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## **A Regional Monitoring Plan for Chicago Wilderness**

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## Executive Summary

Although the Chicago Wilderness (CW) consortium has long recognized the need for regional ecological monitoring to address the consortium's goals, it has proven difficult to establish a regional monitoring program. This report builds on a CW workshop in 2005 that identified specific goals for regional monitoring and provides recommendations for monitoring terrestrial ecosystems. As a first step toward developing this plan, an extensive inventory of current monitoring programs in the CW region was undertaken. This inventory demonstrated that although many organizations are conducting ecological monitoring in the region and are willing to share their data, non-random site selection and variation among protocols, in addition to more minor issues, make many of these data sets difficult to combine to gain a regional perspective. After extensive discussions with a wide range of CW member organizations, we recommend that CW:

- concentrate on monitoring plant and bird communities because these are widely accepted as good measures of ecosystem health and can be monitored with a reasonable investment.
- monitor these communities using the protocols currently being used for CTAP statewide monitoring.
- monitor rare plant communities, for which the CTAP protocols cannot be expected to provide data, using qualitative assessments of threats using the Plants of Concern protocols.
- encourage expansion of other regional monitoring programs already in place, including Plants of Concern, the Calling Frog Survey, the Bird Conservation Network, and the Butterfly and Dragonfly monitoring networks.
- expand resources for data analysis, interpretation, and dissemination.

We recognize that following these recommendations will not provide regional data on many organisms, including most insects and other invertebrates, most reptiles and amphibians, and mammals. Many of these groups, with the possible exception of turtles, generally are difficult to detect and identify, so monitoring them requires more resources (both in terms of expertise and field time) than do plants or birds. Furthermore, in most cases these groups either are too poorly understood to serve as clear indicators of ecosystem health or are highly correlated with other, more easily measured indicators. Therefore we recommend that CW not monitor them at this time.

The CTAP staff currently monitor 64 randomly selected sites in the CW region as part of the statewide monitoring program. An additional 120 sites would have to be monitored in the region to gain sufficient statistical power to detect moderate change in a reasonable length of time. This report proposes a stratified random site selection process for the CW region that spreads sites

geographically despite the non-random distribution of natural habitat in the region. It also describes criteria for choosing sites so they are compatible with current CTAP statewide monitoring sites. Monitoring birds and plants on a three-year cycle at these additional sites, and then managing and analyzing the data, will cost an estimated \$145,000 annually.

Implementing the recommendations in this report will allow CW to make significant strides toward its regional monitoring goals.

## **Introduction**

From very early in its history, the Chicago Wilderness (CW) consortium has recognized that monitoring natural resources throughout the region is critical. Both the Biodiversity Recovery Plan (The Chicago Wilderness consortium 1999) and the Regional Report Card (The Chicago Wilderness consortium 2006) refer extensively to the need to monitor a wide variety of communities, species assemblages, and individual species. This interest in regional monitoring recognizes the need to assess general trends in ecosystem health and to determine whether restoration and management activities are having the desired effects. Despite this recognition of the importance of regional monitoring, and the extensive monitoring already being conducted by many members of the CW consortium (see below), it has been difficult to establish a comprehensive regional monitoring program.

Early in 2005, the CW consortium sponsored a two-day workshop aimed at reaching consensus on regional monitoring priorities (Levin 2005). The principal points of agreement reached at the workshop were:

- The priority goals for regional monitoring should be (1) documenting trends in biodiversity or other measures of ecosystem health for both terrestrial and aquatic communities and selected animal species assemblages, and (2) assessing the effectiveness of management.
- A comprehensive inventory of natural communities in the Chicago Wilderness region is urgently needed. This inventory should map the communities and include some measure of their quality.
- Regional monitoring should integrate, insofar as possible, monitoring already underway by resource management agencies and other organizations in the region.
- Monitoring should provide some information about trends in biodiversity/health for all communities and more in-depth information for selected communities or sites.
- For aquatic systems, in-depth monitoring should focus on high quality sites, especially those at high risk, and on filling in the gaps present in existing monitoring programs.
- For terrestrial animal species assemblages, intensive monitoring should focus on species/assemblages at risk (i.e., those that are threatened, endangered, or otherwise known to be declining), endemic species and or species assemblages for which the

Chicago Wilderness region is significant nationally and globally, charismatic species, some invasive exotic species, and on species that are good indicators of habitat quality.

