pixel of land (approximately 90’ x 90’) into one of 19 land cover categories. Five of these land cover types describe forested land: deciduous closed canopy, deciduous open canopy, coniferous, forested wetland, and swamp. Together, these land cover types account for more than 13% of Illinois’ land cover. For the purpose of this monitoring project, the five “forest” categories have been pooled.

For each randomly selected township, all pixels with forest cover that meet both of the following criteria were identified: 1) pixels that were part of a forest patch that was at least 20 acres in size; 2) pixels that were surrounded by a forest buffer of 114m (4 pixels). Within this available population of forest, the coordinates of a maximum of 50 points were randomly identified as potential monitoring sites in each township. These points were then randomly ranked (1-20) to provide a non-subjective order to follow when evaluating potential study sites. The land cover maps used in the field (Fig. 2) show the location of these 20 points.

b) Wetland

Potential sampling locations for wetlands were determined using the digital Illinois Wetlands Inventory database (Illinois Natural Resources Geospatial Data Clearinghouse, 1997; Suloway and Hubbell, 1994). The data for Illinois were generated from high altitude aerial photography acquired from 1980 – 1987; most of the photography was taken in 1983. This database may miss up to 40% of the State's wetlands, however, it is not biased to missing particular types of wetlands - it is only biased by size and "wetness"(Alan Plocher, Illinois Natural History Survey, pers. com.).

Criteria used to identify potential wetland sampling sites were based on wetland type and size. Specifically, wetlands suitable for CTAP monitoring are dominated by emergent palustrine vegetation (i.e. rooted herbaceous hydrophytic vegetation such as sedges, rushes, forbs, and grasses) and they are greater than two acres in size. There were 16,542 discreet emergent wetlands larger than two acres known from within the State, totaling 166,256 acres (0.5% of Illinois), with a mean size of 10.1 acres. These emergent wetlands were randomly ranked (1-indeterminent) within each selected township to establish sampling priority and field maps have been produced which show their location (Fig. 3).

c) Grassland
Identification of sampling locations for grasslands was based on the Illinois Land Cover database. Two land cover classes, rural grassland and urban grassland, were used. Together they cover more than 19% of Illinois' land surface. The rural grassland category includes pastures, hayfields, idle fields, and non-agricultural land such as reclaimed mine land, road and railroad right-of-ways and remnant prairies. Urban grassland includes open space, parks and golf courses in urban areas. High quality grasslands (native prairie remnants) are rare in Illinois, and they are often very small. Because we did not want to exclude the possibility of sampling these sites, no size constraints were placed on patches of grassland selected for sampling. Specific locations for sampling were determined by randomly placing 50 ranked points within each selected township in areas classified as grassland in the Land Cover database. Field maps show the location of these 50 points (Fig. 4).

3) Habitat criteria for study sites
Criteria have been established to objectively accept or reject sites after ground truthing because the habitat categories recognized by the land cover database are broad (e.g. open woodland may include city parks or relatively young successional woodland, as well as native savannas) and errors may have occurred in the classification of satellite images. In this way, monitoring is restricted to sites that are representative of the intended habitat type. Moreover, by discarding sample plots in highly divergent habitat types (such as pine plantations and city parks), undesirable variation between sites is reduced, which should provide higher statistical power to detect trends. The primary criteria for acceptance is that all sites be minimally to moderately managed, currently in a somewhat natural state and undergoing successional processes such that changes in condition will be possible and detectable.

Potential monitoring sites selected by GIS (described in the previous section) are ground-truthed to determine if they meet the following criteria necessary for inclusion in the pool of sites to be sampled.

A criterion common to all habitat types is that the area sampled by the field crew must be fully within the township being monitored. If the site is only of sufficient size to monitor if part of the sampling is conducted across the border of an adjacent township, then the site is rejected.

a) Forest habitat criteria
All five land cover types identified as “forest” in the Illinois Land Cover database are included in the pool of potentially acceptable monitoring sites for the purpose of determining if a plot meets the size criteria mentioned above (minimum acreage). Although this broad range of forest types

may be suitable for bird monitoring, not all of these sites are acceptable for monitoring plants and insects. Thus, more restrictive criteria are necessary for sites to be acceptable for monitoring.

Forest sites acceptable for CTAP monitoring meet the following criteria when assessed:

- Sites have a diameter [radius] of at least 150m [75] of suitable homogeneous forest habitat. The potential forest types, as categorized by CTAP, are moist/wet uplands (mesic to wet uplands and north-facing slopes), dry uplands (dry to dry-mesic uplands and south-facing slopes), and bottomlands. The site is big enough to include transects which are broken to accommodate crossing streams, trails, etc.
- Forest tracts average 75% canopy cover, although some areas within the tract may be more open due to selective logging or tree fall gaps. Not more than the equivalent of one transect falls within areas with less than 75% canopy cover.
- The majority of the trees in the forest tract are at least 10cm dbh.
  Exception: stunted "pygmy" woodland found on naturally xeric sites
- Forests currently lightly grazed are acceptable (unless the ground cover has been replaced by plantings of pasture grass or a manicured lawn).
- Sites marked to be logged or developed are acceptable as long as monitoring can be completed during the current field season.

The following forest sites are unacceptable:

- Forests grazed to completely denuded of ground cover vegetation.
- Sites that have extreme anthropogenic degradation factors such as ground cover replaced by plantings of a pasture grass or a manicured lawn (e.g. forested city parks).
- Plantations, unless the majority of the trees growing naturally beneath the ones planted are > 10cm dbh.
- If during the year, when a forest is assessed, the water is to deep to safely work in, then it is rechecked during the site assessment season. If the water is still too high at the end of the site assessment season, then the site is rejected.
- No access due to safety reasons or equipment (i.e., boats)

Bird monitoring in forests occurs on a much larger spatial scale than plant monitoring (bird census points are spaced at least 150m apart – see below). Therefore, bird census locations are not restricted to a homogeneous forest type, but otherwise meet all the criteria mentioned above.

b) Wetland habitat criteria

The pool of potential, random monitoring sites was identified from the Illinois Wetlands Inventory database (IWI). A 2-acre IWI size minimum was used for the potential pool of random monitoring sites (based on logistic considerations) in the hopes that it would reduce the number of unacceptable sites that would need to be evaluated after ground-truthing.

Wetland sites acceptable for CTAP monitoring meet the following criteria when assessed:

- The minimum area of suitable habitat is $500m^2$ with a minimum width of 10m (e.g. 50m x 10m or the equivalent).
- Sites have < 50% woody shrub or tree cover.
- An area is considered a wetland if $\geq$ 50% of the relative cover of dominant plant species are wetland plants in the following categories: obligate, facultative wetland, or facultative (as defined in Admiraal et al. 1997).
- If open water is present, then the wetland is suitable if there is $\geq$ 30% plant cover.
- Artificially constructed wetlands and lightly grazed wetlands are suitable.
- Sites scheduled to be plowed, drained, or developed are acceptable as long as monitoring can be completed during the current field season.

Sites with the following characteristics are not acceptable:

- Ponds were excluded if the amount of emergent vegetation does not meet the criteria above.
- If the wetland has been recently plowed (the year of the census), if it is currently being filled, or if the wetland is unsafe to work in (i.e., water greater than 1m deep or too mucky to be safe), then it is discarded.
- If during the year, when a wetland is assessed, the water is to deep to safely work in, then it is rechecked during the site assessment season. If the water is still too high at the end of the site assessment season, then the site is rejected.

c) Grassland habitat criteria
Native grasslands are currently almost nonexistent in Illinois. The once vast prairies have been almost totally replaced by agriculture or urban landscapes. However, “grassland” habitat, as characterized by the Illinois Land Cover database, still occupies 19 percent of the State's land cover (Illinois Department of Natural Resources 1996).

Grasslands identified by the Land Cover of Illinois database include a diversity of habitat types such as pastures, hayfields, airfields, parks, cemeteries, abandoned fields, grassland strips along roadsides, and native prairie remnants. Most of these areas that are physiognomically classified as grasslands, have been planted or are heavily managed in other ways and are now dominated by the presence of exotic species. However, even though these disturbed habitats no longer have a long history of natural succession, disturbed sites may still harbor some native species that once occurred in prairies, and for some native species these disturbed grasslands may be the only refugia standing between them and local extinction. For these reasons CTAP biologists are monitoring a broad spectrum of grassland habitats.

The primary criteria for accepting a grassland site for inclusion in the CTAP monitoring program is that the site be currently managed at a relatively low intensity.

Grassland sites acceptable for CTAP monitoring meet the following criteria when assessed:

- The minimum area of suitable habitat is $500m^2$, with a minimum width of 10m (e.g. 50m x 10m, or the equivalent).

- The grasslands have < 50% shrub cover and < 50% canopy cover.
- Sites scheduled to be plowed or developed are acceptable as long as monitoring can be completed during the current field season.

Examples of acceptable grassland sites include:

- Ungrazed, abandoned, or lightly grazed pastures
- Grasslands that have not recently been planted in monocultures
- Areas planted in alfalfa or clover, if there is ≥ 50% cover of other plant species present (if % of other species is <50%, then it is considered a monoculture)
- Abandoned agricultural fields, as long as they do not still contain crop stubble
- Overgrown or infrequently mowed rights-of-way
- Native prairies (including old cemeteries)
- Old fields
- Prairie reconstructions
- CRP lands

Unsuitable grassland sites include:

- Fields or pastures that are heavily grazed (if not sure if it is heavily grazed or not, then the site is monitored because this probably reflects a low level of grazing).
- Areas currently planted in monocultural, agricultural crops (such as corn, wheat, soybeans).
- Agricultural fields that are fallow and still retain evidence of fresh stubble (less than one season since abandonment).
- Grasslands, hayfields, etc. that are mowed frequently (i.e. more than three times per year).
- Manicured grasslands, such as golf courses, mowed cemeteries, city parks, turf farms, or most airfields.

Each site monitored for plants is always monitored for birds. If the plant site is less than 10 acres in size then a second site that is 10 acres in size or greater is monitored for birds. The above criteria are used for selecting the second bird site, except that manicured airfields or heavily grazed pastures are acceptable for bird monitoring. This is because these habitats may harbor significant grassland bird communities. Finally, monoculture hayfields such as alfalfa and clover are also used for bird sites as these also contain substantial bird populations

4) **Site evaluation, site selection, and documentation**

As mentioned above, with the exception of bird monitoring in wetlands and grasslands, only one site of a particular habitat type is sampled per township (although the same township may be randomly selected to monitor more than one habitat). However, the GIS identifies and ranks multiple potential sampling sites in each habitat. These sites must be evaluated, sequentially, until a site is identified that meets the specified habitat criteria and landowner access is granted to work at the site.

The field crew attempts to determine ownership and gain permission to conduct monitoring at the randomly selected sampling location numbered “1” in each township. If access is granted and the habitat at that site meets the criteria mentioned above, and the site is safe and logistically practical to work in, then this location is accepted as the permanent sampling site in the township. If site number "1" is rejected for any reason (e.g. unacceptable habitat, inability to obtain landowner permission, etc.), the reasons are documented and then site "2" is evaluated, and so on until an acceptable site is found.

The rest of this section describes the specific procedures followed to gain access to sites, conduct site evaluations, and document the results of these evaluations.

a) Landowner access

Regardless of the habitat quality of a site, monitoring is not conducted at a site without the landowner's permission. This issue is particularly important in this project because over 90% of the land in Illinois is privately owned. Therefore, for each potential study site that is visited, ownership is determined. The landowners are contacted to gain permission to access the site and to learn about the land use history at the site.

The field crew uses township land cover maps (Figs. 2, 3, 4) produced by the Illinois Natural History Survey (INHS) in conjunction with Illinois plat maps, USGS topographic maps, and the DeLorme Illinois Atlas and Gazetteer (DeLorme, 1996) to determine location and ownership of the randomly selected sampling points in each township. Although only one site will be monitored, multiple sites will often need to be visited before a site that is suitable and accessible for monitoring is located. It ultimately saves time to get ownership information for more than one site in a township before conducting site evaluations.

Once land ownership is determined, the owner's mailing address and/or phone number is identified. The field crew is usually able to locate landowners by searching a number of address databases on the Internet, county tax records, or by interviewing neighbors and relatives. Purported owners are contacted (either by phone, personal visit or sometimes by letter) to confirm their ownership, at which point the monitoring program is explained to them and access is requested. The field crew clearly states that this is a long-term program and that access is requested not only for one field season, but also for visits every five years. To document this agreement a standard letter of intent is given to the landowner (Fig. 5)

Although no legal or written agreements from landowners are required by CTAP, some owners require a written release from liability in the form of a signed landowner agreement (Fig. 6). Often, for sites that are publicly owned or owned by large corporations access or research permits are required prior to monitoring. Sites such as these are identified early so as to allow adequate time for the permits to be obtained.

Once access to a suitable site is obtained the assessment crew informally questions or presents a questionnaire to the landowner about historical land use practices at the site, current uses, and any plans for future uses (using guideline questions as in Fig. 7). If the landowner is not available or do not want to answer questions the questionnaire is left to be mailed later by the landowner (a stamped enveloped is provided).

Decisions occasionally must be made as to when to abandon unsuccessful efforts to locate or contact landowners, or to obtain permission to access sites. As mentioned in the previous section, the field crew rejects sites if the habitat is unsuitable, unsafe, or it is unreasonable to work in for any reason. Generally, a site will be rejected if the landowner cannot be contacted during multiple attempts over a month, their requirements for permission are unreasonable, or access is denied. The point at which efforts to obtain access become excessive is subjective, but the field crew strives for consistency in their determination of when this point is reached. The underlying objective is to employ a set of protocols that will avoid rejecting sites for subjective reasons, such as perceived habitat quality. When a site is rejected, the reasons for rejection are documented.

b) Site evaluations, ground truthing

Most site evaluations are conducted in late winter or spring. It is logistically untenable to conduct site evaluations during the field season, but problems can also arise by evaluating sites too many months before the field season. It can be difficult or impossible, for example, to assess vegetation characteristics during the dormant season, and the longer the time interval between assessment and sampling, the greater the probability of land use changes occurring at the site (such as logging).

When conducting site evaluations, the field crew gets as close as possible to the predetermined monitoring locations of the potential sampling sites as labeled on the GIS field maps. For forest and grassland sites, these locations are identified based on the best ability of the field biologists to locate the exact randomly identified coordinates depicted on the GIS field maps. These maps are often used in conjunction with USGS topographic maps and the Illinois Atlas and Gazetteer. For wetlands, the GIS randomly identifies patches of habitat (not specific coordinates) as potential sampling locations, therefore these sites are evaluated from the center of the wetland patches.

