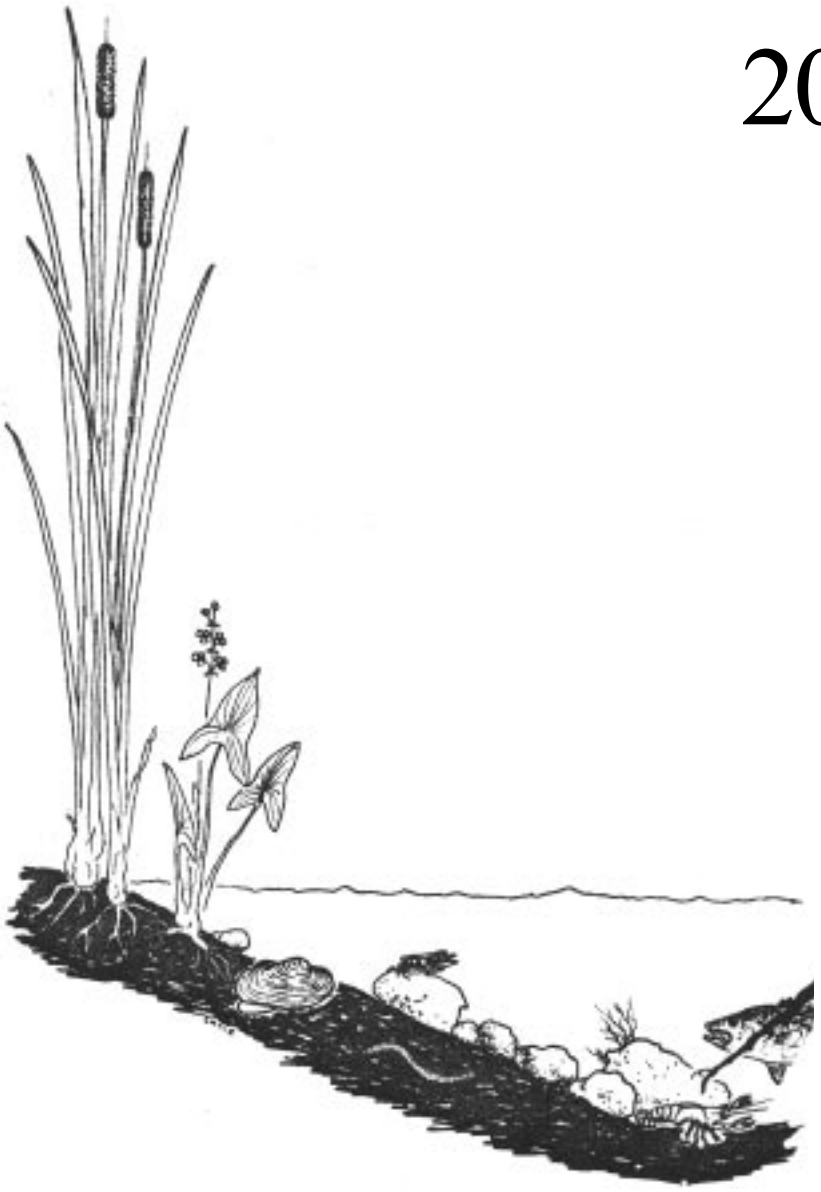
Critical Trends Assessment Program

2001 Report



ILLINOIS
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NATURAL
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Other CTAP Publications

Critical Trends in Illinois Ecosystems
Illinois Land Cover, An Atlas, plus CD-ROM
Inventory of Ecologically Resource-Rich Areas in Illinois
Illinois Geographic Information System, CD-ROM of digital geospatial data

Regional assessments (geological, water, biological, and socio-economic resources) for the following areas or watersheds:

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Calumet Area
Chicago River/Lake Shore
Driftless Area
Du Page River
Embarras River
Fox River
Illinois Big Rivers
Illinois Headwaters
Illinois River Bluffs
Kankakee River
Kaskaskia River
Kinkaid Area
Kishwaukee River
Lower Des Plaines River
Lower Sangamon River
Lower Rock River
Mackinaw River
Prairie Parklands
Sinkhole Plain
Spoon River
Sugar-Pecatonica Rivers
Thorn Creek
Upper Des Plaines River
Upper Sangamon River
Vermilion River
Vermilion River (Illinois River Basin)

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CRITICAL TRENDS ASSESSMENT PROGRAM
2001 REPORT

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Introduction

The Critical Trends Assessment Program was established in 1992 to inform state policy makers about the state of Illinois' ecosystems. During the decade since then, CTAP has developed tools and programs to systematically monitor changes in ecological conditions in Illinois. These programs not only support policymakers to help them make wise decisions about protecting our natural resources, but provide information to state and local land managers and the public as stewards of Illinois lands and waterways.

Last year's report *Critical Trends in Illinois Ecosystems* provides the first summary of these efforts. It represents the culmination of six years of data collection and analysis by state scientists and tens of thousands of volunteer hours by "citizen scientists." This CTAP annual report is the first annual update to that report. It contains seven papers that provide more current data and analysis. We plan to provide more in-depth information each year.