As a result of the workshop, CW contracted the Illinois Natural History Survey to develop a regional monitoring plan that addresses these issues. This report presents that plan for terrestrial communities. The CW Aquatics Task Force independently assessed monitoring needs for aquatic communities.

## **Planning Process**

Developing a regional monitoring plan for CW involves both scientific and policy decisions. We have therefore sought input from stakeholders throughout the process. We held three all-day meetings (17 October 2005, 11 July 2006, and 28 August 2008) to discuss regional monitoring with representatives of many CW member organizations, and have presented aspects of the monitoring plan at numerous meetings of the CW Natural Resource Management Team, Executive Council, and Steering Committee, and at the 2006 CW Congress. In addition, we have discussed specific monitoring issues with many individuals through face-to-face meetings and phone calls. Input received through all these contacts has been vital in shaping this monitoring plan.

As noted above, there is consensus that regional monitoring should incorporate, insofar as possible, monitoring already being carried out within the CW region. Building on existing programs would maximize the data available and allow new efforts to be targeted most efficiently. Although CW previously has attempted to compile information of existing monitoring (Shopland 1999; Trgovcich-Zacok 2003; DeWalt & Lampa 2005), we felt that these inventories were incomplete or outdated. We therefore compiled a list of agencies, organizations, and individuals potentially monitoring natural resources in the CW region. We sought input from the CW Natural Resources Management Team, Science Team, and others to assemble this list. Then, over a period of nine months, Susan Ask, Research Assistant on this project, met individually with representatives of over 100 groups. In the course of these interviews, she asked about monitoring activities, site selection and data acquisition protocols, and data management methods.

The results of this inventory are presented in detail in Appendix 1. We learned that most monitoring is focused on plants and birds, with limited monitoring of other organisms. There are, however, active volunteer programs monitoring frogs and butterflies, and a relatively new volunteer program monitoring dragonflies. Most of those overseeing the programs are quite willing to share data with CW, although some expressed concerns about confidentiality, especially of threatened and endangered (T/E) species locations. As discussed in more detail below, how well existing data can be integrated varies tremendously because of issues associated with site selection, data acquisition protocols, and data management processes.

## **Recommended monitoring**

The recommendations that follow are aimed at addressing the priorities identified during the regional monitoring workshop and subsequent discussions, while taking into account that human and financial resources are not unlimited. We believe this approach is feasible and will yield meaningful results within a reasonable time frame. At the same time, we recognize that gaps in our understanding of trends in ecosystem health and the effectiveness of management will remain.

### ***Birds and Plant Communities***

At the meeting in August 2008, the INHS proposed that the protocols currently being used by its Critical Trends Assessment Program (CTAP) be used to address the core regional monitoring goals for CW. Since 1997, CTAP has been monitoring plant and bird communities at about 450 randomly selected sites throughout Illinois. (Insect samples are also being collected at these sites, but identification and analysis are only at an early stage.) The sites, which are divided approximately equally among forests, grasslands, and wetlands, are visited on a five-year cycle. These data are gathered, quality-controlled, and analyzed by professional scientists. (Although the volunteer-based Eco-Watch program gathered data at additional sites, the terrestrial aspects of this program currently are largely inactive.) For more information on CTAP monitoring, see [ctap.inhs.uiuc.edu](http://ctap.inhs.uiuc.edu).

Because the CTAP sites were randomly selected, on a state-wide basis most are low quality sites on private land. In contrast, within the CW region the majority of CTAP sites are on public land. There are currently 64 CTAP sites within the CW region. Among the region's counties, Lake County has the most CTAP sites (17). In addition to the randomly selected sites, CTAP also monitors high-quality reference sites, which often are not the same for birds and plants. A total of 12 reference sites are found in the CW region.

A power analysis conducted by INHS staff member Greg Spyreas concluded that about 60 sites of each of the three major habitat types should be sampled to have an 80% chance of finding a significant (i.e., with 95% confidence) ecological effect. Thus a total of 180 randomly selected sites should be sampled. This number will allow changes to be detected across the region, but not in individual counties or other subregions. We recommend that these sites be selected using CTAP's standard random site selection method to generate the necessary number of new potential sample sites and then determine how many of the sites selected by this process are already being monitored using protocols compatible with the CTAP protocols. We further recommend that sampling be stratified latitudinally to allow the data to assess likely changes in distribution of both native and invasive species (natural habitat in the CW region tend to be clustered, so stratification increases geographic coverage).