The extent and condition of the habitat at each site is evaluated based on the criteria in section 3 of this report (i.e., Habitat criteria for study sites) and the site characteristics are recorded on field data sheets (Fig. 8). In addition to serving as the mechanism for selecting study sites, the process of sequentially evaluating these sites also provides information useful for ground-truthing and evaluating the GIS/land cover map. Especially in the case of grasslands, it enables CTAP scientists to assist in determining the percentage of the State that is in a condition that is at least minimally acceptable for our monitoring criteria. Therefore, even if the site is unsuitable for CTAP monitoring, the characteristics of the sites are documented.

Safety and logistics of working at the sites are also evaluated during the site visit. Sites are rejected if they are determined to be unsafe or if it is logistically impractical to work on site (e.g., severe flooding, difficult access).

In all habitats, if the predetermined sampling location determined by GIS is not suitable but adjacent sites are suitable, then the exact sampling locations may be shifted slightly (by the following procedures outlined below) rather than rejecting the site.

c) Establishing a study plot
In terrestrial habitats, if the habitat at the predetermined monitoring location (i.e., the center point in forests, the center of the baseline in grasslands, or the center of the predetermined wetland area for wetlands) does not meet the criteria for sampling then:

- If the edge of an adequately sized patch of suitable habitat is located within a 150m radius of the predetermined monitoring location, then the monitoring location is moved into the newly identified patch (a distance just sufficient to conduct the sampling).

- If there is suitable habitat in more than one direction from the original predetermined monitoring location, then the location is moved into the closest suitable habitat.

- If suitable habitat occurs the same distance away from the location, in more than one direction, then the location is moved to the suitable habitat with the lowest compass bearing (e.g. if there is suitable habitat to the east [90^{o}] and south [180^{o}], the center point is moved to the east).

Sometimes only a small part of a suitable patch of habitat is within a 150m radius from the randomly selected monitoring location. In this case, the monitoring location is placed in that suitable habitat, but located at the closest distance that accommodates the minimum area required for the methods. This may result in a monitoring location that is more than 150m from the randomly selected location.

If the edge of acceptable habitat is not found within 150m of the predetermined monitoring location, and/or it is not possible to gain access to the site for long-term monitoring, then that site is rejected and point numbered "2" in the same township is evaluated. This process is continued until an acceptable site is found. If none of the randomly prioritized sites in a township are acceptable, then that township is rejected and evaluation begins in the next available randomly selected township.

Once the monitoring location is established, the study site is temporarily marked with flagging tape, later the site is permanently marked with metal tree anchors that are driven into the ground until they are flush with the surface (so they can not be tripped over). At a few sites owners have requested that tree anchors not be used, or that anchors not be located directly on center points. These exceptions are well mapped. Aluminum tags are tied to the anchor heads to identify the monitoring location and transect points at the site. The monitoring location and transects, as well as reference points, such as permanent fence posts, road intersections, bridges, etc., are recorded by a GPS (Global Positioning System) unit to assist in future relocation. A printout of the GPS points is used to generate a general map of the site.

d) Documentation
Records are kept detailing the characteristics of each site that is evaluated, regardless of whether the site is accepted or rejected. These records include information on landowner contacts (name, address, phone number, etc.) as well as site characteristics (vegetation type, obvious disturbances, etc.). All this information is recorded on a site assessment form (Fig. 8), and later added to a site identification and landowner database (see below).

This process of site evaluation and documentation provides data useful for a variety of purposes:

1) Because the potential sites are selected based on information in the Land Cover of Illinois database, the site evaluations provide a mechanism for ground-truthing the database to determine the accuracy of the land cover classification;
2) Because the randomly ranked sites are evaluated sequentially, site evaluations provide data not only on the proportion of sites that meet the criteria for acceptance in the CTAP monitoring program, but they can also be used in conjunction with information from the Illinois Land Cover database to determine the proportion of land in Illinois that meets these CTAP criteria.
3) The process of contacting landowners to gain access and evaluate sites provides information to assess the success rate and efficiency of program implementation (in terms of time investment). It also helps to learn more about the history and anticipated future use of the sites, and it provides addresses for sending landowners updated information about our activities and project results.

The following is documented for each site:

- On paper [ownership, address & phone, anecdotes about site use/history (landowner informal interview), site characteristics (e.g. age of current vegetation, vegetation type, disturbance)]
- Process of sequentially evaluating sites
- Reasons for rejection if site is rejected (no permission, unsuitable)
- Directions and maps to sites that will be monitored
- Aerial photos (if available, e.g., TerraServer.com)
- In the case of observance of threatened and endangered species, records are sent to Heritage Database

5) Plant Sampling Protocols

a) Forest Sampling Protocols

i) Establishing study plots
Vegetation is sampled in three 1/20th ha plots (50 x 10m) in each forest patch (one forest patch per township). The plots are laid out along 50m transects that radiate out from the site's center point at randomly selected compass bearings, starting at a distance of 10m from the center point (Figs. 9, 10). The transect bearing is determined by picking a random number between 1–360, with the constraint that no two transects can be closer together than 53°. This is to avoid overlap between the transects.

When laying a transect, the tape measure used is initially pulled taut, but then allowed to lay upon the ground at all points along its length, following the contour of the ground. At both ends and at the beginning of each 10m interval, a flag is temporarily placed in the ground. The center point and the beginning of each transect (0m) are permanently marked with a metal tree anchor buried in the ground. Aluminum tags are tied to each tree anchor to identify the center point and transects.

If a transect runs through a patch of uncharacteristic habitat it is relocated by choosing another random azimuth. Examples of uncharacteristic habitat include a habitat type different that the habitat type of the center point, garbage or other refuse, excavations, unnatural soil mounds, etc. Treefall gaps do not constitute uncharacteristic vegetation – they are included in the monitored transects (see Habitat criteria for study sites). If the transect crosses an interruption in vegetation, such as a stream or path etc., where more than one quadrat falls within the interruption, then the transect is terminated on the closest edge of the interruption and resumed, at the same point along the transect, on the distal side of the path.

ii) GPS data
A global positioning system unit (GPS) is used to record the exact latitude and longitude of the center point at each site where plants are monitored. The location of transects are also recorded (as line features).

iii) General site characteristics
At each site the field crew documents the general characteristics of the area around the center point of the plot. Most of these data are recorded on the data sheet in Fig. 11, and include the following:

- A classification of the vegetation community based on the Natural Areas Inventory categories (White and Madany, 1978). Categories used are shown in Table 1.
- A CTAP classification of the vegetation community modified from the Natural Areas Inventory categories.
- Additional plant species not recorded during the quantitative survey. This information is recorded on data sheets such as Fig. 12.
- Brief notes describing the type and extent of obvious disturbances in the study area, defined as a circle with a 60 meter radius from the center point. This information is used to

supplement the information gained from the landowner regarding the disturbance history of the site (Fig. 7).

- The general "health" of the forest, with comments on visible evidence of disease, insect damage, pollution, drought, etc.

iv) Slope and aspect

The general slope (i.e., % slope) and aspect (i.e., Azimuth) of the each transect is recorded. This is in reference to the general area that contains the transect(s) and quadrats, not necessarily the slope or aspect of the transect directly. In transects with considerable micro-topography throughout their length, an estimate or average of the overall or dominating aspect and slope conditions is provided. Slopes are measured in percent. Aspects are measured in degrees azimuth and are always taken facing downhill from the point where the slope was measured.

v) Photographs

Digital photos and/or 35mm slides are taken from the center point in the four cardinal directions (0^o, 90^o, 180^o, and 270^o). Photos are taken at eye level using the widest angle the camera lens will allow (generally 28mm). Pictures are taken with the highest F-stop and greatest depth of field light will allow. To avoid confusion about which site the photos depict, a photo is also taken of the site's data sheet after the habitat shots are taken.

vi) Ground cover (including woody cover < 1m tall)

The ground cover of vascular plants is estimated in ten 1/4m^2 square quadrats along each transect (Fig. 10). The quadrats are set every 5m along the transect, starting at the 0 point. Quadrats are placed 1 meter off the transect on alternating sides. The first quadrat is always placed to the left of the transect, the next to the right, etc. More specifically, plots are placed so they cover 0.0-0.5m on left, 5.0 - 5.5m on right, 10.0 - 10.5m on left, etc., at a distance of 1.0 - 1.5m from the center of the transect.

In each quadrat all herbaceous and woody (< 1m tall) species rooted inside the quadrat are recorded along with an estimate of cover for each species. To standardize cover estimates a modified Daubermire method is used (Bailey and Poulton, 1968; Abrams and Hulbert, 1987). Cover classes include: <1%, 1-5%, 5-25%, 25-50%, 50-75%, 75-95% and 95-100%. Percent cover estimates are also reported for various composite categories including total herbaceous cover (all vascular herbaceous species combined, but excluding moss and other non-vascular plants), total woody cover (for plants < 1m tall), all vegetation combined (woody and herbacous vascular plants), bare ground, leaf litter, and moss cover. In all cases, vegetation is only counted for individuals that are rooted in the quadrat, and vegetation will only be counted if it covers part of the quadrat while undisturbed. In other words, plants rooted in, but that are bent over so their cover is mostly outside the quadrat, will only be given a cover value based on the foliage that covers the quadrat where it lies naturally. Data on ground cover are recorded on data sheets similar to those in Fig. 13.

vii) Woody vegetation < 5cm dbh, but at least 1m

Woody plants and vine in the shrub layer are sampled in a 50m x 4m (Fig. 10) subplot centered along each transect. Each species is recorded along with a count of the stems, at least one meter tall and less than 5cm dbh (diameter breast height), rooted in the subplot. A stem is counted if it rises from ground level. Stems forking above ground level are counted as one rather than two. The stem counts for each 10m interval are kept separate as well the stem counts for the 0-1m and 1-2m on either side of the transect. These data are recorded on data sheets like Fig. 14.

viii) Woody vegetation ≥ 5cm dbh
Woody plants in the tree canopy and subcanopy layer are sampled in a 50m x 10m (Fig. 10) subplot centered along each transect. Each species is tallied by recording the dbh of each stem greater than or equal to 5cm dbh. A stem is counted along the edge of the plot if at least half the diameter of the stem is within the plot. Dbh classes are used when recording the data: 5-9.9cm, 10-14.9cm, 15-19.9cm, 20-24.9cm, 25-29.9cm, 30-39.9cm, 40-49.9cm, 50-59.9cm and 60cm and above. For those >60cm dbh observers record the exact dbh measurements. Similar to the shrub subplot stem counts for each 10m interval are kept separate. Fig. 15 is an example of a data sheet used to record these data.

ix) Big Plot
A species list is generated by carefully searching the entire 10m x 50m area centered around the third transect (i.e., 5m on each side of the 50m-long transect, usually the third transect) and recording every species encountered. Because of time constrains searching, collecting, and identifying specimens is limited to 30 minutes in the big plot. If conditions are unsuitable (i.e. storming, darkness, etc.) this information is not gathered. Fig. 12 is an example of a data sheet used to record these data.

x) Collection of voucher specimens
Specimens of all plants of questionable identity are collected (when possible outside the quadrat). Each specimen is given a unique collection number on the data sheet (Fig. 12). Collection numbers are assigned by using the site identification number as the first part of the number and then sequentially numbering each specimen collected for that day as the last part of the number. For example, the first plant collected at a forest site with a township number of 506 and a site number of 2 is given a collection number of 050602F-1.

Once specimens have been identified, each specimen is mounted on a herbarium sheet, labeled with the standard collection and location information (Fig.16), and deposited in the Illinois Natural History Survey Herbarium (ILLS).

b) Wetland Sampling Protocols

i) Establishing study plots

A baseline is placed along the edge of the wetland vegetation and parallel to the long dimension of the wetland. Either long edge is used for the baseline, but most often the edge used is the side that is most accessible. The baseline length is 50m long, unless the habitat patch is less than 50m long (Figs. 9 and 17). In the latter case, the length of the baseline is the length of the habitat patch. The center of the baseline is placed at the center of the length of the wetland. A 41m transect(s) is placed perpendicular to the baseline, running into the wetland. The 0 point of the baseline is permanently marked with a metal tree anchor buried in the ground. A point is randomly selected along the baseline from which a 41m transect is placed perpendicular to the baseline, running into the wetland. When lying the transect, the tape measure is pulled taut, but laid upon the ground at all points along its length.

Herbaceous vegetation is sampled in $1/4m^2$ quadrats at an interval of every 2m along the transect, starting 2m from the baseline. A total of 20 quadrats are sampled per site. Quadrats are placed 1m from the transect on alternate sides, starting on the left at the 2m point (e.g. the first quadrat covers the area from 2-2.5m along the transect, at a distance covering 1-1.5m left of the transect).

If there is not a sufficient amount of palustrine/emergent habitat on the first transect to run the entire length (i.e. < 41m), then the field crew returns to the baseline and runs another transect from a second randomly selected point along the baseline and continues as before. Transects are terminated when they reach open water with less than 30% plant cover or when the opposite end of the wetland is encountered. Transects are placed at least 8m apart and no closer than 4m from the edge of suitable habitat to accommodate insect sampling [i.e., a maximum of 6 transects on a 50m baseline]. If the length of suitable habitat on an additional transect(s) is greater than the length needed to finish setting all the quadrats, then the field crew picks a random distance along the transect to begin setting quadrats. For example, if 12 plots are set on transect #1 and the second transect is 30m long, then the first of the remaining 8 plots is placed at a randomly selected distance of 2 -12m from the start of the transect.