Monitoring by CTAP scientists shows that most Illinois streams have fair to poor habitat quality and species diversity. Species of large predatory stoneflies, in particular, have experienced drastic range losses across the state because of human disturbances. Agricultural basins seem to be the most heavily impacted. Tremendous improvements have occurred, however. The change from livestock-based to grain-based agriculture and installation of better wastewater treatment facilities has drastically reduced organic wastes entering streams. The fact that very truly intolerant species remain in the state most likely is the result of historical degradation, nonetheless the contribution of contemporary degradation cannot be ignored. EPT species richness has not improved greatly due to the great dispersal distances between islands of sensitive species. Reintroduction of sensitive species may be necessary to bridge this geographic gap.

Monitoring by RiverWatch citizen scientists shows that Illinois streams are generally dominated by organisms that are moderately tolerant of organic pollution. The most common taxon found in the state was sowbugs. Overall, the 309 RiverWatch sites monitored in 2000 averaged fewer than 10 macroinvertebrate taxa. EPT taxa, which generally do not tolerate organic pollution, were found more often in rocky bottom streams and in areas less subject to human disturbances, such as urbanization and housing construction. In contrast, bloodworms and aquatic worms, which are tolerant of pollution, were more abundant in silty bottom streams and disturbed sites and less abundant at sites where forestland or pastures dominated the landscape.

CTAP data indicates that all types of terrestrial ecosystems – forests, wetlands, and grasslands – suffer from invasion of introduced plant species. The impact of non-native species on ecosystems can be devastating, reducing the diversity of native plants and the quality of habitat for native wildlife. CTAP vegetation monitoring shows that forest sites support higher species richness than wetlands and grasslands and are less dominated by non-native species. In wetland sites, non-native species such as reed canary grass often entirely

take over, existing as a near monoculture. Fescue and Kentucky bluegrass dominate most Illinois grasslands because they generally have been or are being used as pasture. These non-native species appear to be more abundant in northern Illinois than in central or southern Illinois. Finally, only two threatened or endangered plant species were found in all the sites visited. Since these randomly selected sites rarely contain pristine habitat, this is not surprising. It does, however, underscore the necessity to preserve high quality undisturbed natural communities.

While forests may not be as dominated by non-natives as other terrestrial habitats, monitoring by ForestWatch citizen scientists shows they are widespread even there. In the ground cover, disturbance-sensitive and non-native indicator species were both found at roughly half of the sites monitored. However, non-natives covered nearly 10 times as much area as the disturbance sensitive species and twice as much area as the common natives. In the shrub layer of forests, invasives were even more widespread, being present at 60% of sites, and representing nearly two-thirds of shrub and vine stems at the average site. Bottomland forests seem to have a greater problem with non-natives in the ground cover, whereas upland forests have a more serious problem in the shrub layer. Invasive trees were not a significant problem across most of the state, with the major exception of buckthorns in northern Illinois. Other problems were also detected in Illinois forests: nearly one-fourth of the oak-hickory forests seem to be suffering from some degree of maple takeover and one-third of the sites with flowering dogwoods have a problem with dogwood anthracnose.

CTAP monitoring of bird species at more than 300 forest, wetland, and grassland sites over the last four years shows the cumulative effect of habitat loss, degradation, fragmentation, and cowbird parasitism: bird species are declining over large segments of their ranges. In forests, only four highly area sensitive species were detected at more than 4% of sites. The Brown-headed Cowbird, a nest parasite, was one of the birds detected most often — at more than three-quarters (76.3%) of the sites. An average of only 1.8 grassland dependent species were detected in grasslands, a very low value when compared with historical data for Illinois. A total of only 22 wetland-dependent species were detected, with only 1.3 of these species found per wetland site. Only half of the wetland sites supported any wetland-dependent species, and only two-thirds of these contained more than one species.

Many of the sites monitored by the CTAP scientists and EcoWatch citizen scientists are under public ownership – 120 state sites, 48 federal sites, and 147 county sites. The CTAP data provide some sense of the success of preserving and managing natural lands in public ownership. Federal stream sites display high macroinvertebrate diversity, while urban and rural private stream sites show lower diversity due to organic pollution and other disturbances. State and county stream sites are of intermediate quality. In forests, state sites indicate the most success in keeping down invasive groundcover plants and in preserving disturbance-sensitive plants. Federal sites show less invasive shrubs than other sites. Regardless of ownership and management, these nuisance plants continue to be a serious problem across the state.

In general, the ecosystems of the Chicago Wilderness counties suffer more from the effects of

human disturbance. Many streams in the area score poorly on the MBI and EPT indices, two measures of organic pollution, particularly in the Chicago River and Upper Des Plaines watersheds. The forests of the Chicago Wilderness area likewise reflect the effects of urban disturbance. Non-native invasive plants such as buckthorn and garlic mustard plague the area to a greater degree than in other parts of the state. While EcoWatch monitoring results reflect the generally degraded nature of ecosystems in the Chicago area, stream quality is generally much better than in the past and there remain streams of high quality, particularly in the Prairie Parklands area (around Midewin) and the Kishwaukee watershed. High quality natural areas, including forests, prairies, and wetlands, remain throughout the area as they do throughout the state. Proper management can preserve them for future generations.

Despite these significant challenges, opportunities abound to improve and protect the natural resources of Illinois. CTAP will continue to provide information on the condition of Illinois ecosystems to support stewardship, but the endeavor will continue to require the joint efforts of government, private organizations, and caring individuals.