To assess this process, INHS staff used the following process for the core CW region counties (McHenry, Lake, Kane, DuPage, Cook and Will). Random sites were selected using a one-square mile grid overlaid on the six counties. Each grid square roughly corresponds to one section within the General Land Survey system. Ten blocks for each county and each habitat were

selected for a total of 120 sites. Each randomly selected grid block was then inspected using Illinois landcover data in a GIS and air photos (2005 Illinois DOQ and Google Earth). Additionally, potential sampling locations for wetlands were determined using the digital Illinois Wetlands Inventory database. If no suitable habitat was detected in a block, an alternate grid block was selected.

The potential monitoring sites selected by the GIS method described above must be ground-truthed to determine if they meet CTAP's habitat criteria. These criteria were established to objectively accept or reject sites 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 criterion for acceptance is that all sites currently are undergoing natural ecosystem processes such that changes in condition will be possible and detectable. More detailed criteria are described in Appendix 2.

A preliminary application of this approach for the six-county core Illinois portion of the CW region showed that at least half of the likely forest sites and at least one-third of the likely grassland sites already are being monitored for plants by an agency or organization. The monitoring protocols vary, but it still may be possible to integrate the data either unchanged or with minor modifications of the protocols already in use for those sites. It is less clear how many likely wetlands are being monitored, but it appears that wetlands will require the most effort to sample. Although we have not compared the Bird Conservation Network (BCN) monitoring locations to these sites, we expect that it may be somewhat similar to or perhaps even better than existing plant monitoring. Ground-truthing these sites and then determining in detail which are currently being monitored in CTAP-compatible ways will be necessary before this aspect of the monitoring plan can be finalized.

Assuming that our estimates of the proportions of regional monitoring sites already being monitored for plants and birds are close, we estimate that monitoring the remaining sites on a three year basis would require that CTAP add a half-time botanist and a half-time ornithologist. In addition a coordinator with analytical skills would be needed to implement the monitoring and provide "custom" analyses to different CW constituents. Adding in costs for travel, field supplies, and overhead would bring the total annual cost to about \$145,000.

A major weakness of the CTAP monitoring described above is that it focuses exclusively on the region's major plant communities. It will therefore provide little or no data on the status and trends of rare plant communities such as fens, bogs, sand prairies, savannas, and flatwoods. To address this issue, we recommend that these communities be monitored qualitatively, using the threat indicators currently in use by the Plant of Concern (POC) program. Although designed specifically to monitor threatened or endangered plant species, the POC also includes protocols for assessing habitat threats. In most cases these rare communities are relatively high quality and are protected and managed, so it is not likely that they are changing in ways that require quantitative monitoring. Furthermore, many of them are fragile and qualitative monitoring will

disturb them far less than would quantitative monitoring. Another advantage of this approach is that it will allow the integration of data being gathered by the POC program. Because the universe of these communities in the CW region is relatively small, sampling can be close to 100% over a span of five years. By monitoring these communities qualitatively at regular intervals, CW will have adequate data on their status and trends with a reasonable investment of time and effort.

## ***Other Taxonomic Groups***

Although we believe that CW's regional monitoring efforts should concentrate on plant and bird communities, we recognize that doing so will leave gaps in CW's knowledge of the status and trends in other groups. In the rest of this section, we provide recommendations for monitoring these groups. For each group, we summarize the current status of monitoring and the strengths and weaknesses of the group for understanding ecosystem health. We then recommend what steps, if any, CW should take to monitor that group regionally.

### **Terrestrial invertebrates**

*Current monitoring.* Relatively little terrestrial invertebrate monitoring is currently underway, and the data that are being gathered tend to be related to specific projects or to individuals' interests. The notable exceptions are the Illinois Butterfly Monitoring Network ([www.bfly.org](http://www.bfly.org)), which is well established, and the relatively recently established Dragonfly Monitoring Network ([www.anisoptera.org](http://www.anisoptera.org)). In addition, the CTAP is monitoring leafhoppers at relatively few, but randomly selected sites. The CTAP monitoring is conducted by professional scientists, whereas the butterfly and dragonfly monitoring involves trained and supervised volunteers.

*Strengths and weaknesses.* Most invertebrate groups are difficult to monitor because their identification requires expertise that is difficult to obtain. For many groups, there are only one or at most a few qualified individuals anywhere in the world. Collecting, sorting, and distributing specimens for identification are costly and time consuming. In some cases, presence of individual species depends primarily on the presence of their obligate host plants; data about these invertebrates adds little to understanding ecosystem health that cannot be learned from plant monitoring, which is easier to conduct. However, in other cases invertebrates, especially those that are predators, may reflect other characteristics of the habitat. Unfortunately, so little is known about most invertebrates that it is hard to interpret their significance in relation to ecosystem health.