Plots falling into patches of uncharacteristic habitat due to a degradation factor are relocated (e.g. garbage dumped locally, excavations, unnatural soil mounds) by choosing another random number along the baseline. If the transect crosses an interruption in vegetation, such as a stream or path etc., where more than one quadrat falls within the interruption, then the transect is terminated on the closest edge of the interruption and resumed at the same point along the transect on the distal side of the path.

ii) GPS data

The coordinates of the baseline 0m point as well as the baseline and transects are recorded with a GPS unit. If the area of suitable habitat is about 10 acres or less then the boundary of the wetland is documented with a GPS unit. The boundary of any open water in the wetland is also recorded using a GPS unit if the extent of the open water is less than about 10 acres in size. For wetlands larger than 10 acres, part or all of the boundary coordinates may be documented with a GPS, depending on logistic constraints. In cases where GPS boundary measurements are not taken, notes are made on those parts of the wetland extending further in any direction and a site sketch is made.

iii) General site characteristics
Characteristics for the site encompassing the baseline and the longest transect are recorded at each wetland site and follow similar procedures to those already described for forest sites (see forest general site characteristics). The data sheet used for recording the general conditions of the wetland site is shown in Fig. 18.

iv) Slope and aspect
The general slope (i.e., % slope) and aspect (i.e., Azimuth) of the area containing the transect(s) are recorded. Generally this will correspond to the "tree subplot" and therefore the whole study site. Slope and aspect are measure as in Forests (see forest protocols).

v) Photographs
Digital photos and/or 35mm slides are taken of each site in each of the four cardinal directions (0^o, 90^o, 180^o, and 270^o) while standing on the 0m point of the baseline. For more detail, see the section on forest general site characteristics.

vi) Ground cover (including woody cover < 1m tall)
The ground cover of vascular plants is estimated in twenty $1/4m^2$ square quadrats along the transect (Fig. 17). In each quadrat all herbaceous and woody (< 1m tall) species rooted inside the quadrat are recorded along with an estimate of cover for each species. To standardize cover estimates a modified Daubermire method is used (Bailey and Poulton, 1968; Abrams and Hulbert, 1987). The following cover classes are used: <1%, 1-5%, 5-25%, 25-50%, 50-75%, 75-95% and 95-100%. In addition to estimating cover for each species individually, estimates for total percent cover for the composite categories of all species combined, all woody species, and all herbaceous vegetation are given. These data are recorded on data sheets like Fig. 19.

vii) Woody vegetation < 5cm dbh, but at least 1m tall
These methods are similar to those used at forest sites and the data sheet used is also similar (Fig. 20). For each species, the number of individual stems at ground level that are rooted within 2m on both sides of the transect(s) established for the quadrats are counted. The total length and portion of the transect(s) that is sampled is the same as that sampled with quadrats. Thus the total length of transect(s) sampled is 41m (i.e. a 4m x 41m area). Separate tallies are kept for the 0-1m and 1-2m distances from the transect(s). Woody vegetation data are recorded on data sheets like that shown in Fig. 20.

viii) Woody vegetation $\geq$ 5cm dbh
A plot is established with the dimensions of the length of the baseline and the length of the longest transect (usually, 50m x 41m). Each species is tallied by recording the dbh of each stem greater than or equal to 5cm dbh. A stem is counted along the edge of the plot if at least half the diameter of the stem is within the plot. Dbh classes are used when recording the data: 5-9.9cm, 10-14.9cm, 15-19.9cm, 20-24.9cm, 25-29.9cm, 30-39.9cm, 40-49.9cm, 50-59.9cm and 60cm and above. For trees >60cm dbh, the actual dbh is recorded. Tree data are recorded on data sheets like Fig. 20.

ix) Big Plot
A species list is generated by carefully searching the entire 50m x 41m area (or baseline x longest transect). All encountered species are recorded. In the case that more than one transect is used then the searching area will be the length of the baseline and the length of the longest transect. Because of time constrains searching, collecting, and identifying specimens is limited to 30 minutes in the big plot. If conditions are unsuitable (i.e. storming, darkness, etc.) this information is not gathered. Fig. 21 is an example of a data sheet used to record these data.

x) Collection of voucher specimens
Specimens of plants of questionable identity are collected and vouchered as described in the section on forest plant monitoring methods.

c) Grassland Sampling Protocols

i) Establishing study plots

If there is a sufficient amount of habitat suitable for sampling, the field crew sets a 50m baseline parallel to the shortest dimension of the suitable habitat patch (Figs. 9 and 17). If the patch is too narrow to run a baseline a distance of 50m, then it is still laid out as far as possible. The baseline is centered as closely as possible, on the randomly selected point (i.e. 25m on either side of the randomly selected point). For example, if the grassland is 70m wide and the random point is 15m from the edge, then the baseline would run 15m to the one edge and continue 35m on the other side rather than placing all 50m to one side. The 0 point of the baseline is permanently marked with a metal tree anchor buried in the ground.

If the baseline is in the middle of a large patch of suitable habitat, then to avoid bias, a coin is flipped to determine which side of the baseline the transect should run. A 41m transect is run perpendicular to the baseline at a randomly selected distance along the baseline. When laying the transect, the tape measure is pulled taut, and then placed upon the ground at all points along its length.

Herbaceous vegetation is sampled in $1/4m^2$ quadrats at 2 m intervals along the transect, starting at the 2m point on the transect. A total of 20 quadrats are sampled. Quadrats are placed 1m from the transect on alternate sides, starting on the left (e.g. the first quadrat covers the area from 2-2.5m along the transect, at a distance covering 1-1.5m left of the transect).

If there is not a sufficient amount of habitat on the first transect to run the entire length (i.e. < 41m), then the field crew returns to the baseline and runs another transect from a second randomly selected point along the baseline and continues as before. Transects are at least 8m apart and no closer than 4m from edge of suitable habitat [i.e., a maximum of 6 transects on a 50m baseline]. If the length of suitable habitat on an additional transect is greater than the length needed to set all the remaining quadrats, then the crew picks a random distance along the transect to begin setting quadrats. For example, if 12 quadrats are set on transect #1, and the second transect is 30m long, then the first of the remaining 8 quadrats is placed at a randomly selected distance of 2 -12m from the start of the transect. In small patches where the maximum number of randomly selected transects (6) running perpendicular to the baseline would be insufficient to sample 20 plots, then the baseline is placed along the edge of the habitat patch (rather than centered on the randomly selected sample point).

ii) GPS data

The coordinates of the baseline 0m point as well as the baseline and transects are recorded with a GPS unit. If the area of suitable habitat is about 10 acres or less then the boundary of the grassland is documented with a GPS unit. If the area is greater than 10 acres, only part of the boundary may be assessed and, additional notes and site sketches are made to describe the further extensions of grassland.

iii) General site characteristics

Characteristics for the site encompassing the baseline and the longest transect are recorded at each grassland site and follow similar procedures to those already described for forest sites (see forest general site characteristics). The data sheet used for recording the general conditions of the grassland sites is shown in Fig. 22.

iv) Slope and aspect
The general slope (i.e., % slope) and aspect (i.e., Azimuth) of the area containing the transect(s) are recorded. Generally this will correspond to the "tree subplot" and therefore the whole study site. Slope and aspect are measure as in Forests (see forest protocols).

v) Photographs
Digital photos and/or 35mm slides are taken of each site in each of the four cardinal directions (0^o, 90^o, 180^o, and 270^o) while standing on the 0m point of the baseline. For more detail, see the section on forest general site characteristics.

vi) Ground cover (including woody cover < 1m tall)
The methods used to sample ground cover in grasslands are the same as those used in wetlands and the data sheet used (Fig. 23) is also similar. The ground cover of vascular plants is estimated in twenty $1/4m^2$ square quadrats along the transect. In each quadrat all herbaceous and woody (< 1m tall) species rooted inside the quadrat are recorded along with an estimate of cover for each species. To standardize cover estimates a modified Daubermire method is used (Bailey and Poulton, 1968; Abrams and Hulbert, 1987). The following cover classes are used: <1%, 1-5%, 5-25%, 25-50%, 50-75%, 75-95% and 95-100%. In addition to estimating cover for each species individually, estimates for total percent cover for the composite categories of all species combined, all woody species, all herbaceous species, all graminoid plants and all forbs are given.

vii) Woody vegetation < 5cm dbh, but at least 1m tall
These methods are the same as those used at wetland sites, and the data sheet used (Fig. 24) is also similar. For each species, the number of individual stems at ground level that are rooted within 2m on both sides of the transect(s) established for the quadrats are counted. The total length and portion of the transect(s) that is sampled is the same as that sampled with quadrats. Thus the total length of transect(s) sampled is 41m (i.e. a 4m x 41m area). Separate tallies are kept for the 0-1m and 1-2m distances from the transect(s). Woody vegetation data are recorded on data sheets like that shown in Fig. 24.

viii) Woody vegetation ≥ 5cm dbh
These methods are the same as those used at wetland sites and the data sheet used (Fig. 24) is also similar. A plot is established with the dimensions of the length of the baseline and the length of the longest transect (usually, 50m x 41m). Each species is tallied by recording the dbh of each stem greater than or equal to 5cm dbh. A stem is counted along the edge of the plot if at least half the diameter of the stem is within the plot. Dbh classes are used when recording the data: 5-9.9cm, 10-14.9cm, 15-19.9cm, 20-24.9cm, 25-29.9cm, 30-39.9cm, 40-49.9cm, 50-59.9cm and 60cm and above. For trees >60cm dbh, the actual dbh is recorded. Tree data are recorded on data sheets like Fig. 24.

ix) Big Plot
A species list is generated by carefully searching the entire 50m x 41m area (or baseline x longest transect). All encountered species are recorded. In the case that more than one transect

is used then the searching area will be the length of the baseline and the length of the longest transect. Because of time constrains searching, collecting, and identifying specimens is limited to 30 minutes in the big plot. If conditions are unsuitable (i.e. storming, darkness, etc.) this information is not gathered. Fig. 25 is an example of a data sheet used to record these data.

x) Collection of voucher specimens
Specimens of plants of questionable identity are collected and vouchered as described in the section on forest plant monitoring methods.

6) Terrestrial Insect Sampling Protocols

Understory arthropods (with a primary focus on insects) are sampled in each terrestrial habitat at the same times and locations where plant sampling takes place. Information on establishing study plots and collecting location information and site characteristics are found in the previous sections on plant sampling (see Figs. 9, 17, and 26).

a) Sampling locations
Sampling involves the collection of insects on two parallel transects at each site. In the forest habitat, insect transects are placed 3m to each side of one of the three, 50m-long plant transects. Usually the first transect (the three plant transects are arbitrarily numbered) is chosen, but sometimes the insects are collected on the transect with vegetation most suitable for insect sampling. In wetland and grassland habitats there is only one, 41m-long plant transect, but in some cases the study site is so small that the plant transect must be broken into more than one segment. In these situations, the insect sampling is still generally conducted 3m to each side of the transect, with data collection interrupted between the segments.

If this process is to laborious depending on the vegetation structure an alternate sampling area may be identified (e.g., a line parallel to the baseline on side opposite to transects). In these situations, path of travel and area colleting are recorded (see next section).

b) Sampling methods
The collection methods used in each habitat are identical. Two standard sweep net samples are collected at each site and data about the sampling are recorded on data sheets similar to those shown in Fig. 27 (forest sites) and Fig. 28 (wetland and grassland sites). The collections are standardized by making 100 sweeps of the net in each transect sample. A stroke is one swing of the arm, to the left or right, in front of the collector as he or she walks forward. Usually, each swing of the arm would be accompanied by a step, so an insect transect is about the same length as the plant transect – 40 to 50 meters. However, it is the number of sweeps that is standardized rather than the distance sampled. The height and length of the sweep varies with the vegetation encountered, but usually the lowest part of the arch would sweep approximately along the top 1/2 meter of vegetation and the highest part of the arch would be about shoulder height. Once the net starts swinging it is kept in continuous motion so insects will not escape.

In situations where the plant transect is broken into more than one segment, the net is swept to the end of the first transect segment as described above, at which point the net is twisted closed to hold the arthropods already captured. The sampler then travels to the next transect segment and sampling continues until 100 sweeps are made.

The net is easily swept through most vegetation, but when vegetation is too prickly (i.e. *Rosa multiflora*, *Rubus* sp., or *Ribes* sp.*),* too dense, or too tall to sweep through, then the sweep path deviates around these into vegetation more suitable for sweeping. This may mean that the sweep path deviates away from the transect for a few meters, or that an alternate transect (or transect segment), other than the first is swept. On occasion, another location (which may or may not be a linear path) within the study other than a transect, such as unmowed strips or along the baseline in wetlands and grasslands, is swept. The study site is defined as the area forming a circle of

75m radius in forests and the rectangular area formed by the length of the baseline and longest transect in wetlands and grasslands.

Once the net is swept through the vegetation 100 times, the open end is quickly twisted closed with the hands. The insects inside the net are shaken into PTUIEs, Photo Tactic Utility Insect Extractors. The PTUIEs are used to separate insects from duff (leaves, seeds, sticks, etc.) in the field while the insects are still alive.

A PTUIE consists of a large plastic jar kept dark inside by applying layers of paint or black plastic and duct tape on the outside of the jar. A hole is cut into the lid of the jar. A straight sided, clear, 16oz.-soda bottle, with a corresponding hole in its side, is riveted and sealed with a hot glue gun to the lid of the large plastic jar. A whirl pac (plastic bag), one third full of 70% ethyl alcohol, is attached to and hangs down from the mouth of the soda bottle (Fig. 29). Insects are attracted to the light passing through the clear soda bottle, then drop into the ethyl alcohol in the whirl pac attached to the mouth of the bottle, thus separating themselves from the duff.

Insect sampling begins as soon as the plant transects of a site have been laid out. This allows the PTUIEs to be set up as long as possible while plant monitoring occurs. To begin the process, two whirl pacs are labeled with collection numbers, filled about one third full with ethyl alcohol and attached to the two soda bottles, which in turn are attached to the jar lids of the two large plastic jars. The two soda bottle assemblies and the large plastic jars are place separately in a shady place, safe from wind and foot traffic.

The insect sample from the sweep net is placed inside the large plastic jar of the PTUIE. The soda bottle assembly with the jar lid is replaced quickly without dumping the alcohol from the whirl pac into the jar. The assembled PTUIE is placed in the shade and on a stable surface that will allow the whirl pac to hang down lower than the large jar. It is allowed to sit a minimum of 30 minutes to allow the insects to move from the dark of the large plastic jar into the light of the soda bottle, and drop into the alcohol. Optimally, the PTUIE is allowed the sit until there is no more insect activity. This time length is effected by how many insects are in the sample and the type of duff they are moving through. The amount of time the PTUIEs are allowed to sit is recorded on the field sheet.

Once the sample is collected, the whirl pac bag is removed. The sample number is written on paper, with pencil, and placed inside the whirl pac. The top edge of the whirl pac is folded over three times and twist tied closed to create a nearly leak proof seal.

In their constant pursuit of food, spiders sometimes set up web traps in the lid opening, preventing them and other arthropods from dropping into the alcohol. The PTUIEs are picked up and gently tapped to nudge them down the soda bottle neck. Once the insects have stopped coming out of the dark jar and have dropped into the alcohol the PTUIE can be opened to remove the duff. An examination of the jar will reveal arthropods that never left the darkness. They will include small homopterans, which stick to the sides of the jar because of condensation. There will also be moths and other nocturnal arthropods. This failure to extract every arthropod swept into the net is acceptable in quantitative sampling because it is a consistent variable from sample to sample. The insects that remain in the jar are emptied with the duff. The PTUIEs are thoroughly cleaned out at the next site when the condensation has dried and any remaining material that was stuck to the sides of the jar is removed. After processing, all the samples are stored in vials of 70% ethanol and maintained for future study and possible inclusion into the permanent INHS insect collection.