Aquatic Report:
Stream Quality Based on Monitoring of EPT Taxa

R. Edward DeWalt

Introduction

The Changing Illinois Environment: Critical Trends (Illinois Department of Energy and Natural Resources 1994) discussed several areas requiring additional research related to understanding the condition of flowing water habitats in the state. One such area was the need for long-term studies on aquatic insects. This is an assemblage for which long-term, quantitative information is lacking in Illinois. Systematic works provide qualitative information on where species of mayflies (Burks 1953), stoneflies (Frison 1935), and caddisflies (Ross 1944) were located and some indication of the quality of habitat in which they existed. CTAP professional scientists have been gathering quantitative data on mayflies, stoneflies, and caddisflies from randomly chosen streams since 1997. During this first five-year cycle of data collection, 150 sites were monitored. The objective of this first phase was to assess the current condition and geographic trends in stream quality across the state.

Methods

Several parameters were measured to assess stream condition including water chemistry, habitat quality, EPT taxonomic richness, and Hilsenhoff Biotic Index. Each of these is explained below. Snapshot values of several water chemistry and physical attributes were collected at each site using a Solomat 520-C multiparameter meter. These include water temperature, dissolved oxygen, pH, and conductivity. The meter was calibrated each day of use for all parameters measured.

Measurements of habitat quality are important in estimating the potential for healthy aquatic communities in a stream system. Habitat degradation, nutrient enrichment, and siltation from a variety of sources cause the most damage to aquatic systems (Karr et al. 1986). CTAP uses a 12-point quality scoring scheme developed by the USEPA (Barbour et al. 1999 and Plafkin et al. 1989). Values range from 0 to 180, with greater values indicating better habitat quality.

Stream conditions were also assessed using three orders of environmentally sensitive aquatic insects: the Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) (collectively, EPT taxa). These often contribute a major proportion of the abundance and species richness to the aquatic macroinvertebrate assemblage found in streams. EPT taxa richness (number of unique taxa in a sample) 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).

The Hilsenhoff Biotic Index (HBI), developed in Wisconsin, is a weighted average of the organic pollution tolerance of aquatic insects. Most taxa in the region have been assigned tolerance values that range from 0 to 10 (Hilsenhoff 1987). The HBI may range from 0 to 10 also, with higher values indicating greater tolerance or poorer condition.

The following data represent 66 sites for which all EPT specimens have been identified.

Results

Table 1 summarizes the distribution of EPT sampling efforts across all Illinois Streams Information System (ISIS) basins and for each of the five years of sampling. CTAP uses the ISIS basins to examine spatial patterns in stream conditions.

Table 1. Number of CTAP randomly chosen stream sites sampled during a 5-yr cycle beginning 1997.

Watershed	1997	1998	1999	2000	2001	Total
Big Muddy/Saline/Cache	4	3	1	5	1	14
Embarras/Vermilion S	3	0	7	1	6	17
Fox/Des Plaines	2	4	3	0	4	13
Kankakee/Vermilion N/ Mackinaw	3	7	5	7	3	25
Kaskaskia	4	6	1	2	5	18
LaMoine	2	4	5	2	3	16
Little Wabash	1	1	1	2	1	6
Rock	3	3	3	4	3	16
Sangamon	4	1	2	3	1	11
Spoon	3	1	3	4	3	14
Total	**29**	**30**	**31**	**30**	**30**	**150**

Dissolved oxygen values varied greatly across the state, but some trends included daytime values that were occasionally supersaturated in the Kankakee/ Vermilion N/ Mackinaw and Embarras/ Vermilion S basins. Streams in the Kankakee ISIS basin had the lowest percentage of forest cover within a 25 m buffer and tied for the second highest percentage of channelization across ISIS basins (Illinois Department of Energy and Natural Resources 1994). This coupled with great quantities of fertilizer entering the streams leads to increased algal growth and supersaturation of oxygen during the daytime. However, at least some of these streams experience large reductions in oxygen during pre-dawn hours, presumably due to respiration of the same algae (DeWalt et al. 1999).

The statewide average for habitat quality was 86 points (Fig. 1), indicating that most Illinois streams had fair to poor habitat quality. The basins with the highest habitat quality appeared

to be the Little Wabash, the La Moine, and the Sangamon, while the worst basins were the Kankakee/ Vermilion N/ Mackinaw and the Kaskaskia. The latter have most of their land use in row crop agriculture and streams have been channelized and cleared of trees.