*Recommendations.* Because little monitoring is already underway and additional monitoring would be very costly and difficult to interpret, we do not recommend monitoring most invertebrates at this time. We do recommend utilizing the results of the butterfly and dragonfly monitoring networks. CW could improve the value of these data by encouraging more randomization of monitoring sites, which might require investing in support of professionals to visit lower quality sites that are difficult to get volunteers to monitor.

## **Reptiles and amphibians**

*Current monitoring.* Monitoring of reptiles and amphibians in the CW region currently is limited and mostly focused on a few T/E species at specific locations. The exception is the Calling Frog Survey ([www.habitatproject.org/default.asp?cid=19](http://www.habitatproject.org/default.asp?cid=19)), a program involving trained and supervised volunteers that has been monitoring frogs and toads since 2000.

*Strengths and weaknesses.* (Dr. Chris Phillips, Illinois Natural History Survey, provided substantial input on this section.) The biggest challenge with most reptiles and amphibians is low detectability, meaning that they are difficult to find even when present. Considerable time and effort is required to get sufficient data to assess population sizes reliably. For some species that can be detected relatively easily, for example juvenile salamanders, identification requires expertise that is hard to find. In some cases, enough is known about the biology of individual species that populations can be estimated from landscape characteristics (for example, size of suitable habitat). For these species, these indirect measures can be more easily obtained than direct population measures. In most cases, amphibian and reptile habitat requirements are species specific, and therefore monitoring will not yield information about community level ecosystem health.

*Recommendations.* Because they often are difficult to monitor and do not reveal community level information, we do not recommend that CW undertake monitoring of most reptile and amphibian species at this time. We do, however, encourage expansion of the Calling Frog Survey, especially the addition of randomized sites. This may require investing in support of professionals to visit lower quality sites that are difficult to get volunteers to monitor. We also recommend establishing a regional turtle monitoring program. In contrast to many other reptiles, turtles are relatively easy to detect, are easily identified, and provide information about the overall health of wetlands and the adjacent uplands. This program could be volunteer-based, with training provided on monitoring protocols and species identification. If CW chooses to develop a turtle monitoring program in the future, INHS staff can provide input on monitoring protocols and site selection.

## **Mammals**

*Current monitoring.* Almost no mammal species are being monitored in the CW region. Populations of some species, notably deer and a few T/E species, are being monitored at specific locations.

*Strengths and weaknesses.* Small mammals, which may be sensitive indicators of ecosystem health, require specialized trapping procedures to determine population levels accurately. Larger mammals are more easily detected, but most of those in the CW region are generalists that tolerate or even thrive in degraded habitats and therefore are of limited value in assessing ecosystem health. Monitoring deer populations is of value, however, because of the significant negative impacts of large populations on plant community health.

*Recommendations.* Because they are difficult to monitor or do not reveal valuable information about ecosystem health, we do not recommend that CW monitor most mammal species at this time. Continuing or expanding monitoring of deer populations, however, would be of value in assessing population control measures and garnering support for improving these, if necessary. As an alternative or supplement to direct monitoring of deer populations, it may be desirable to develop a volunteer-based deer browse monitoring program. This may be more valuable for its public engagement than for the additional data it will yield on deer populations.

## **Plant species**

In addition to the plant community monitoring we have described in detail above, we recommend continued monitoring of T/E species.

*Current monitoring.* The most extensive monitoring of T/E plants in the CW region is through the Plants of Concern (POC) program ([www.plantsofconcern.org](http://www.plantsofconcern.org)) developed by the Chicago Botanical Garden with significant support from CW. This mostly volunteer-based program has clearly standardized protocols for gather data on plant populations and threats to them. It currently monitors about 40-45% of the known T/E plant occurrences in the region, and also monitors a significant number of regionally rare species that are not formally listed as T/E.

*Strengths and weaknesses.* With proper training, volunteers can reliably identify and census specific T/E species, providing reliable data of known occurrences. Finding previously unknown populations is more difficult, but it is likely that most large populations of T/E plants in the CW region have already be located. Although individual T/E species may not be informative about overall ecosystem health, the relatively large number of species (176 species monitored by POC, of which 56% are endangered or threatened) makes them of inherent interest, as does their T/E status. Like birds, many plants are charismatic, so changes in their populations can be used to engage policy makers and the public in conservation efforts.