Finally, if the vegetation is too wet due to rain nearly before plant sampling, insect sampling is not conducted.

c) Notes on sampling methods

Sweep sampling collects arthropods that travel on leafy understory vegetation. It under-samples terrestrial and bark dwelling insects, as well as many fast aerial fliers and canopy dwelling insects. Many arthropods have pronounced circadian activity patterns, so this method also under-samples most nocturnally active species. However, sweep sampling provides a good, easily quantifiable collection of arthropods and can be easily employed in all the habitats CTAP biologists are monitoring.

d) Collection numbers

Each collection is given a unique collection number on the data sheet (Fig. 27 and 28). Collection numbers are assigned by using the site identification number as the first part of the number and then attaching a number followed by the letter "I" to the site identification number. The collection from the first sweep, usually on the left side of the transect, is given the number one and the second, usually the right side of the transect, is given the number two. For example, the first sweep, at a forest with a site identification number of 050602F is given a collection number of 050602F-1I (see plant methods for an explanation of the generation of site identification numbers).

7) Bird Sampling Protocols

a) Requirements and yearly preparation
To be qualified to conduct CTAP bird monitoring, members of the CTAP field crew must be familiar with the songs and calls of all bird species likely to be encountered in Illinois. Each spring the observers review tape recordings of the calls and songs of Illinois species. Because about 90% or more of the birds detected are not seen, it is also critical that observers have good hearing. Hearing loss will seriously affect the census results.

Unlike sampling of other taxa, samples cannot be collected for later verification. Not only is it important to be able to identify all birds detected, but it is also important to be able to accurately estimate the distance to each bird detected. Small differences in estimated distances can lead to very different estimates of population density, thereby leading to higher variance estimates and lower statistical power to detect trends. This means that inter-observer differences in distance estimates could mask real trends in population density. Therefore, yearly efforts must be made to control for observer differences by having the observers spend time together calibrating their distance estimates. This is particularly important because the project is expected to continue longer than the tenure of any given member of the field crew. Quality control is a critical issue for CTAP bird monitoring, so the importance of yearly calibration cannot be overestimated.

Calibration of distance estimates is accomplished by having the field crew visit habitats of various densities. At each site the crew independently estimates the distance to various trees, shrubs, or other landmarks. They then compare their estimates to the actual distances as determined by a calibrated laser rangefinder. They continue this process until each of their estimates for distances of less than 50m are accurate to within 5m and their estimates between 50-100m are accurate to within 10m. Moreover, they should have at least 90% accuracy at estimating if distances are greater than or less than 50m, 75m, and 100m. This process is then repeated by estimating the distances to actual birds seen, and then birds that are heard but not seen (but whose location can be confirmed afterwards). Calibration takes some practice because different species are louder than others, and even the density of the vegetation or the humidity can effect how well sounds travel (in other words, how quickly signals decay), which effects perceived estimates of distance.

Finally, in addition to estimate distances, the observer has to be able to determine the direction of each bird species. Knowledge in the use of a compass is also essential.

b) Establishing census points
The size of the habitat patch where the study sites are located will vary. Therefore the number of bird census points that can be fit into a site may vary. Because of this, the number of points censused at a site is not standardized. A minimum requirement, however, is that one census point is always located at the center point of the site (the randomly selected point where plant monitoring is centered).

Although the center point (CP) is the only required census point and overlaps with the botanical center point, additional census points (up to a maximum of about 15 points) may be added. Once added, all these points should be censused during each subsequent census. These additional census points should be numbered consecutively (1,2,3, etc.).

In large forest patches these census points can be established along existing trails at 150m intervals. In small patches the points may be scattered through the forest (at 150m intervals) in whatever locations will maximize the number of points that can be fit into the forest patch. However, no point should be closer than 150m from any other point, and a point is made to stay 50 or more meters from the forest edge. When establishing these points, if time allows, the field observer locates the approximate census locations on the field map before entering the forest, and then attempts to find those predetermined sites by visiting the site. This will help avoid biasing the census by establishing points at what appear to be the best sites for birds. When establishing forest census points, it is important to stay within the forested habitat, however, small areas of other habitat types within the forest (e.g. small wetlands, areas of second growth) are still acceptable.

At wetland and grassland sites, similar procedures are used for placing census points, however, the points are not required to be 50 m from the habitat edge. This would be impossible in many cases because these habitat patches tend to be small in Illinois (see Grassland habitat criteria). In wetlands and grasslands sites, census points are placed 300 m apart due to the more open habitat.

A scouting trip is generally made to each site the day before conducting the census to find the center point and establish any additional census points. This saves precious census time in the morning.

Once census points are established, these same locations will be used for all subsequent censuses. Therefore, the location of the points should be accurately labeled on the field maps so that they can be located during subsequent visits. Since census points will not be permanently marked in the field, it is important to make notes of any information that will help to relocate them. For example, observers record the distance and direction to each point from the previous point, and they occasionally record the distance and direction to large trees, bends in a stream, trail intersections, or other recognizable landmarks. Field notes should be detailed enough so that another person would be able to find these sites. In addition, to the all field notes and maps for subsequent census points relocation, all point are GPSed.

c) Recording habitat data
Detailed vegetation data are collected at the center point by CTAP botanists. However, we would also like to know something about the habitat at each additional bird census point. CTAP ornithologists take note of the habitat type at each census point using the same classification as the botanists (Table 1).

d) When to census
Censuses should be conducted during the period of peak breeding activity when territorial males are singing, but after the spring migration period is mostly completed. In Illinois the acceptable period for censusing generally lasts from the last week of May through the third week of July, however, yearly weather fluctuations may shift this period slightly earlier or later. Because of the large latitudinal range encompassed by Illinois, it is most efficient for sampling to begin

earlier and end earlier down south, so an attempt is made to start in southern Illinois and proceed north until the breeding season has "caught up" in more northern areas of the state.

On any given day, the first point of a census (usually the center point) – should be censused as close to sunrise as possible (once it is light enough to identify birds visually). Because bird activity can drop off dramatically as the day progresses, the last point count should be completed no later than 4-41/2 hours after sunrise. No census point should be initiated later than 10:00 am, or should continue past 10:30 am, with the possible exception of 11:00-11:30 am on cool, overcast days.

e) Acceptable weather

For data to be comparable among census points and among years, censuses must be conducted under favorable weather conditions. There should be good visibility with little or no precipitation and light winds. Occasional light drizzle may not affect bird activity, but censuses are not conducted when there is heavy fog, steady drizzle or rain, or when wind speed exceed 12 mph (Beaufort scale of 4-5 – see Table 2. Weather conditions, including noise levels, are recorded for each census point.

f) Conducting point counts

Each point count lasts 10 minutes. From a stationary location at the census point, the observer records all (but only) the birds detected by sight or sound during the 10 minute period. The data are recorded directly onto the data sheets - tape recorders are not used for later transcription. A watch (preferably a stopwatch) is used to keep track of the time. The data sheet (Fig. 30) also provides space to record when the 3 minute, 5 minute, 6 minute, and 8 minute marks are reached during the count (see example data sheet). This is because monitoring programs often differ in the length of their censuses, and this will facilitate comparisons to those studies.

When conducting the point counts, absolutely no coaxing is allowed. Observers do not "spish", imitate calls, or use playback recordings: they remain entirely silent during the counts.

Observers record the direction and estimated distance to each bird, being particularly careful to note which birds are detected within or beyond 50 meters of the census point. Usually the initial distance to a bird is recorded. If however, the bird was initially farther away than 50 m, but subsequently moved closer than 50 m, the closer distance is recorded.

Often multiple individuals of one species will be detected. To help keep track of the number of individuals detected during a count, a column is provided on the data sheet to record the direction to each bird. The direction information is also helpful for determining if a bird heard at one census point is the same as one heard at a previous point. (For example, a bird heard 80 m to the north at one point may be the same as one heard 70 m to the south at the next point, if the next point is 150 m north of the first point). If the observer is absolutely certain a bird detected at a point count is the same individual detected at a previous point, then the bird is not counted again. Normally, the bird is recorded on the point that it is closer to.

The data sheet also provides space to record if the birds are or are not actually in the focal habitat patch. For example, observers may detect Turkey Vultures or Chimney Swifts flying over the forest, and loud birds such as Ring-necked Pheasants or American Crows in surrounding agricultural fields may be detected from within forest patches. Because these birds are not in the focal habitat patch, they are coded differently (Table 2). Birds flying over the census point should still be reported as occurring within 50 meters if they are within 50 m of the census point at any time while they are flying over.

For birds occurring in large flocks, a column is provided to record the number of individuals detected at a given distance and direction (Fig. 30).

Finally, although the purpose of the point counts is not to provide an inventory of birds at a given site, interesting birds are often detected before or after a point count is conducted, or while walking to the points. Even though these birds are not recorded on the point counts, they often provide important information about a site. Therefore, the data sheet provides space to record these additional bird sightings.

g) Playback tapes in wetlands

Point count censuses do not provide an equal opportunity for detecting all species of birds. Certain groups of birds will be under-sampled, including nocturnal species such as owls and nightjars, gallinaceous species such as turkeys, species that are often quiet (such as raptors), and other species that are often cryptic, such as some wader and other marsh birds. Using playback tapes in wetlands helps increase the probability of detecting many wetland species. Therefore, in wetland habitats, an additional census period is conducted after each point count is completed. Fourteen wetland species (Table 3) expected to be found in many "healthy" Illinois wetlands have been recorded on a cassette tape for a duration of approximately 1 minute followed by a pause of approximately 1 minute. This tape is played at each wetland census point and the response to any species on the tape is documented.

h) Additional grasslands and wetlands for bird monitoring

The site monitored for plants is always monitored for birds. For grasslands, if the plant site is less than 10 acres in size then a second site, if available, that is 10 acres in size or greater is monitored for birds. The same criteria used in the Grassland habitat criteria section are met for the second bird site, except that manicured airfields, some monocultures such as alfalfa and clover, or heavily grazed pastures are acceptable for bird monitoring. This is because these habitats may harbor significant grassland bird communities even though the sites are highly manicured and therefore not suitable for plant monitoring. In these grasslands point counts are conducted as previously described. In the case of wetland sites, many of the primary sites are small and degraded. If other, generally the largest, wetland sites are available in the target township, then some of those sites may also be monitored for birds. This depends to some extent on the time available. Extra bird sites are monitored using the same protocol as for the primary wetland sites, including the use of the playback tape.

II - Aquatic monitoring protocols: Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) (collectively, EPT taxa).

1) Selection of Random Stream Locations
Stream reaches were chosen for sampling at random from two scales. The first scale is at the level of the township, of which over 1700 exist in Illinois. CTAP chose 150 townships from this population (Fig. 31). The Illinois Streams Information System (ISIS, 1999; Fig. 32), a digital database of Illinois streams, was used as the basis for identification of stream reaches within a township. The database includes streams draining areas greater than 10 mi^2, based on USGS 1:100,000 scale data. Each stream is represented by discrete segments beginning and ending at the Public Land Survey section lines (those that demark sections on topographic maps) or at the confluence of streams. Stream segments contained within each township were randomly ranked to establish sampling priority (Fig. 33). Those with the lowest rank number were visited first to access them for suitability of sampling.

2) Acceptability of Stream Segments
Stream segments are acceptable for use if the following criteria are met:

- Reasonable access by road or short footpath is available. Moderate amounts of sampling gear are necessary for this work. Therefore, relatively short distances to the stream are advantageous for finishing sampling protocols in a timely fashion. Sites should require ≤30 min. walk to reach a sampling location from an existing road or footpath.
- The stream segment must afford safe entry into the streambed. Safe parking must be available. Moreover, streams must be wadeable to be safely and effectively sampled.
- No stream segment should be sampled immediately below a wastewater treatment outfall, or where a strong smell of sewage is evident.
- Moderate-to-severe flooding of a stream segment removes a segment from immediate consideration. This segment may be scheduled for a latter visit when floodwaters have receded. Alternatively, other suitable segments may be sought within the township.
- Sampling of the stream segment must be accomplished within a suitable biological window for the assemblage in question.
- The stream segment should be sufficient in size to support aquatic life throughout most years. Occasionally, no stream segments in a selected township hold water throughout the year. These are then rejected entirely, and another township is chosen and assessed for suitability.

3) Establishing a Sample Reach
Once a stream segment meets the above criteria, a specific sample reach is established. Frequently, more than one suitable access site is available due to multiple access points. Some guidelines are provide below that minimized bias in selecting the reach:

- The downstream-most road crossing is chosen whenever possible. This provided samples that reflected the whole of the segment, and increased the likelihood of flowing water throughout the year.
- Reaches on small streams are established at sufficient distances from the confluence with larger ones to avoid any influence of the latter (i.e. due to flooding).
- Reaches are established in habitat that is prevalent for the segment.

- Reaches are established no closer than 20 m from bridges, large culverts, or major drainage tiles. These structures may influence the local community by producing scouring of the streambed.
- Only naturally occurring substrates are sampled. Sampling of unnatural substrates (i.e. road building materials) where no coarse mineral substrates naturally occur may bias samples.

Sample reaches are approximately 100 m in bank length (meanders included). This distance is generally sufficient to provide a diversity of habitats including riffles, undercut banks, pools, and wood debris snags.

4) Geographic Referencing of the Sample Reach

Location information is recorded for the reach from 1:24,000 scale maps and from DeLorme Illinois Atlas and Gazetteer (DeLorme, 1996). Geographic coordinates are recorded on site using one of several makes of global positioning system or by obtaining coordinates from Delorme's® CD Street Atlas USA 2.0 (DeLorme, 2000). These locations are generally recorded from the middle of the reach. The following location information is gathered for each reach:

- seven digit unique site code
- county
- stream name (if unnamed, then recorded as Unn. trib. of the nearest parent stream)
- nearest permanent, small municipality (e.g., not Chicago or Springfield), straight line distance (in km) from center of town to reach, and 8 point compass direction from town
- principal meridian, township, range, and section numbers
- latitude and longitude in decimal degrees to 4 significant digits, longitude as negative number
- Illinois township number, rank, stream segment number

5) Photographs

Photographic documentation occurred at each sample reach to document landuse. A minimum of two photographs, usually facing upstream and downstream from the center of the sample reach, were taken. These photographs are archived in digital format to document changes in landuse over time.

6) Aquatic Insect Sampling Methods - Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) (collectively, EPT taxa)

a) Phenology of Sampling

Burks (1953), Frison (1935), Ross (1944), and INHS insect collection databases are consulted for information on the phenology of EPT species in Illinois. April 1 through 15 May provided the greatest diversity of EPT species. Even though adults of many of these species can be taken later in summer, the immature specimens (the object of sampling efforts) would be largely guaranteed to still inhabit streams across Illinois within this time frame. To control for differences in phenology along the great latitudinal span of the state, sampling began in southern Illinois and proceeded northward.

b) Sampling Protocols

EPT are sampled using a standardized, semi-quantitative, multi-habitat approach. This approach is designed to capture a large proportion of the EPT species found in wadeable streams, while also weighing time spent at each site and resources available for processing of samples. In Illinois streams, the greatest proportion of EPT species are taken in two general classes of habitat: high energy and low energy. High-energy habitats occur where water tumbles over hard substrates. These substrates included coarse gravel and cobbles (riffles) and woody debris (a.k.a. snags). In Illinois, snags and riffles supported similar EPT species, and are viewed as interchangeable. Some streams have abundant riffles, while others have snag habitat (where sand, clay, or silt were the predominant channel substrates). Low energy habitats included undercut banks, pools, vascular plants, and shallow runs. These support a subset of the riffle assemblage and fauna typical of slow water and root zone at the water/land interface. Undercut banks are the preferred low energy habitat type as they provide the most slow-water taxa. Hence, in most streams, riffles or snags and undercut banks are sampled. Occasionally, neither riffles nor undercut banks are available (as in recently ditched agricultural streams). In that case, runs provided the only habitat to sample.

i) High-Energy Habitats

Two riffle samples are taken from two separate riffles within the reach. The sample area is standardized to the dimensions of the dipnet bag (34 X 45 cm) superimposed upstream of the dipnet. Larger mineral substrates are washed to dislodged taxa into the net. Cobbles are inspected visually for tightly adhering taxa, then discarded. Finer substrates are turned by hand, then kicked using the foot to dislodge taxa deep in the sediments.