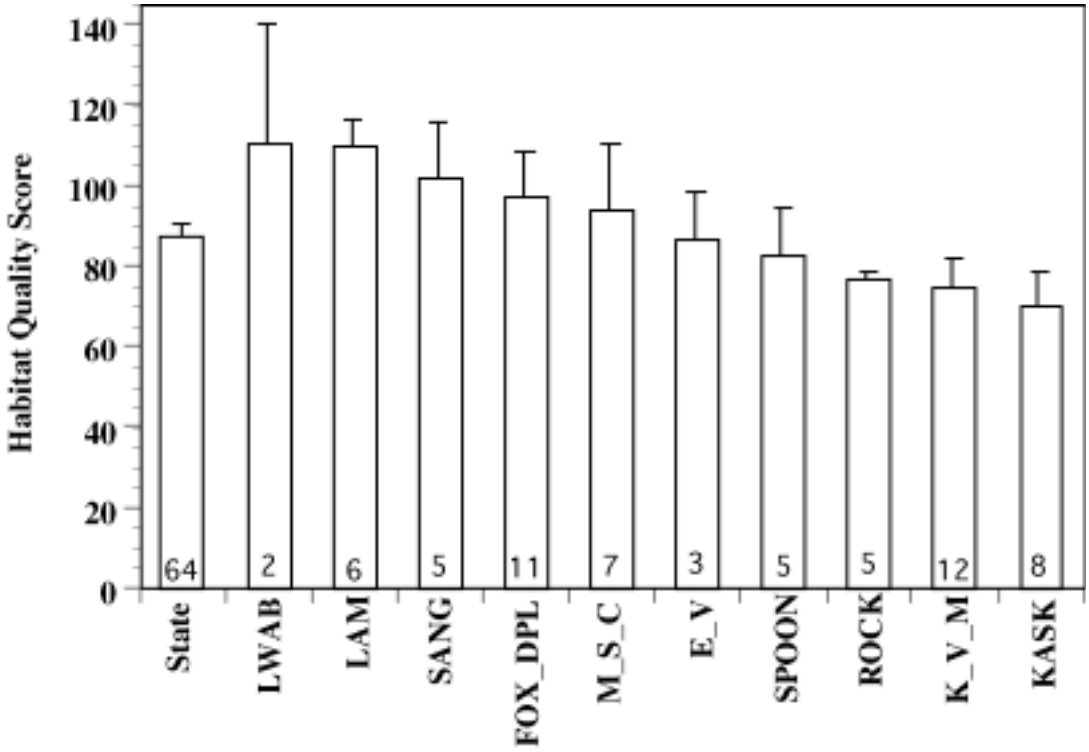

Fig. 1. Mean and standard error of habitat quality scores for CTAP streams. Abbreviations not obvious above are E-V = Embarras/ Vermilion S, SANG = Sangamon, LAM = La Moine, LWAB = Little Wabash, M-S-C = Big Muddy/ Saline/Cache, K-V-M = Kankakee/Vermilion N/Mackinaw, KASK = Kaskaskia. Number in bars indicate sample size.

EPT species richness averaged 7.2 across the state, indicating relatively poor to fair species diversity (Fig. 2). The INHS has ample historical data to indicate that values were higher in the early part of the century. It appears that modern stream conditions favor those species that have egg, nymphal, or pupal diapause – life history traits that minimize exposure to high summer temperatures, low dissolved oxygen, and stream intermittency. Those without such traits lose out in natural selection. This includes those species that have multiple year cycles; hence, species of large predatory stoneflies have experienced drastic range losses across the state. Again, highly agricultural basins seem to be the most heavily impacted.