*Recommendations.* The POC program should be continued and expanded if possible so that it includes more T/E species and more populations. Because of the importance of POC, CW should consider working with the Chicago Botanical Garden to develop stable long-term funding for POC. Emphasis should also be placed analyzing the POC data and making the results available in ways that protect the confidentiality of T/E plant locations.

## **Data management and analysis**

Effective regional monitoring requires not only that data be gathered, but that the data are effectively managed and analyzed and that the results are disseminated widely. If CW chooses to have CTAP monitor plant and bird communities, an infrastructure for data management is already in place. Some existing regional monitoring programs, including the Bird Conservation Network, the Plants of Concern program, the Butterfly and Dragonfly monitoring networks, and the Calling Frog Survey, also have effective centralized data management systems. Much of the remaining data listed in Appendix 1 are not centrally managed, and in are stored in a wide

variety of formats, including paper forms. Although most of these data sets inherently are of limited use for regional monitoring (because of incompatible protocols or sampling strategies), utilizing those that are of use will require an investment to integrate their management into a centralized electronic system.

Even when data are effectively managed, resources for data analysis and interpretation often are inadequate. We therefore recommend that CW work with its members and other organizations to analyze the data and make the results widely available. This may require hiring or contracting with individuals who have the advanced statistical expertise necessary for analyzing complex monitoring data.

## **Conclusions**

Although monitoring data are being gathered at a host of sites throughout the CW region, in most cases issues of biased site selection and incompatible protocols preclude integrating these data to assess regional ecosystem health. Developing a regional monitoring program will instead primarily depend on new data gathered specifically for that purpose. We make the following recommendations for CW's regional monitoring:

- concentrate on monitoring plant and bird communities because these are widely accepted as good measures of ecosystem health and can be monitored with a reasonable investment.
- monitor these communities using the protocols currently being used for CTAP statewide monitoring.
- monitor rare plant communities, for which the CTAP protocols cannot be expected to provide data, using qualitative assessments of threats using the Plants of Concern protocols.
- encourage expansion of other regional monitoring programs already in place, including Plants of Concern, the Calling Frog Survey, the Bird Conservation Network, and the Butterfly and Dragonfly monitoring networks.
- expand resources for data analysis, interpretation, and dissemination.

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## **Appendix 1. Summary of Current Monitoring Projects in the Chicago Wilderness Region**

As part of this project, Susan Ask, Research Assistant on this project, interviewed about 130 researchers and coordinators of inventory or monitoring programs from over 100 organizations—forest preserve districts, conservation organizations, research institutions, and volunteers—to gather details about the focus and the methods of their monitoring. The results of these interviews are presented in the Excel file that accompanies this report. Those interviewed spanned the Chicago Wilderness region including areas of Illinois, Wisconsin and Indiana. This compilation is not complete; there is certainly more research, surveying and inventory work carried out, but time constraints and practical limitations prevented her from reaching every potential program in the region.

The working definition of monitoring for this survey was: “has this site been studied on a (more or less) recurring interval and are there plans to continue monitoring on a regular basis?” The respondent determined whether or not this definition applied to their field work. Information was gathered exclusively on terrestrial systems. Following this criterion, many programs did not qualify as monitoring.

There is tremendous diversity in the Chicago Wilderness region: diversity in the biota and diversity in the monitoring programs. Within the region there are more than 250 monitoring programs, involving at least 35 different organizations. These programs

- monitor trends in individual species, taxonomic groups, and communities, and vary from single sites to region-wide.
- in some cases seek to identify trends in biodiversity and in others aim to assess the effectiveness of management.
- monitor organisms including plants, fungi, birds, mammals, amphibians and reptiles, butterflies, dragonflies and damselflies, and other insects.
- monitor some ecosystem processes, including nutrient cycling, biomass, atmospheric fluxes and air quality, and soil processes.
- include professionals and volunteers, with volunteers including both moonlighting professionals and trained amateurs; the experience and expertise of volunteers is, for the most part, not well documented.
- range from a data set that spans 100 years to some programs are just beginning; most monitoring programs started after 1990.
- typically include monitoring intervals of 1, 2 or 5 years between visits, but due to resource limitations may not occur at regular intervals.
- usually use a variety of protocols, even for the same taxonomic group; as might be expected, the greater the number of groups monitoring a taxonomic group, the more variation among protocols.