Two snag samples, limbs 2-10 cm in diameter and approaching 3 m in total length, are collected from flowing water areas. Entrained leaf packs associated with snags are not partitioned from the wood. The wood and associated debris are dislodged into the net. Large debris are inspected for cryptic taxa, washed, and discarded until a relatively small volume remains in the net.

ii) Low-Energy Habitats

Two bank samples are collected from current-swept banks where the exposed roots of trees or grasses are abundant. The dipnet is thrust to the bottom of the bank into fine sediments, which are disturbed by foot. The net is progressively moved up the bank in the rooted zone and substrates variously kicked and pulled free into the net.

Two aquatic vascular plant samples are collected when no bank habitat is available. This is accomplished by pulling all vegetation from a 34 X 45-cm area. These are placed in the net for latter inspection. Kicking of the sediments in the sample area dislodged organisms that flowed into the net.

c) Habitat Quality Assessment

Values for over 50 variables are recorded during each stream visit. This information, recorded in a standardized form (Fig. 34), tracks information as varied as location, date and time, stream identity and size, sediment and water characteristics, and a 12-point habitat quality rating system. This form is adopted from various USEPA documents (Barbour et al. 1999 and Plafkin et al. 1989). Conditions are assessed for the 100-m stream reach only.

d) Water Chemistry
All water chemistry and temperature values are obtained using a Solomat 520-C multiparameter meter. This instrument is calibrated daily as per manufacturer instructions. Measurements are taken from upstream of sampled habitat to ensure that sampling activities do not interfere with instrument readings.

e) Sample Processing, Vouchering of Specimens
All EPT specimens are picked while in the field. Sample debris from each replicate is placed in a white tray and flooded with water. Specimens are deposited in 80% EtOH. All EPT specimens are identified to species where possible, stored in separate vials, and labeled with the location information summarized above. These vials are deposited in the INHS insect collection as a voucher of the taxa present at each site.

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IV - Tables and Figures

a) Terrestrial monitoring protocols

i) Figures

ii) Tables

b) Aquatic monitoring protocols

i) Figures

V - Appendix

Logistics for using EPT to indicate stream health

CTAP assessment of wadeable streams is heavily based on the condition of biological communities. Assessment of near-stream habitat quality and measurement of several *in-situ* chemical and physical parameters provide additional that may help to identify specific stress agents causing impact. Barbour et al. (1999) discussed some of the strengths of using biological communities to assess stream health:

- They are a reflection of the ecological integrity (the protection of which is a primary goal of the Clean Water Act) of the stream
- They integrate the effects of different stressors, providing a broad measure of their aggregate impact
- They integrate stressors over time and provide an ecological measure of fluctuating environmental conditions
- When compared to the cost of assessing toxic pollutants, sampling of biological communities can a be cost effective
- The health of some biological communities is of direct public interest (e.g., commercial and sport angling)
- Biological communities may provide the only practical means of evaluating some impacts due to the lack of specific criteria (e.g., habitat degradation due to flooding caused by change of hydrologic regime)

Aquatic Macroinvertebrates as Indicators of Stream Condition

The use of aquatic macroinvertebrates (in most situations, dominated by insects) as indicators of water quality has increased dramatically in the past two decades, and the widely recognized effectiveness of this assemblage for detecting impairment in streams and rivers ensures its continued use (Davis and Simon 1995, Loeb and Spacie 1994, Barbour et al. 1999, Rosenberg and Resh 1993b). Several reasons for using aquatic macroinvertebrates are summarized from Rosenberg and Resh (1993a) and Barbour et al. (1999):

- They occur in all streams and within nearly all microhabitats
- A large number of species offer a wide range in responses to environmental stresses
- They are sedentary, permitting effective spatial analysis of pollutants and disturbance effects
- They have long life cycles, allowing investigation of temporal changes cause by perturbations.
- Sampling requires few personnel, inexpensive gear, and produces only minimal, short-term impacts upon the community
- They are the food base for most vertebrates found in streams.

EPT as Indicators of Stream Condition: In order to reduce the cost and effort associated with sampling the entire assemblage, CTAP has elected to use three orders of aquatic insects as indicators of condition: the Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) (collectively, EPT taxa). These often contribute the major proportion of the abundance and species richness to the aquatic macroinvertebrates assemblage found in streams. EPT taxa richness (number of unique types in a sample, but may be identified only to the genus level), is one of the most efficient indices of stream condition. The history and usefulness of EPT taxa was recently summarized by Lenat and Penrose (1996). Lenat (1993) found that quality ratings based on the EPT index varied predictably across Mountain, Piedmont, and Coastal Plain Ecoregions in North Carolina. Wallace et al. (1996) reported that EPT richness correlated well with several measures of stream ecosystem function (e.g., nutrient processing) and demonstrated that it could assess habitat-specific impact. Barbour et al. (1992) stated that EPT taxonomic richness varied much less than total invertebrate richness, density, or biomass estimates. They concluded that the EPT index was relatively easy to obtain, and that it was one of the simplest indices for non-biologists to use and understand. Additionally, numerical disturbance/pollution tolerance values, indicating the relative sensitivities, exist for many EPT (and other macroinvertebrates) taxa resident in the upper Midwest (Hilsenhoff 1987) and are summarized for elsewhere in the U.S. by Barbour et al. (1999).

Additional reasons for adopting EPT taxa is the INHS' long and distinguished history of research on the systematics, ecology, and distribution of these insects. State identification manuals exist for all three orders (Burks 1953 for mayflies, Frison 1935 for stoneflies, and Ross 1944 for caddisflies). These were the benchmark works of their time, and in some instances still serve as the regional standard. Most specimens associated with these statewide treatments still reside in the insect collections of the INHS. This allows confirmation of specimens by directly comparison to type or authoritatively identified specimens. Data capture of some 710,000 EPT specimens has just been completed, permitting a rapid comparison of present data with that collected before the worst degradation of Illinois streams took place. These databases have increased the efficiency of evaluating of losses in EPT species across the state (DeWalt et al. 2001, DeWalt et al. 2002, Webb and Harris 1993). A web-based EPT database is available at www.inhs.uiuc.edu/cbd/EPT/index.html.

Ecological Indicators Derived EPT Assemblages: EPT samples do not automatically constitute environmentally informative data. While knowing the environmental requirements of certain species may lead to their use as indicator organism, often there is not enough information about each species to use them as a predictive tool. Most stream biologists today rely upon numerical ecological indicators, with known statistical properties, to make sense of sample data. Below is a summary of the metrics and multimetric indices used by CTAP to monitor stream condition.

EPT	
Species Richness	decrease
Taxa Dominance (proportion of individuals devoted to single most abundant taxon)	increase
Hilsenhoff Biotic Index (HBI)	increase
Physical/Chemical Parameters	
Habitat Quality Index	decrease
Temperature	mostly increase
Dissolved Oxygen	decrease/increase
PH	decrease/increase
Conductivity	increase

Habitat destruction and degradation drastically reduce livable space for aquatic organisms. This, coupled with nutrient enrichment and siltation from farm fields and residential and industrial construction sites has done the most damage to aquatic systems (Karr et al. 1986). Measurements of habitat quality are important in estimating the potential for healthy aquatic communities in a stream system. For example, an increase in water temperature may indicate agriculture land or an urban area near the stream. This may lead to the loss of cool water species. Dissolved oxygen in Illinois streams can vary from supersaturated conditions brought on by heavy algal blooms during daylight hours, to hypoxic conditions in the early morning hours. The latter may result from high loadings of organic material from human and livestock sources, from demand by the heavy blooms of algae, or may occur naturally due to slow flow or autumnal leaf fall. Low oxygen may limit some species presence in a stream, especially those lacking well developed gills and summer diapause of eggs or larvae. pH generally is near neutral in most Illinois streams. Some mine drainage can depress pH in coal mining areas of the state. High pH can result from increased photosynthesis in agricultural (cleared riparian zone) streams, through dissolution of naturally occurring calcareous bedrock, and through industrial wastes with high pH.

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APPENDIX 7

USEPA Wetland Bioassessment Fact Sheet 5 –

Developing and Index of Biological Integrity

Developing an Index of Biological Integrity

United States Environmental Protection Agency	Office of Water Office of Wetlands, Oceans and Watersheds (4502-F)	EPA843-F-98-001e July 1998

Wetland Bioassessment Fact Sheet 5

One method to assess biological integrity of wetlands is to develop an index of biological integrity (IBI) for an assemblage of wetland plants or animals. An IBI is made by combining several biological indicators, called metrics, into a summary index. A well-constructed IBI that can allow scientists to: (1) measure condition, (2) diagnose the type of stressors damaging a wetland's biota, (3) define management approaches to protect and restore biological condition, and (4) evaluate performance of protection and restoration activities.

FOUR STEPS TO CREATE AN IBI

1 Select an Assemblage	2 Test and Evaluate Metrics	3 Combine Metrics into an IBI	4 Test and Validate IBI

1 Select an Assemblage

An assemblage is a group of plant and animals that are combined to form a larger group. Common wetland assemblages include:

- VASCULAR PLANTS

- AMPHIBIANS
- BIRDS
- ALGAE
- MACROINVERTEBRATES (snails, insects, clams, crayfish, etc.)

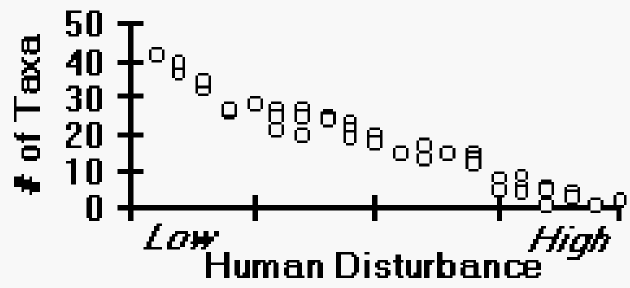
2 Test and Evaluate Metrics

A metric is a measurable component of a biological system with an empirical change in value along a gradient of human disturbance Scientists can measure many biological attributes of wetlands such as the diversity of amphibians or the number of pollution-tolerant insects. Some of these attributes will provide valuable information about biological integrity and other attributes will not. The goal is to identify **metrics**, which are attributes that show an empirical and predictable change in value along a gradient of human disturbance. The gradient of human disturbance can represent the amount of logging, agriculture, development, impervious surfaces, or other land use or activity in a watershed, or some combination of land use, depending on the purpose of the bioassessment. An example of a metric is taxa richness of macroinvertebrates (the number of taxa of insects, snails, clams, crayfish, etc.). Several states have found that macroinvertebrate richness decreases as a wetland is degraded by human activities.

(**Figure 1**). For illustrative purposes, Figures 1-5 were developed using hypothetical data, but are based on figures that were provided by Dr. James Karr (University of Washington). As Figure 1 shows, there is a clear response to increasing human disturbance and this attribute could be used as a metric.

A metric is a measurable component of a biological system with an empirical change in value along a gradient of human disturbance

Figure 1: Macroinvertebrate Taxa Richness of 40 Wetlands



In contrast, total abundance of macroinvertebrates is often more dependent on natural environmental variability of wetlands and does not show a reliable change in response to human disturbance (**Figure 2**). As Figure 2 shows, there is no clear response to increasing human disturbance and this attribute would not be useful as a metric. In these two examples, total taxa richness of macroinvertebrates could serve as a metric and total abundance could not.

Figure 2: Total Macroinvertebrate Abundance of 40 Wetlands

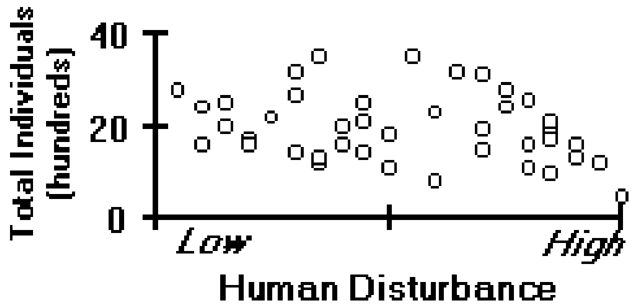
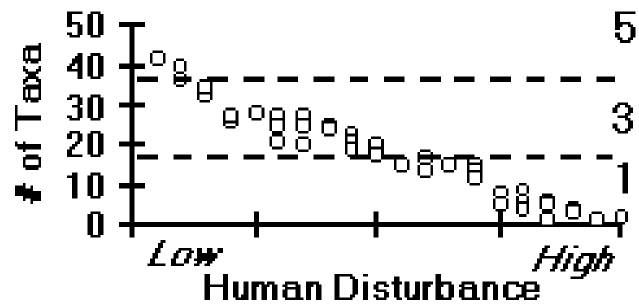


Figure 3: Macroinvertebrate Taxa Richness of 40 Wetlands



3 Combine Metrics into an IBI

Typically, an IBI is formed by combining at least 7 metrics from one biological assemblage. One approach of combining metrics into an IBI is to assign scores of 1, 3, or 5 to the metrics according to how they respond to human disturbances. For example, the diversity and richness of macroinvertebrate taxa may consistently decrease with increasing human disturbance (**Figure 3**). In this case, we could assign a score 1 to indicate poor conditions, 3 to indicate moderate conditions, and 5 to indicate minimally impacted conditions (**Figure 3**). Another metric, the relative abundance of tolerant

Figure 4: Percent Macroinvertebrate Tolerant Taxa of 40 Wetlands

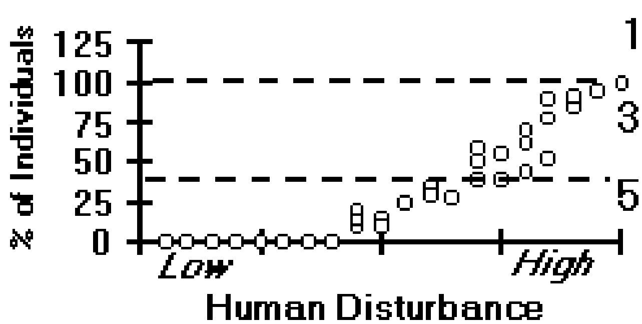
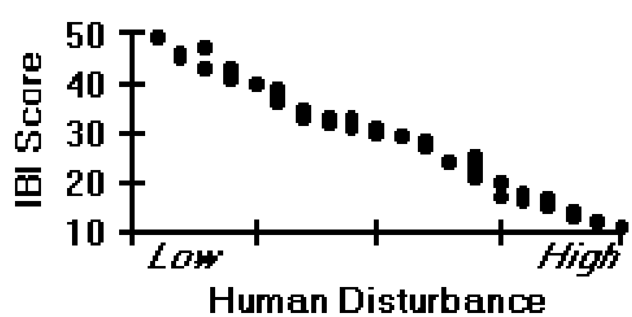


Figure 5: Index of Biological Integrity Scores of 40 Wetlands



taxa [(number of tolerant individuals in sample) / (total number of individuals in sample) x 100], may increase with increasing human disturbance (**Figure 4**). In this case, a wetland dominated by tolerant taxa would receive a low score and a wetland with a small percentage of tolerant taxa would receive a high score .