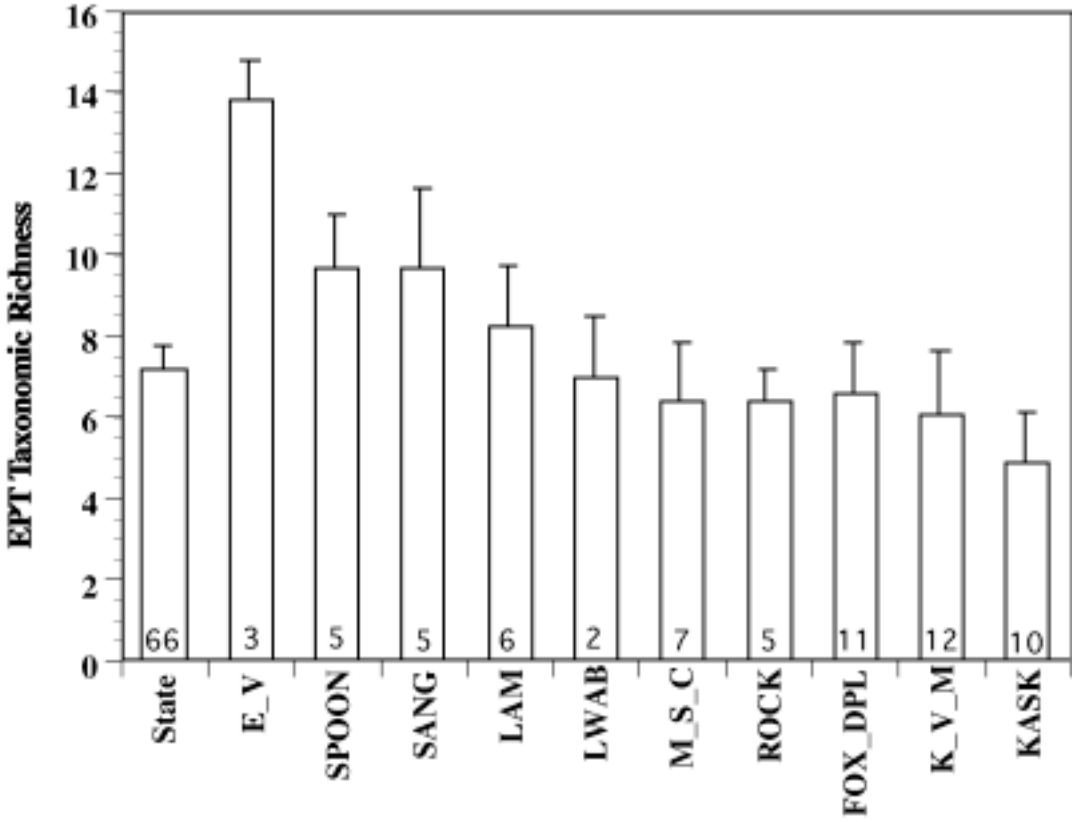

Fig. 2. Mean and standard error of EPT taxa richness for CTAP streams. Abbreviations not obvious above are E-V = Embarras/ Vermilion S, SANG = Sangamon, LAM = La Moine, LWAB = Little Wabash, M-S-C = Big Muddy/ Saline/Cache, K-V-M = Kankakee/Vermilion N/Mackinaw, KASK = Kaskaskia. Number in bars indicate sample size.

HBI averaged 5.2 statewide, indicating that streams were moderately impacted by organic enrichment (Figure 3). As a reminder, this index increases with greater organic enrichment and poorer stream quality. The Rock River basin had the highest average HBI of all groupings, which indicated that it was the most organically enriched. This basin has more cattle grazing than most other basins in the state, which contributes organic material to rivers through runoff. This is especially evident in many of the smaller streams of the region. Larimore and Bayley (1996) suggested that organic enrichment of streams in Champaign County had decreased since its zenith in the 1940s – 1960s. The change from livestock-based to grain-based agriculture and the installation of better wastewater treatment facilities has drastically reduced organic wastes entering streams in the county. This trend has presumably occurred in similar areas of the state.

Spearman Rank correlation suggested several interesting relationships among stream variables (Table 2). Trichoptera species richness increased from south to north. It is not yet known whether this is a historical trend or a recent development due to stream degradation. Conductivity also increased with latitude and appears related to changes in surface geology (low mineral rock in the south and limestone and dolomite in the north) and possibly to degree of urbanization, but the latter requires more investigation. Fine sediments seemed to decline toward the north, but increased toward the west, a trend that seems to follow soil type along the cline.

EPT richness was highly significantly correlated with both Ephemeroptera and Trichoptera richness, and all three were highly correlated with abundance. These are typical relationships between components of the index and with abundance. Abundance is a complex predictor of stream quality, with high and low abundances indicating impact. Several sites supported no EPT taxa, indicating that they were heavily impacted. Of course, abundance at these sites was zero.

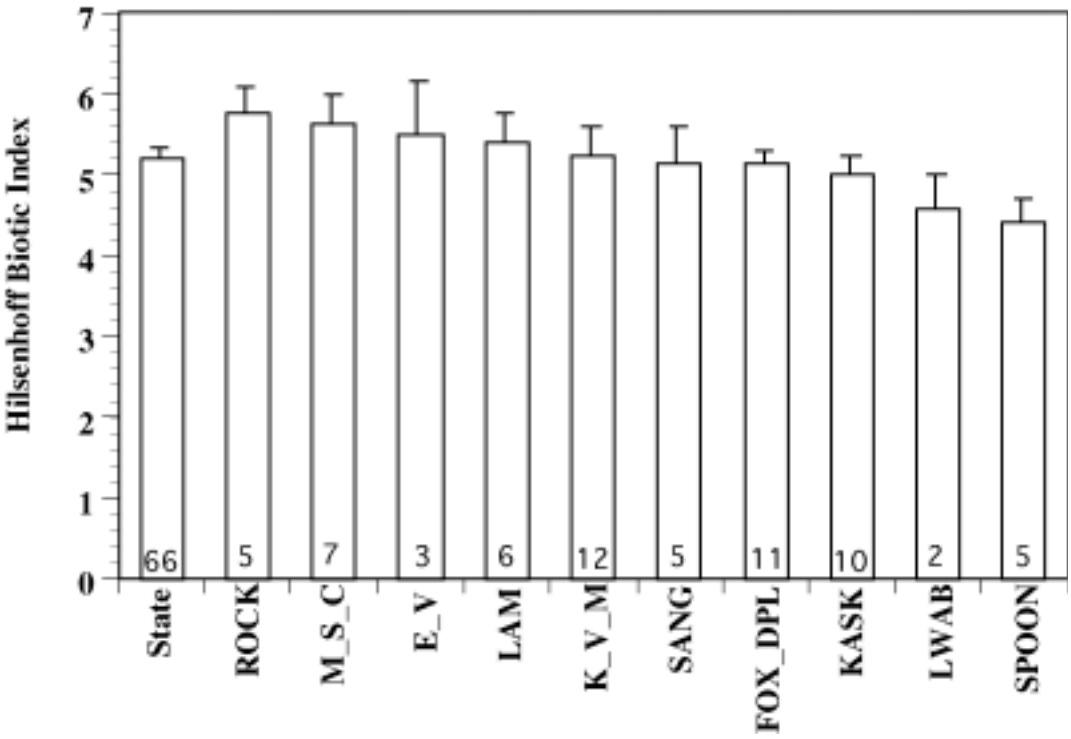

Fig. 3. Mean and standard error of HBI scores for CTAP streams. Abbreviations not obvious above are E-V = Embarras/ Vermilion S, SANG = Sangamon, LAM = La Moine, LWAB = Little Wabash, M-S-C = Big Muddy/ Saline/Cache, K-V-M = Kankakee/Vermilion N/Mackinaw, KASK = Kaskaskia. Number in bars indicate sample size.