- store data in Microsoft Excel or Access, often with paper as a backup, and sometimes as the only record of the monitoring effort; only a small portion of monitoring data is available with GIS shape files.

## ***Issues for Regional Monitoring***

This inventory identified several issues that present challenges for bring data from existing monitoring programs together to gain a regional perspective. The most significant of these are discussed in more detail below.

### **Site selection**

Site selection and plot placement often are not random. A site may be chosen because of easy access, because it is particularly interesting (especially “natural”) or based on a qualitative assessment that the site is representative of a certain condition. All of these reasons pose challenges for comparing the data from these sites and aggregating these data into a meaningful regional perspective.

### **Methodological differences**

The methodological problems are most evident for monitoring birds and vegetation, perhaps because there are so many different efforts to monitor these groups and many researchers (professional and volunteer) have their own methods. Although bird monitoring primarily utilizes times point counts, methods vary widely in duration and distance of birds reported (and whether the distance to the individuals is estimated). Plant monitoring uses plot-based and plot-less methods, and plot size and shape vary considerably among plot-based methods. Additional methodological differences can be seen in the field, but often are not recorded, such as when to count a specific stem as “in” or “out” of the plot—often based on whether it is rooted in or out of the plot. Although there are methods for aggregating data collected using differing protocols, these generally lead to a loss in power compared to using a single protocol.

### **Concerns about volunteers and citizen scientists**

Some respondents expressed concern about the value of data collected by volunteers. The concerns were typically about:

- lack of skill and training in identification and measurement protocols,
- large numbers of observers causing unacceptably high variation,
- potential bias among volunteers looking for a certain result, and
- volunteers doing things without landowner permission.

Some respondents felt these issues are so problematic that they strongly oppose volunteer-based regional monitoring. Others felt that with sufficient training and quality control by professions, volunteer-based programs can provide fully usable data.

## **Communication and data sharing**

Good communication with landowning agencies is important, but might not always be the current practice or perception. In particular, some landowners commented that some volunteers and organizations have not sought permission for monitoring on their property. Several land owners and managers have not received data from outside organizations in a timely or useful way. For example, some reports aggregate data in ways that are not useful for land managers. Providing raw data in addition to analysis might address this issue.

A similar issue is sharing data among agencies or organizations. Nearly everyone who responded to the survey is willing to share data, although some respondents require more control over data or cannot readily release certain sensitive location data.

## **Limited resources for monitoring and analysis**

Many landowners/managers and organizations noted that they have limited resources for monitoring. It has also proven difficult to commit resources to manage and analyze data. Consequently, some monitoring data exists only in field notebooks and never having been entered into a spreadsheet or analyzed beyond the stage of giving a qualitative impression of conditions.

## **Appendix 2. CTAP Habitat Selection Criteria**

Habitat-specific criteria for inclusion in the pool of sites to be sampled are described below.

### ***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. Forest patches must be at least 20 acres in size to be considered for monitoring. 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 and denuded of 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.

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.

### ***Wetland habitat criteria***

The pool of potential, random monitoring sites was identified from the Illinois Wetlands Inventory database (IWI). Specifically, wetlands dominated by emergent, palustrine vegetation (i.e. rooted herbaceous hydrophytic vegetation such as sedges, rushes, forbs, and grasses) are selected.

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

- The minimum area of suitable habitat is 500m<sup>2</sup> 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.
- 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 to be plowed or developed are acceptable as long as monitoring can be completed during the current field season.

Sites with the following characteristics are not acceptable:

- Farm ponds are 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 over 1m deep or too mucky to be safe), then it is discarded.

### ***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.

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. 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.

Grasslands identified by the Land Cover of Illinois database include a diversity of habitat types as listed above. 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 non-native plant species. However, even though these disturbed habitats no longer have a long history of natural succession, disturbed sites may still harbor some native plant, bird and insect 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 any site management (e.g. mowing, haying, grazing) be 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<sup>2</sup>, with a minimum width of 10m (e.g. 50m x 10m, or the equivalent).
- The grasslands have < 50% shrub cover and < 50% tree canopy cover.
- Sites 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  $\geq 50\%$  cover of other plant species present (if % of other species is <50%, then it is considered a monoculture)

- recently abandoned agricultural fields, as long as they do not still contain crop stubble
- overgrown or un-mown road or railroad 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 a monoculture of agricultural crops (such as corn, wheat, soybeans).
- Agricultural fields that are fallow and still retain evidence of 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, cemeteries, city parks, turf farms, or most airfields.