If 10 metrics were scored in this manner, then the scores could be added together to form the index of biological integrity (IBI) with potential scores ranging from 10 (maximally impacted) to 50 (minimally impacted). The IBI scores should form a relatively straight line when plotted against the gradient of human disturbance (**Figure 5**). Sometimes there will be scores that are far from the line which should be investigated. More often than not, an outlier is either the result of (1) misclassifying the wetland or (2) a stressor, such as acid mine drainage, that is damaging the wetland biota and was not captured by the gradient of human disturbance.

4 Test and Validate IBI

After developing the IBI, the scientists would then test the IBI to see if it accurately detects the effects of human disturbances on the biological assemblage. One approach is to (1) randomly split the data into two halves, (2) develop the IBI on one half of the data, and (3) test the IBI on the other half of the data. The results should be similar. Scientists can also test the IBI on more than one gradient of human disturbance. For example, the scientists may first develop the IBI with a gradient such as the percent of a watershed that is logged. During subsequent years, they could test the same IBI across another gradient of human disturbance, such as percent of watershed with impervious surfaces or distance of wetlands to nearest road or farm field. Some metrics will consistently show clear patterns regardless of the type of human disturbance used on the X axis.

After testing and validating the index, they could directly measure the health of similar wetlands without having to measure every attribute. They would only have to measure the ten metrics and some basic chemical and physical characteristics of the wetlands to help diagnose the type of stressor(s) damaging wetlands and to develop plans to reduce the impacts. When reporting results of a bioassessment, the IBI score should always be accompanied by a narrative description of the overall site condition, scores of the individual metrics, and a narrative descriptions of each metric as compared to conditions found in reference wetlands of the same type and region.

Previous Index Next

APPENDIX 8

U.S. Environmental Protection Agency, 2007, Wetland Development Program Grant proposal: Creation of a Wetland Index of Biotic Integrity for the State of Illinois, submitted by the Illinois Natural History Survey

Project title:

Creating an Index of Biological Integrity (IBI) to Monitor and Assess Illinois' Wetlands

Applicant:

The Board of Trustees
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Geographic Location:

Illinois

Total Cost:

$264,015 (requested 196,750)

Abstract

We propose to develop an Index of Biological Integrity (IBI) for Illinois wetlands. We will use data from the Illinois Natural History Survey's Critical Trends Assessment Program (CTAP) on >200 Illinois wetlands gathered since 1997 to develop the IBI. It will then be used to create a standardized statewide Bioassessment Protocol capable of scoring and ranking wetlands based on their relative impairment. Through this process we will better understand the specific factors responsible for wetland degradation.

Project Description

Introduction

Wetlands, Policy, and Conservation

Jurisdictional wetlands are largely protected by law, but many are highly impaired. Understanding the condition of wetlands is important to achieving both regulatory and conservation goals. From a regulatory perspective the Clean Water Act mandates maintaining and restoring the physical, chemical, and biological integrity of the waters of the United States (33 U.S.C. Section 1225). These three components of integrity determine the ecological status or ecological integrity of wetlands (See section: *IBIs as compared to assessment's of biologic, chemical, or physical integrity* below). From a conservation perspective, over 90% of the Midwest's wetlands have been destroyed, while the biological integrity[1] of most of the remaining wetlands is poor (i.e., they are impaired). An example of one of the many conservation related consequences from poor biological integrity and lack of suitable wetland habitat is the widespread listing of wetland species on state or federal endangered species lists. Thus, tracking and monitoring wetland conditions over time has become necessary for many reasons, and many states are in the process of creating wetland monitoring programs [for a summary see Table 1 (U.S.E.P.A. 2002b); and http://www.epa.gov/owow/wetlands/bawwg/case.html].

Illinois

While Illinois has a long and formative history in natural areas assessment and protection (Schwegman 1973; White 1978; Swink and Wilhelm 1979); and in fact the Illinois Natural History Survey is the birthplace of IBIs (Karr et al. 1986; Taft et al. 1997), it has yet to develop a scientific, repeatable system, which objectively scores and ultimately ranks its wetlands. The ability of other states to assess their wetlands with multi-metric bioassessments has produced significant benefits. Wetlands managers, policy makers, and conservation practitioners now have scientifically based tools for wetlands assessment and monitoring—and once these data are available they may serve a multitude of uses. Thus, Illinois would gain immensely by developing a widely applicable system to monitor and assess the condition or ecological/biological integrity of its wetlands.

IBIs as compared to assessment's of biologic, chemical, or physical integrity

There are several ways to conduct wetlands bioassessment. These approaches include IBI's (Indices of Biotic Integrity), HGM (HydroGeoMorphic), Rapid Assessment Methods (RAM), advanced statistical approaches, and hybrids or combinations of these (Sutula et al. 2006). It is becoming apparent, especially given limited resources, that the

[1] Biological integrity has been defined as ''. . . the capability of supporting and maintaining a balanced integrated, adaptive community of organisms having a species composition, diversity and functional organization comparable to that of natural habitat of the region Karr, J. R. (1981). "Assessment of biotic integrity using fish communities." Fisheries **6**: 21-27.''.

easiest and most cost effective way to assess terrestrial wetlands is by tracking the status of their biotic communities through multi-metric, multi-taxa bioassessment (U.S.E.P.A. 2002c). Specifically, highly cost effective and comprehensive information can come from IBI data. The assumption is that if a wetland's biological condition measured by the IBI is good, innumerous wetland functions, watershed services (e.g., flood storage), chemical (e.g., water quality) and physical habitat properties will also be acceptable.

Beyond their efficiency, multi-taxa IBI's are ideal because they can bridge incongruencies between policy goals, which are typically related to human freshwater use, and conservation goals related to biological integrity of terrestrial wetland communities. For example, in some cases, commonly used water quality measures (e.g. dissolved oxygen, nitrates, etc.) used to set as goals for freshwaters, will not indicate a high-quality reference wetland community (Karr 1995). Similarly, regular sedimentation and nutrient influxes naturally characterize floodplain forests, while relatively low dissolved oxygen values characterize many swamps and marshes. These typical water quality monitoring criteria would misrepresent a wetlands natural quality as poor—when it may actually be healthy and undisturbed (for a recent study and review of wetlands, ambient nutrient levels, and nutrient monitoring in the agricultural Midwest see Craft et al. 2006). There is no reason however, that additional characteristics such as water quality, other hydrology data, and/or physical habitat properties (e.g. wetland area) can not supplement biological information, and be incorporated into final wetland scoring/ranking bioassessment.

While IBIs in general have commonly been applied to aquatic systems there have been surprisingly few created for wetlands, a habitat that has an obvious "…legal, policy and scientific need to assess wetland condition and develop ecological performance goals for wetland creation, restoration and enhancement."(Mack In Press). If done well, a wetland IBI can be used to judge the effectiveness of mitigation projects, prioritize restoration and conservation projects, and address many other regulatory and conservation issues. Therefore, we propose using biological data to create an IBI, which can then form the core of an Illinois wetland bioassessment.

Goals of this project

1. To create and test a multi-taxa IBI, which accurately scores the wetlands of Illinois across their entire gradient of human disturbances.

2. To create a bioassessment scoring system using this IBI that is easily understood, implemented, and communicated across all levels of government, non-government sectors (e.g., environmental consulting firms), land managers, and the public, to rank Illinois wetlands. We will attempt to control for differences in wetland type and geographic location with a simple ranking system that creates relativized scores, which are comparable across the states wetlands.[1]

[1] This step will complete what is what is commonly referred to as "Level 3", in a statewide monitoring and bioassessment program. Level 3 creates and then summarizes highly detailed, information intensive, reference level assessments. These provide the basis from which Levels 1 & 2—GIS/Remote Sensing based and Rapid Assessment based methods, can be created and calibrated, thereby completing a comprehensive 3 tier Wetlands Bioassessment Program.

3. To produce a more comprehensive understanding of the relationship between physical features, human disturbances, and wetland flora and fauna communities; so as to better understand the causal mechanisms of wetland impairment in Illinois.

Methods

Because the most important and largest part of our proposed Wetland Bioassessment Protocol is creating the IBI, the majority of methods that follow (Steps 1-4) will focus on its creation. Furthermore, the most significant hurdle in creating the IBI, and therefore, the most significant hurdle in the entire process is the collection of vast amounts of data necessary for the critical Step 1 (below). Data must be collected on a variety of different variables and taxa at a large number of wetlands. Over the past 10 years the Critical Trends Assessment Program (CTAP) has biologically sampled and re-sampled over 200 wetlands throughout Illinois (http://ctap.inhs.uiuc.edu/). Because these data are collected in a scientifically rigorous, standardized fashion, they are highly suitable for an IBI. Therefore, a large part of the IBI creation process has been completed. Much of what follows in the methods are descriptions of how the resultant CTAP data will be used. CTAP methods are thoroughly documented (Molano-Flores 2002), available online http://ctap.inhs.uiuc.edu/mp/monitoring.asp, and therefore, only those that are directly relevant to the IBI creation will be addressed in this proposal.

Step 1. Establishing Biological Responses of the Wetlands Across a Human Disturbance Gradient

This first step in the IBI creation process can be further divided into four steps

A) Categorizing wetlands

When developing a bioassessment method, a preliminary goal is to "… establish classes of wetlands that have similar biological communities that respond similarly to human disturbances" (U.S.E.P.A. 2002c). By wisely grouping the wetlands to be monitored, you avoid "comparing apples to oranges". There are any number of categorization schemes that have been used for wetlands, but most bioassessments modify and combine existing classifications to suit their own purposes (e.g. they may consider Vegetative Communities, HydroGeoMorphic classes, Geographical and Physiographical Regions, Human Usage Categories). The process of grouping and splitting wetland types to more accurately fit and describe the biological data is an "iterative process" that changes as the data reveal patterns. With this is mind, our preliminary conceptual organization will be the following three categories:

- **Palustrine emergent wetlands**. These include riverine, depressional, and in some cases lacustrine and impoundment fringe wetlands where there is a broad enough littoral zone for wetland development. The hydrology of these wetlands range from wet-mesic prairies and wet old fields that may barely meet jurisdictional wetlands criteria by being saturated for only a short time during the year, to marsh and hemi-marsh communities, which can be inundated nearly year-round.
- **Palustrine forested wetlands**. These are primarily floodplain or bottomland forests hydric enough to meet jurisdictional wetlands criteria. These must have at least 75% tree canopy cover.

- **Groundwater wetlands**. These are a variety of wetlands that are primarily groundwater fed. They include bogs, fens, seeps, and some coastal (Lake Michigan fringing) wetlands such as Pannes.

As such, this is not a geographical approach, but rather it is a habitat based, with some hydrogeomorphic considerations. Geographic variation (primarily a latitude gradient in Illinois) will be accounted for during the calibration of the bioassessment scoring system. The first two categories in the classification scheme loosely correspond with CTAP sampling methods (Molano-Flores 2002), which are based primarily on obvious physiognomic physical characteristics of the dominant vegetation (i.e., amount of tree cover), while the third group accounts for rather anomalous wetlands in Illinois that are rare, often small, and are probably less affected by landscape level human disturbances. Despite its large size, much of Illinois can be considered rather homogenous and gradational with respect to its highly glaciated, largely agricultural landscape. The net result being that the overwhelming majority of the state's wetlands are identified by the Illinois Wetland Inventory as one of the first two categories. This is as opposed to some other statewide wetland bioassessments, which because of dramatic eco-regional distinctions, are best suited to a geographical approach (see Minnesoata http://www.pca.state.mn.us/water/wetlands/cwamms.html; Eggers and Reed 1997).

There are in some instances wetland communities such as marshes and sedge meadows that grade into a seep community, and as such are both ground water fed and run-off/rain fed (Schwegman 1973). Similarly, there are wetlands of an intermediate successional state, that if allowed time would change from an emergent to a forested wetland (not to be confused with the more stable "Shrub Wetland" community type). Such overlap is unavoidable, and in such cases, care will be taken to best place the wetland. This functional classification scheme is in-line with what similar midwestern states have deemed most appropriate for their bioassessments based on advanced statistical tests of floristics (Mack 2004; Mack in Press). Although, it should again be noted that our groupings will be refined and may change as the process develops.

B)Biological assemblages we will monitor

There have been many taxa groups used for IBI's, each having their strengths and weaknesses (Table 2 summarizes commonly chosen groups U.S.E.P.A. 2002c). In our case, we will build the IBI based on existing data collected by CTAP on birds, terrestrial arthropods, and vascular plants.

- Plants are an obvious choice as indicator taxa to measure biological integrity and create an IBI. They are large, obvious, sensitive, diverse, often long lived, well studied, and cost effective to sample (U.S.E.P.A. 2002d). Plant based IBIs and Biological Integrity Assessments have been shown to work well in midwestern wetlands, as well as other regions (Brooks et al. 1998; DeKeyser et al. 2003; Matthews 2003; Mack 2004; Herman 2005; Jones 2005; Reiss 2005; Nichols et al. 2006; Rothrock et al. 2007).

- Terrestrial arthropods are largely untested as ecological indicators in wetlands. Aquatic macroinvertebrates are well studied, and like fish they are affected by water quality. But, the obvious hurdle to their widespread use in wetlands monitoring is that many wetlands do not have standing water in them for much of the year. Therefore, if shown to be sensitive, terrestrial insects would prove another very useful tool in wetland IBI applications. Although they have yet to be incorporated into a formal wetland IBI, several independent studies, as well as preliminary analyses using CTAP data suggest that they contain enough information to be sensitive bioindicators (Dietrich and Biyal 1998; Adamus et al. 2001). Furthermore, relatively course taxonomic distinctions (e.g., morphospecies) or even biomass may provide enough information to overcome the primary obstacle to their use-- the absence of trained entomologist for species identification (Buffington and Redak 1998; Alvarez and Cushman 2002; Tallamy 2004).