HBI was negatively correlated with some richness variables and with abundance, and was an expected outcome. This relationship bolsters the use of both as indicators of water quality. However, because only EPT taxa were collected, sites that had zero EPT could not be scored for HBI. Only two sites fit this description. An interesting interpretation from the low coefficients of correlation between EPT and HBI is that even where there is higher than average EPT, the taxa that remain have relatively high tolerance values. In essence, very few truly intolerant species remain in the state because of historical, not contemporary, degradation.

Table 2. Significant Spearman Rank correlation results for CTAP stream sites in Illinois. For each pair of variables, the signed coefficient of correlation, probability, and sample size are shown.

Correlation	r_s	Prob.	# Obs.
Geographic coordinates			
Trichoptera richness and latitude	0.3	0.005	66
Conductivity and latitude	0.4	0.001	49
Fine sediment and latitude	-0.3	0.01	66
Fine sediment and longitude	0.4	0.0007	66
Taxonomic Richness, Abundance, and Hilsenhoff Biotic Index			
Abundance vs. EPT, E, and T richnesses	0.6-0.8	0.0001	66
EPT vs E and T richnesses	0.7-0.9	0.0001	66
HBI vs EPT and E richness, and abundance	-0.3 to -0.4	0.001-0.008	64
Habitat Quality			
Habitat Quality vs. T and EPT richnesses	0.3-0.35	0.01-0.003	64
Habitat quality vs. % Fine sediment	-0.47	0.0001	64
Water Temperature and Chemistry			
P richness vs. conductivity	-0.38	0.007	49
pH and dissolved oxygen	0.56	0.0001	46
P richness vs. temperature	-0.55	0.0001	60
T richness vs. temperature	0.31	0.01	60

Habitat quality correlated with EPT richness and Trichoptera richness, but with a low coefficient of correlation. One interpretation that this suggests is that good habitat does not always lead to higher EPT richness. Other factors such as organic and chemical pollution may be limiting the biotic potential of these sites. Additionally, it is possible that habitat quality has recovered, but that EPT richness has not improved due to great dispersal distances. In other words, because populations of EPT species that are most intolerant to pollution are isolated they are not able to migrate to other sites with improved water quality.

Plecoptera were negatively correlated with both temperature and conductivity. Stoneflies are temperature sensitive and are known to decrease along agricultural and urbanized gradients,

the latter often increasing conductivity in streams. Conversely, Trichoptera correlated with increasing water temperature. Most Trichoptera are adapted for warm water conditions, with large surface area to volume ratios contributed by fingerlike gills, especially so in the hydropsychids, or net-spinning caddisflies, the most abundant of the remaining caddisfly families in Illinois.

Conclusions

Initial findings strongly suggest that Illinois streams exhibit overall poor habitat quality. Considering the available data, very few high quality streams remain in the state, and great distances generally separate these. It appears that natural selection has worked against the most sensitive of aquatic insects through a complex array of landscape modifications that influence stream temperature, habitat quality, and hydrologic regimes.

Over the next five-year cycle, improvements based on changing land practices may be observed. These could most rapidly be seen in habitat quality and to a limited degree in some water chemistry parameters. Increases in EPT richness are possible in relation to these changes, but would most likely due to a homogenization of the available regional species pool. Dispersal of truly sensitive aquatic insects may be delayed for some time due to the great distances between "islands" of sensitive EPT assemblages (Zwick 1992). Aquatic insects are not as vagile as fish, and may require longer time spans to reinvade restored streams (Barbour et al. 1999). Any large-scale restoration in the near future might require reintroduction of sensitive species to help bridge this geographic gap.

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RiverWatch:
Stream Quality in the Year 2000

Alice Brandon

Introduction

The RiverWatch Program uses several indices to estimate the quality of Illinois streams. The Macroinvertebrate Biotic Index (MBI) is an index that rates stream health using 1) a taxa's tolerance to pollution and 2) the number of organisms sampled. The lower the MBI value the better the stream quality. This index is similar to the HBI discussed in the article on CTAP stream monitoring but is calculated from thirty-six macroinvertebrate taxa rather than just EPT species (mayflies, stoneflies and caddisflies).* Other stream indices used by RiverWatch to characterize stream quality include total taxa richness and the percentage of EPT taxa and worms (bloodworms and aquatic worms) in the samples. Total taxa richness (the number of unique taxa in a sample) is an important measurement of stream biodiversity. Typically, as stream quality increases so does taxa richness. EPT taxa are generally considered to be intolerant to pollution and habitat degradation. Therefore, streams with a high percentage of EPT taxa tend to have greater biological integrity and health compared to streams with low percentages. In contrast, bloodworms and aquatic worms are generally very tolerant of pollution and other human disturbances and therefore are abundant in degraded streams. Finally, volunteers collect valuable information on the statewide occurrence and distribution of species of special interest including native mussels and exotic species, such as the zebra mussel.