We know of only two examples of IBI creation based on terrestrial arthropods. Kimberling et al. (2001) were able to develop disturbance estimates by using past land-use histories for 25 sites in eastern Washington. They categorized each site coarsely into undisturbed or disturbed and further subdivided disturbed sites into those with mechanical disturbance, those with past agriculture, sites where buildings once stood, or sites used to dump toxic chemicals. Given the known history, each site was also scored based on the extent, time, frequency, and impact to soil of the disturbance. Given this ranking, they successfully developed an IBI using metrics from the arthropod community. A subsequent study using similar scoring criteria showed concordant results suggesting a successful set of metrics (Karr and Kimberling 2003).

- Though birds are rarely used in IBIs, and despite sometimes conflicting disturbance response signals, there is evidence that their contribution to multi-metric wetland IBI's can not only be strong, but it can be novel when compared to species assemblages such as amphibians, plants, diatoms, or fish (Brazner et al. 2007). For example, because they are so intimately tied to habitat structure many marshes which are dominated by cattails or other large macrophytes, may score relatively low in botanical diversity, yet be relatively high-quality bird habitat. Therefore, despite birds insensitivity to many stressors and disturbances, their ability to identify valuable wetlands of rather low botanical diversity, high mobility, imperviousness to some landscape disturbances and area effects, makes their potential contribution of unique, non-redundant, information valuable to fill in gaps in IBI's that are heavily plant weighted (U.S.E.P.A. 2002a).

  Research by Brooks and O'Connell focused on using bird communities in wetland systems in the Mid-Atlantic region (Brooks et al. 1996; O'Connell T.J. et al. 2000). In these studies, the wetlands chosen to create the biological dose response curves were previously ranked during a large effort to assess and protect wetlands in Pennsylvania. The wetlands were evaluated and ranked in a three-category scale based on soil properties, sediment deposition, vegetation characteristics and amphibian surveys. In addition to these rankings, this successful IBI collected bird data at relatively large spatial scales (up to 2 km transects), allowing researchers to measure disturbance using aerial photography and GIS. They characterized the amount of different land uses (urbanization, agriculture) or vegetation types within a circle (1 km in diameter) surrounding the site where biological metrics were measured, in addition to collecting local vegetation data. Given the large-scale sampling of birds, the metrics responded well to changes in landscape structure caused by urbanization or agriculture.

The breadth of disturbances by which birds may respond is well illustrated by Bradford et al (1998), who used professional opinion from "local range scientists" to categorize sites into low, medium and high levels of impacts from cattle grazing. In addition, low impact sites were protected from grazing for "many decades", while high impacts sites had known heavy grazing. These data were used to successfully develop a bird-based IBI for Great Basin rangelands.

C) Establishing a Human Disturbance gradient

To develop an IBI one must establish empirical relationships between biological metrics and human caused disturbance. Thus, a gradient of human disturbance must be developed and reference sites of high and low quality selected. Sites can either be ranked along the disturbance gradient based on a combination of abiotic factors or physical features, or disturbance can be measured directly as specific variables. In streams, abiotic factors include water quality, levels of urbanization or agriculture along a stream, and distance downstream from a point source of pollution. Yet unlike completely aquatic systems, relatively few terrestrial or semi-terrestrial IBIs exist. As such, there is not yet a prescribed method for measuring disturbance in terrestrial systems.

When assessing levels of disturbance, professional judgment is commonly involved. Professional judgment typically draws the line between a three-category scale of low, moderate, and severely disturbed sites. Measurements of disturbance are often specific to the site of interest and to the type of disturbance. The majority of disturbance evaluations are entirely qualitative in their assessments (e.g. low, moderate, highly disturbed sites). For example, Brooks et al. (1996) classified wetland sites under three categories (vegetation, water quality, and surrounding landscape condition) and considered a site pristine if it had high rankings for two of three categories, while being mildly disturbed for the third category.

Levels of disturbance are becoming increasingly more comprehensive, incorporating both on and off-site disturbance indicators (i.e. local and landscape level measures). These are ideally combined into a linear multi-metric index. States such as Pennsylvania, Ohio, and Florida have well developed Human Disturbance Gradients of this type. But, even the best disturbance gradients fail to capture the desired amount of information. It is of course, impossible for a disturbance gradient to incorporate every way humans disturb wetlands, and one should not "become preoccupied with disturbance gradients", because the biota of a site will ultimately be a more trustworthy measure of disturbance (Karr and Chu 1999; U.S.E.P.A. 2002). However, it is clear that IBI calibration works best where more attention and more effort is given to creating the most comrehensive Human Disturbance Gradient possible. Unfortunately, many IBIs created thus far are limited because their relatively data poor Human Disturbance Index (Mack In Press).

In terrestrial systems, local disturbances at small spatial scales (1-10 m) can impact local vegetation and hence, may potentially alter the value of metrics used in an IBI. Thus, developing IBIs for use at spatial scales where many smaller scale management decisions take place; controlled burns, restored sites, invaded patches, road cuts or fire breaks (i.e. 1-100ha), would seemingly require detailed information about current and past disturbance at a fine spatial scale. Thus, ranking sites apriori based on non-biological data to develop the biological-dose response curves is potentially problematic because gaining such fine-scale information may be impossible for some sites, leading many wetland IBI's to largely rely on landscape position and surrounding land uses to generate their Human Disturbance or Stressor Gradient (Brown and Vivas 2005; Reiss 2005). Where surrounding landscape land cover and disturbance are heavily, or exclusively, relied upon to create Human Disturbance gradients, the implicit assumption is that because the wetlands are largely associated with moving waters, being embedded within a highly disturbed matrix will 1) negatively alter its hydrology, 2) provide only propagule pressure from weedy seed sources and, 3) most likely correlate to a history of mechanical disturbances to the site itself. Therefore, wetlands surrounded by highly disturbed areas will themselves be highly disturbed and of low native floral and faunal value. But generally, we feel that up to this point most Human Disturbance Gradients have inadequately captured direct, localized site disturbances and land use histories.

Examples from two specific habitats best illustrate this failure. In the case of highly discrete groundwater wetlands, such as fen, bogs, and seeps, where direct sites disturbances may be paramount to biological quality overreliance on landscape indicators would clearly lead to erroneous scoring. Similarly, floodplain forests are also susceptible to human disturbance misclassification, where, for example a massive logging or livestock grazing event 50 years ago could devastate a sites flora and fauna for centuries after the disturbance (Spyreas and Matthews 2006), while the forest itself may be situated in such a landscape position as to score relatively high in its Human Disturbance Gradient score. In Ohio for example, the Landscape Disturbance Score could only account for 37% of the variation associated with Vegetative Biological Indicators, while the more localized on-site metric of the Rapid Assessment Metric was able to account for 72% (Mack 2004).

CTAP is well situated to provide as comprehensive a Human Disturbance Gradient as is possible to create an Illinois IBI, by incorporating its data gathered from landscape level disturbances (e.g. Remote Sensing GIS Information, Aerial Photography), with land use and disturbances to the actual wetland (localized on-site). CTAP gathers local disturbance information during site visits as well as collecting historic disturbances as available (e.g. Statewide aerial photographs taken in 1940, landowner interviews). Additionally, because these sites have been sampled two and in some cases three times over a 10 year period, changes in the biological condition due to disturbances over short periods of time can be closely compared to long-term historic disturbance data to create a spatially and temporally suitable gradient.

Finally, although it has previously been suggested that high quality, less disturbed reference sites with respect to human disturbance should have relatively easy accessibility (e.g. usually public lands) (Brooks et al. 1996), we feel it is imperative to consider the "ambient" disturbance level to a region's wetlands and avoid ease of sampling biases. For example, because CTAP sites are selected completely randomly, and a majority of CTAP wetlands are under private ownership and management, they are more likely impacted by disturbances common to highly agricultural landscapes (e.g., livestock use, herbicide use, planting by non-native plants for pasture and forage, tillage, sedimentation, eutrophication). On the other hand, many wetlands used thus far for wetland IBI creation and validation are either publicly owned (state, federal, county), or they are unaffected by common disturbances associated with privately owned/managed wetlands (i.e., they are wetland mitigations and restorations). Thus, the incorporation of privately owned wetlands from a highly agricultural landscape will provide a wider, more accurate representation of "average" disturbance intensities, and thus provide a more robust Human Disturbance Index.

D) Wetland sampling across a range of human disturbances

CTAP data are gathered according to a spatially randomized and probabilistic protocol (Molano-Flores 2002). Wetlands are represented by numerous plant communities, hydrologic regimes, and physiognomic classes, all of which are monitored on 5-year site revisit cycles (map of wetlands sampled available at http://ctap.inhs.uiuc.edu/images/gis/ctap-habitat.jpg). Due to their random selection (randomization occurs on three different spatial levels), these wetlands lie along a gradient from pristine to highly-disturbed. This abundance of highly disturbed wetland data (see forests in Mack 2004) is essential to providing a broad range of disturbance by which to build and score accurate metrics. For example, the two most commonly selected and sampled wetlands classification in CTAP are forested wetlands (n=92) and emergent wetlands (n=172).

In addition to obtaining data for random and functionally "average" or "ambient" wetlands conditions in Illinois, CTAP is continually gathering data on wetlands that constitute the highest biological quality, least degraded/disturbed wetlands of different community types that exist across the state. This targeted supplemental data is essential to creating IBIs, as has been shown by earlier failures attributed to deficiencies, or a lack of high-quality community data (Mack 2004).

Step 2. Metric Selection and Scoring.

Several criteria must be met when developing IBI metrics. First, a clear relationship between the IBI and disturbance gradient should be detectable or obvious and the metric should adequately distinguish sites with different levels of disturbance (Kerans and Karr 1994). Second, the successful metrics should not be redundant. Because the IBI model is a multi-metric index, redundant metrics should be avoided. For example, declines in overall species richness may be caused by declines in a suite of intolerant taxa. Third, a robust metric should correlate with more than one measure of disturbance. An IBI's ability to assess biological responses to human disturbance is strengthened by including several measures of disturbance that can be independently quantified. For example, if plant species richness were a robust metric, it should respond across a suite of independent measures of wetland degradation, such as levels of agriculture, grazing, or exotic species. Lastly, the metric should respond to disturbance despite natural temporal or spatial variability. One challenge to biological assessments is the inherent natural variation of biological systems, which fluctuate through time and across space (McBride et al. 1993). Thus, metric selection should identify metrics that show strong responses across disturbance gradients despite their natural variability.

We will investigate the correlation between each candidate metric and disturbance using exploratory data analyses, correlations, regressions and ANOVA. For example, a confirmed relationship that intensive agriculture decreases plant species richness in wetlands would demonstrate that plant species richness is a suitable biological metric for evaluating agricultural disturbance on wetlands. This relationship between biological responses (e.g. species richness) to different levels of disturbance (e.g. light, moderate, heavy agriculture) is an underlying principle in generating a "dose-response curve," where the biological attribute is plotted against a gradient of disturbance (Karr et al. 1986).

By categorizing the disturbance gradient into 3 or 4 levels of disturbance, ANOVA can determine if the candidate metrics varies across these categories. Once we determine a suite of metrics showing responses across the gradient we will determine if these metrics are redundant by comparing their taxonomic composition and level of correlation. If redundant, that metric showing the strongest response across the gradient will be kept.

We are confident the CTAP monitoring protocol will supply ample data across species to generate a large number of candidate metrics. We will investigate species and genus richness as potential metrics (i.e., birds, plants, and in some cases arthropods); as well as range of vegetation variables related to cover and structure. We will first attempt to create four types of metrics for each taxon. The generic goal will be to find measures that portray the "proportion of tolerant species" and the "proportion of intolerant species" (or genera)—as the number of species at a site with positive or negative responses in presence-absence across the disturbance gradient divided by the total number of species detected at a site. For example, if 10 species occurred at a site and five were intolerant, the proportion intolerant would equal 0.5. We will also calculate the "relative abundance of tolerant species" and the "relative abundance of intolerant species" by summing the relative abundances of those species with positive or negative responses to increasing disturbance. In summary, the proportion tolerant or intolerant species metrics used species presence-absence data, while the relative abundance metrics used counts of individuals across species.

The list of potential IBI metrics is vast and will not be reviewed here. But, in addition to the aforementioned metrics, because it is the largest source of data and therefore it usually generates the most metrics, we will also investigate a wide range of potential metrics associated with the plant data. For example, the Ohio wetland IBI has utilized 13 metrics based on plant data. Specifically, we will rely on regional studies of floristic quality and diversity measures (Matthews 2003; Taft et al. 2006), as well as past IBI work on plants in the region to generate our initial list of potential metrics to explore (Mack 2004; Rothrock et al. 2007; Mack in Press). The initial arthropod metrics we will explore are those used by past IBIs (Kimberling et al. 2001), as well as others deemed potentially suitable in the literature (Tallamy 2004). Additionally, where we have data of finer taxonomic resolution (Homopterans are identified to species), we will explore emerging indices of rarity, habitat fidelity, and conservation value that have recently been created for this order (Dietrich and Wallner Unpublished Data). Finally, bird metrics to explore have also been reviewed elsewhere (see Table 1 U.S.E.P.A. 2002a), and recently there has been a large growth in the body of literature concerning not only bird IBIs, but bird indices of conservation value and habitat condition. We will incorporate these studies to evaluate potential avifauna metrics (Howe et al. 2007; O'Connell et al. 2007) (for a wetland example see http://www.epa.gov/owow/wetlands/wqual/arem_man/).

Overall we anticipate investigating 25-40 potential metrics, with the goal of finding 10-15, non-redundant metrics that show strong, repeatable responses across the gradient and measure unique aspects of the biological response to disturbance in wetlands.

Scoring system

Once empirical relationships between disturbance and biological metrics of the system are established, a scoring system will be developed to allow ranking of the sites and a method of comparison. Scoring systems are arbitrary and vary across investigators, the ecosystems where IBIs are developed, and the taxa used in the IBI. For example, in many aquatic IBIs, and in the methods described by Karr and Chu (1999), scoring entails trisecting the range of values of the metric and assigning a 1, 3, or 5 to each section, with 5 representing the least impacted site. However, O'Connell et. al (2000) used a ranking scheme of 1, 2, and 3 in their bird-based IBI. They ranked sites with highest occurrence of specialist guilds, reflecting highest biological integrity, with a 3, next highest a 2, and the lowest a 1. Despite the scoring system used, if it is reported, highly transparent, and the scale equal across disturbance categories, then it should not diminish the value of the methodology.

For the IL-Wetland IBI proposed here, we will use the 1,3,5 scoring system recommended by Karr and Chu (1999) and used by Diffendorfer in his previous work (Diffenforfer et. al submitted). The method is robust, the most common standard available, and easily interpretable.

<u>Step 3. IBI Development and Analysis.</u>

Our methods will be based on previous work. For example, Kimberling et al. (2001) used nonparametric Mann-Whitney U tests to determine if metrics could distinguish undisturbed from disturbed sites and Spearman rank correlations to test for correlations between a metric and levels of disturbance. They performed Discriminate Function Analysis (DFA) to determine if a multivariate statistical approach using disturbance types as categories would rank the sites similarly to the multi-metric IBI. O'Connell et al. (2000) used ANOVAs, and Spearman Rank Correlations to determine if metrics generated by bird surveys varied in value across three categories of wetland rankings (high, medium, low quality) or if the rank of wetlands was correlated with the value of the metric. Furthermore, they used Cluster Analysis to determine the maximum number of site categories with statistically distinguishable bird communities. Metrics generated from the bird point count data varied across wetland categories, indicating they could be reliable indicators of disturbance. Furthermore, a number of large-scale variables measured using GIS explained significant amounts of variation in the bird community, suggesting both localized disturbances and larger-scale changes in landscape impact bird communities. The cluster analysis indicated the IBI could distinguish between five categories of disturbance with statistical confidence.

We will perform a series of analyses to determine IBI performance and stability; generally, the final IBI will be the sum of the individual metric scores. Specifically, the first task will be to confirm the relationship of the IBI to the disturbance gradient by regressing the IBI score against the disturbance gradient. Second, we will use cluster analysis and follow-up ANOVAs to determine how many levels, or categories, of disturbance the IBI can distinguish. Finally, to better understand the biological response to the disturbance gradient, we will use ANOVA to examine differences each of the IBI metrics across the cluster categories.

Step 4. Validation and Verification.

After demonstrating that an IBI can discriminate sites with varying levels of disturbance, the final step is to validate the IBI. Validation is the important step in the IBI creation where a model's predictions are tested and possibly refined, using a new set of data from comparable wetlands in the region, but independent of those used to construct the model (Karr and Chu 1999). Given the large number of wetlands available in the CTAP dataset, we will divide the data into two datasets, one used for IBI development and the other for validation. We will subsample the data to assure adequate stratification of regional sites, different habitat types, levels of disturbance, and wetland size in both datasets. After developing the IBI with the first half of the data, we will know the mathematical relationship between IBI and the disturbance gradient via a regression of IBI score on disturbance. We can then use this regression equation to predict the IBI score for wetlands in the other half of the data, given the measured disturbance variables at each site. We will then compare the predicted IBI to the observed IBI, and refine as needed.

Potential Supplemental Data and Analyses

Once an IBI is created it may be used in any number of capacities. Currents trends are for states to integrate the IBI results into a Bioassessement Protocol that often includes non-biological data. Obvious examples of criteria that may be added to the bioassessment are the wetlands size, hydrological characteristics (hydroperiod, flood pulsing, open water, water depth), and physical structure of the wetland. To this end, we plan on using a newly designed, automated, maintenance-free hardware system to monitor hydrology and create hydrograph data for CTAP wetlands. This new method would be a relatively low cost alternate to current hydrological monitoring methods. This technique uses I-button© temperature sensitive data loggers that can be installed in less than an hour and can record data for several years without the need for visiting or upkeep. The method relies on monitoring the difference between water temperature and the temperature of the air. Incorporating these data into the bioassessment dataset will be preliminary, and the initial exploratory testing will place these at wetlands at the two extremes of the disturbance gradient. If the water fluctuation data prove to be useful, funds will be pursued to deploy these devices in many more wetlands.

Products

We will produce an IBI that can be used for regulatory and conservation applications. The IBI will be provided to interested parties and the general public upon request. In addition, we will work with interested parties and our partners at IEPA and IDNR to train interested personnel to gather the data and use the IBI. We will us Microsoft Excel or similar widely used spreadsheet software to enter and score the IBI data. We will also provide interested parties data sheets in which to collect the field data and provide suggestion on how to most effectively store and manage these data.

In addition to creating the IBI, the process of determining the factors responsible for wetland degradation will allow us to address the following questions, and disseminate this knowledge.

How do birds and plants differ in their response to human disturbance?
How does hydrology affect the different taxa groups?
How do different components of the human disturbance gradient (e.g. local versus landscape disturbance, historic vs. contemporary) affect the taxa responses?
How profound are regional differences in IBI scores?
How did our chosen metrics vary by habitat?

Available resources

The Illinois Natural History Survey (INHS) is part of the Illinois Department of Natural Resources, with the bulk of the staff and resources being located on the campus of the University of Illinois-Champaign. The Illinois Natural History Survey, particularly the Critical Trends Assessment Program (CTAP), will be key in the successful development of a wetland IBI. As previously mentioned CTAP has a decade of data on over 200 wetlands. CTAP is funded by the IDNR and has six full-time scientists with an approximate annual budget of $500,000. We expect to also draw from the enormous amount of field experience of the CTAP scientists when investigating potential metrics in the model. INHS also maintains a large GIS program, which in cooperation with the Illinois Geological Survey provides a database of high-resolution statewide aerial photographs, which and are available for several different years, dating as far back as 1940.

It is increasingly recognized that a key element of a monitoring project is developing a probabilistic approach to sampling the “average” site in a given area. CTAP has already addressed this issue with the current data being collected from randomly selected sites. Thus, by combining monitoring and IBI development in this proposal we will provide a framework for other states to use when initiating a comprehensive wetland monitoring program. Additionally, because CTAP is an ongoing program we anticipate continuing to provide data on how wetlands are responding to disturbances into the future. For example, it is possible that changes in climate or the introduction of new exotic species may change the relationships between metrics and the disturbance gradient, and therefore the IBI. As a continuing program CTAP will allow us to address such issues.

Multi-agency Approach

Many agencies are charged with the conservation of wetlands. Agencies such as IDNR, IEPA, and IDOT have to evaluate, monitor, and conserve wetlands throughout the state. The initial driving force in this proposal to develop a wetland IBI came from multi-agency meetings in which representative from many (5+) agencies meet to discuss how to monitor and quantify the condition of Illinois wetlands. Throughout the development of an IBI we intend to continue to interact with these agencies. We will provide the IBI to these agencies and will be open to any comments and suggestions about the reliability of the model, as well as the ease with which the model can be applied.

PI qualifications (CVs attached)

Dr. Michael Ward is an ecologist with the Illinois Natural History Survey and a visiting assistant professor in the Department of Natural Resources and Environmental Sciences at the University of Illinois. He is the coordinator of the Critical Trends Assessment Program (IDNR funding source), manages the Statewide Bird Survey grant (IDNR funding source), and has an active research program studying the population dynamics of wetland birds.

Dr. Jay Diffendorfer is an ecologist with the Illinois Natural History Survey with extensive knowledge of how to create IBIs. Dr. Diffendorfer developed a multitaxa IBI for costal sage scrub in an around San Diego, California (funding source California Department of Fish and Game).

Greg Spyreas is a plant ecologist with the Critical Trends Assessment Program at the Illinois Natural History Survey. Greg is currently pursuing his doctorate at the University of Illinois, Urbana-Champaign and is interested in the how wetland plant communities respond to disturbance.

Schedule

We expect this project to take three years. The initial year will be devoted to creating the human disturbance gradient by which to score the biological data. This involves collecting, summarizing and analyzing an enormous amount of data. The next year will be devoted to determining the metrics used in the model. As mentioned previously, there are potentially hundred of variables that need to be investigated to determine their correlation with the disturbance gradient. And, chosen metrics can be easily confounded because different types of wetlands may differ in their relationships with given metrics, and given variables may or may not be predictive of disturbance levels across geographic boundaries. The final year will be devoted to validation of the IBI, and then calibrating the scoring system to be comparable across geographic regions and wetland types. The final step will be producing and disseminating easily understood summaries of the project.

Budget Justification

We are requesting $**196,750.00**; most of these funds are for the hiring of a post-doctoral scientist, whose duty it will be to create the IBI. Given the large amount of data, the large amount of variables and the latitude differences in wetland plant communities throughout Illinois, the creation of an IBI will be a full-time undertaking for the first two years and in the third year when the model is being tested there may also be the need to further refine the model. We are requesting supplies and contractual funds in order to purchase a computer and the statistical software needed to create the model. Finally we are requesting funds for travel to present the findings of this research as scientific meetings (out-of-state travel) and to meet with other state agencies (in-state travel)

The match for this project will be from the salaries of Dr. Michael Ward and Dr. Jay Diffendorfer. Dr. Ward will be using 11% of his salary in the first year followed by 11% in the second and 7% in the third. The time he devotes to this project will include analyzing bird data, communicating with state agencies and supervising the post-doc. Dr. Diffendorfer will provide 10% of his salary in the first year, followed by 11% in the second year, and 8% in the final year. Because of his experience developing IBIs he will spend most of his time analyzing data and determining the disturbance gradient.

Letters of Support

Attached are letters of support from the Illinois Environmental Protection Agency and the Illinois Department of Natural Resources.

APPENDIX 9

Letters of Support from the Illinois Environmental Protection Agency and the Illinois Department of Natural Resources for the Development of an Illinois Wetland Index of Biotic Integrity by the Illinois Natural History Survey

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77 West Jackson Boulevard
Chicago, Illinois 60604-3590

Re: Illinois Wetland Index of Biotic Integrity Funding Request

Dear Ms. Traub:

I am writing to you in support of an Illinois Natural History Survey (INHS) application for Region V Wetland Program Development Grant funding for *"Creation of a Wetland Index of Biotic Integrity for the State of Illinois."* Mr. Gregg Good of my staff has worked with the applicant and others to prepare and support this application.

As you may know, staff in my Agency's Bureau of Water have been developing a document entitled, "*Plan for a Statewide Wetland Monitoring and Assessment Program*" (Plan). This Plan, developed over the past year under agreement with Region V, is nearing completion, and has received major input and support provided by the INHS, Illinois Department of Natural Resources (IDNR), as well as numerous other Federal, State, and local agencies and organizations.

Effective conservation and management of wetlands requires knowledge of their current status and how they respond to various levels and types of disturbance. Therefore, a critical portion of the Agency's Plan calls for the development of a multimetric Wetland Index of Biotic Integrity (Wetland-IBI) specifically developed for wetland "Level 3" intensive site assessments, as advocated by USEPA's "three-tiered" wetlands assessment approach.

The Illinois Wetland-IBI is proposed to be developed from an enormous dataset collected from over 200 wetlands as part of INHS's Critical Trends Assessment Program (CTAP). Wetland-IBI development will create the basis for a bioassessment protocol that in accordance with the USEPA's wetland conservation goals under the Clean Water Act, can be easily understood, implemented, and communicated across all levels of government, non-government sectors, land managers, and the public. It will also produce a comprehensive understanding of how specific taxa supported by wetlands respond to physical features of wetlands and levels of disturbance. This understanding of how biological patterns and processes are affected by disturbance will assist in proactive, rather than reactive, management of wetlands.

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MARION – 2309 W. Main St., Suite 116, Marion, IL 62959 – (618) 993-7200

Complementing the development of the Agency's Plan and this Wetland-IBI grant application is an additional application to IDNR for "State Wildlife Grant Program" funding for the purpose of *"Updating the National Wetlands Inventory (NWI) for the state of Illinois."* The currently used Illinois-NWI was first generated more than 25 years ago and is in dire need of update. This application, made roughly two months ago to IDNR, would support NWI update by Ducks Unlimited, Inc., using 2005 and 2007 aerial photography, and will meet all U.S. Fish and Wildlife Service national mapping standards.

Like the Illinois-NWI update, I fully endorse this INHS Wetland-IBI application for a Wetland Program Development Grant. I look forward to the project's implementation and the resulting improvements in our capabilities to make accurate assessments of our water resources. Please know that the INHS and Region V will have my staff's full support towards its implementation.

Should you have any questions or comments concerning the application or the project, please feel free to contact Gregg Good of my staff at 217/782-3362, or Gregg.Good@illinois.gov.

Sincerely,

Marcia T. Willhite

Marcia T. Willhite
Chief
Bureau of Water

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cc: Kevin Pierard, Chief, Watershed and Wetlands Branch, WW-16J
Sue Elston, Wetlands Program Manager, WW-16J
Catherine Garra, Wetlands Biologist, WW-16J
Felicia Gaines, Regional Grant Coordinator, WS-15J

Bcc: Toby Frevert
Bruce Yurdin
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Joe Marencik
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Rod R. Blagojevich, Governor
Sam Flood, Acting Director

June 28, 2007

Jo Lynn Traub, Director
Water Division
U.S. EPA Region 5
77 W. Jackson Blvd.
Chicago, Illinois 60604

Dear Ms. Traub:

The Department of Natural Resources solicits your approval of the Illinois Natural History Survey project, *Creation of a Wetland Index of Biotic Integrity (IBI) for the State of Illinois*, for a Region V Wetland Program Development Grant.

The Illinois Environmental Protection Agency and the Department have an established relationship with regard to stream monitoring and conservation of the State's aquatic resources. The "Plan for a Statewide Wetland Monitoring and Assessment Program" developed by the IEPA's Bureau of Water is a primary example of our collaborative efforts to advance science in order to achieve the goals set forth under the Clean Water Act. An Illinois Wetland IBI will facilitate state efforts to improve the functional services (health) of Illinois' wetland ecosystems.

The proposed IBI will be developed using data acquired by the IDNR state-funded Critical Trends Assessment Program (CTAP). CTAP monitors the condition of forests, wetlands, grasslands, and streams throughout the state of Illinois. It has provided a baseline from which to assess changes in ecological conditions as well as to compare regional and site-specific patterns throughout Illinois. CTAP was the first-ever attempt at a statewide comprehensive assessment undertaken by a state natural resource organization. (See http://ctap.inhs.uiuc.edu/ for extensive overview of this program)

As administrator for the IL Interagency Wetland Policy Act, the IDNR provides statutory oversight for State-funded projects that involve wetlands. The proposed IBI will greatly enhance the ability of this wetland program to assess adverse impacts to wetland resources and to monitor wetland mitigation sites and wetland banks. In addition, a Wetland IBI will compliment wetland conservation strategies within various state programs as well as enhance federal/state partnerships such as the Conservation Reserve and Enhancement Program. It will also contribute essential bioassessment information for our joint wetland ventures with the U.S. Fish and Wildlife Service, Nature Conservancy, Ducks Unlimited, and U.S. Army Corps of Engineers.

Once again, I encourage you to fund this INHS proposal. Please contact either myself or Todd Rettig at 217/785-5500 if you have any questions.

Sincerely,

Tom Flattery

Tom Flattery, Director
Office of Realty and Environmental Planning

CC: Marcia Wilhite, Chief, IEPA Bureau of Water
Todd Rettig, Manager, IDNR Division of Ecosystems and Environment