Statewide Results

The average MBI score for monitored streams was 5.8 with the scores ranging from 3.3 to 10.4. The majority of stream sites had a MBI score of less than 6.0. Less than 10% of sites had a high MBI score above 7.6. This indicates that Illinois streams are generally dominated by organisms that are moderately tolerant of organic pollution.

Streams sites, on average, displayed a taxa richness of 9.4. Taxa richness ranged from one to 20 taxa (out of the 36 possible). The most common taxon found across all sites were sowbugs, while the least common taxon were snipe flies. Twelve percent of the monitored sites recorded less than five indicator taxa, 55% had six to 10 taxa, and 32% had greater than 10 taxa.

Fingernail clams were the most common species of special interest reported and occurred at 28% of the monitored sites. They are indicators of good stream quality. Chinese mystery snails were not reported at any monitored sites and only one site reported zebra mussels;

* EPT = Ephemeroptera, Plecoptera, and Trichoptera insect orders.

these are both invasive non-native species of concern to biologists. Volunteers noted the presence of native mussels at 10% of the sites (Table 1).

Table 1. Macroinvertebrates of special interest across all monitored sites.

Organism	Occurrence
Native mussels	33 sites (10%)
Fingernail clams	88 sites (28%)
Zebra mussels	1 site (0.3%)
Asian clams	33 sites (10%)
Chinese mystery snail	0 sites
Rusty crayfish	21 sites (7%)

A Spearman rank correlation was used to examine the relationship between indicator organisms and stream bottom substrates. (Correlation allows one to measure the degree of the relationship between two sets of data. The higher the correlation, the more related the data sets are to each other.) Certain stream substrate types were significantly correlated with particular indicator taxa (Table 2). For example, EPT taxa were positively correlated with rocky bottom streams, indicating this type of stream supports greater numbers of pollution intolerant taxa. In contrast, bloodworms and aquatic worms were negatively correlated with rocky bottom streams and positively correlated with silty bottom streams, indicating these taxa thrive in silt and other muddy bottom habitats.

Table 2. Spearman rank correlation coefficients between % indicator organisms and % stream substrate types across all sites; the percentage indicates the variability in each taxa that can be explained by substrate type, ns = no significant correlation (BLD = bloodworms, AQW = aquatic worms; p > 0.05).

	Boulder (%)	Cobble (%)	Gravel (%)	Silt (%)
Mayflies (%)	10%	13%	ns	-17%
Stoneflies (%)	14%	18%	ns	-12%
Caddisflies (%)	23%	31%	17%	-21%
BLD (%)	-15%	-21%	-11%	17%
AQW (%)	ns	-13%	ns	22%

A Spearman rank correlation was also used to look at the relationship between indicator taxa and land uses. Certain indicator taxa were significantly correlated with specific watershed land uses (Table 3). Generally, mayflies and stoneflies were negatively correlated with human disturbances to the landscape such as urbanization and housing construction. Caddisflies, which are considered pollution intolerant taxa, were positively correlated with

Table 3. Spearman rank correlation coefficients between % indicator organisms and land uses across all sites; the percentage indicates the variability in each taxa that can be explained by substrate type, ns = no significant correlation (BLD = bloodworms; AQW = aquatic worms; p > 0.05).

	Forests (%)	Urban n (%)	Crops (%)	Livestock (%)	Housing construction (%)	Ungrazed fields (%)	Commercial industrial (%)
Mayflies (%)	11%	-15%	17%	12%	-13%	ns	-13%
Stoneflies (%)	16%	-11%	ns	ns	ns	17%	ns
Caddisflies (%)	ns	ns	ns	11%	15%	ns	14%
BLD (%)	ns	ns	12%	ns	ns	ns	ns
AQW (%)	-14%	ns	ns	ns	ns	-12%	12%

housing construction and commercial/industrial sites and were not significantly associated with more benign land uses such as forestland and un-grazed fields. This can be explained by the inclusion of the caddisfly family, Hydropsychidae, in total abundance counts. This family tends to be more tolerant to pollution than most other caddisflies and is one of the most common taxa collected by volunteers.

Bloodworms and aquatic worm taxa are typically associated with polluted streams that contain poor habitats. RiverWatch data supports this assertion with aquatic worms having a negative correlation with forestland and un-grazed fields land uses and a positive correlation with commercial/industrial land uses (Table 3). Therefore, aquatic worms were more abundant at human disturbed sites and less abundant at sites where forestland or pastures dominated the landscape.

Monitored Streams by Watershed

RW volunteers monitored 309 sites statewide in 2000. However, there were an additional 48 sites where volunteers attempted to monitor but could not due to flooding or low water levels. There was a 10% decrease in total monitored sites from 1999 to 2000. However, the decrease in monitored sites was partially explained by an increase in flooding frequency during the 2000-monitoring season.

The occurrence of flooding increased by 38% from 1999 to 2000. A comparison of streams by watershed showed that seven watersheds saw a decrease in total monitored sites (Table 4). Most of these decreases were fairly small, with the exception of two watersheds where there was a substantial decrease in total monitored sites. The substantial drop in monitored sites within the Rock and Big Muddy watersheds was primarily due to flooding (nine sites in the Big Muddy and 10 in the Rock River watersheds).

Table 4. The number of streams monitored by watershed from 1999 to 2000.

Watershed	Streams in watershed	1999	2000	Change
Rock	190	46	36	- 10
Fox	135	88	84	- 4
Kankakee	174	20	23	+ 3
Spoon	133	17	15	- 2
Sangamon	136	10	15	+ 5
La Moine	191	41	38	- 3
Kaskaskia	195	42	36	- 6
Embarras	153	17	20	+ 3
Little Wabash	120	5	0	- 5
Big Muddy	160	56	42	- 14
Total*	**1587**	**342**	**309**	**-33**

*Number of streams is based on the Illinois Streams Information System database, which contains all streams that have a watershed size of 10 square miles or more. RiverWatch volunteers also monitor streams with watersheds smaller than 10 square miles.

RiverWatch Stream Indices by Watershed

The Rock River and Big Muddy watersheds averaged the lowest MBI scores (5.1-5.2), indicating higher water quality by this measure. The Embarras watershed showed the poorest average MBI (6.6), although several other watersheds — the Sangamon, La Moine, and Kaskaskia — also had MBI scores over 6.0 (Table 5).

Mean taxa richness ranged from 7.7 to 11.0 by watershed, with the Kankakee River having the highest taxa richness and the Big Muddy River having the lowest taxa richness. However, the Big Muddy scored well on other measures; it had the second best MBI score and a low number of pollution tolerant organisms such as bloodworms (Table 5). Across the majority of indices the Sangamon, Embarras, and Kaskaskia watersheds scored the poorest, displaying the highest percentage of bloodworms and aquatic worms and the lowest percentage of EPT taxa (mayflies, stoneflies, and caddisflies). In comparison, the Rock and Kankakee watersheds had the highest numbers of EPT taxa (36% and 37%, respectively).

In addition, watersheds that were dominated by rocky bottom substrates also tended to have the highest percentage of EPT taxa and scored better over most indices while the watersheds dominated by silt/sandy substrates, such as the Sangamon watershed, scored poorer over most indices (Table 5).

Table 5. RW indices separated by watershed for the 2000 monitoring season; mean Macroinvertebrate Biotic Index (MBI), mean taxa richness and the mean percentage (%) of Ephemeroptera, Plecoptera and Trichoptera (EPT), bloodworms (BLD), and aquatic worm (AQW) indicator organisms in the samples. The mean percentage (%) of the watershed dominated by rocky bottom versus silt/sand substrates is also included.

Illinois Watersheds						
	Mean MBI	Mean Taxa Richness	Mean EPT Taxa (%)	Mean BLD & AQW (%)	Rocky Substrates (%)	Silt/Sandy Substrate (%)
Rock	5.1	10.2	36 %	3%	55%	40%
Fox	5.9	9.2	27%	7%	56%	34%
Kankakee	5.5	11.0	37%	3%	55%	45%
Spoon	5.5	10.7	25%	2%	51%	41%
Sangamon	6.3	8.2	13%	17%	37%	56%
La Moine	6.2	9.7	20%	8%	35%	51%
Kaskaskia	6.2	8.0	14%	10%	34%	53%
Embarras	6.6	7.9	21%	20%	44%	54%
Big Muddy	5.2	7.7	24%	4%	56%	22%

Botanical Report:
Tracking non-native species in Illinois

Brenda Molano-Flores, Jamie Ellis, Connie Carroll, and Greg Spyreas

Introduction

Non-native species are a global problem. Determining the impact and the rate of invasion by non-native species is a long-term endeavor. In Illinois, the Illinois Department of Natural Resources established the Critical Trends Assessment Program (CTAP) to determine the current condition and future trends of Illinois' streams, forests, wetlands, and grasslands. One of the many issues that the program is trying to address is the abundance and impact of non-native species, particularly in the terrestrial habitats.

Since 1997 CTAP biologists from the Illinois Natural History Survey (INHS) have been conducting monitoring on 30 sites per terrestrial habitat per year for a total of 450 sites at the end of 2001. They will revisit each of these sites every five years beginning in 2002 to assess changes. The ultimate goal of CTAP is to help scientists, local groups, lawmakers, state and federal agencies, and citizens of the state make better management, conservation, and policy making decisions regarding Illinois' ecosystems. Here we present preliminary results associated with the abundance of non-native plant species in Illinois' forests, wetlands, and grasslands.

Methods

INHS staff randomly selected monitoring sites from across the state on both public and private land using the Illinois Land Cover Map and Illinois Wetland Inventory. In four years (1997-2000) CTAP biologists visited a total of 103 forest, 108 wetland, and 97 grassland sites (Fig. 1). Table 1 shows some of the types of forests, wetlands, and grasslands that they monitor. Staff visit the monitoring sites during the growing season from mid-May to the end of August.

At each site biologists collect data on herbaceous and woody vegetation data. In forests they establish three 50 m transects and set ten 1/4 m^2 quadrats along each to estimate ground cover using a modified Daubenmire method. Also, in each transect they establish a 4 m x 50 m shrub plot and a 10 m x 50 m tree plot. In wetlands and grasslands the INHS scientists use a single 41 m transect. Along this transect they place twenty 1/4 m^2 quadrats to estimate ground cover and establish a 4 m x 41 m shrub plot and 41 m x 50 m tree plot. The locations of the center point and transects at each site are geo-referenced to facilitate relocation.

For each site, biologists measure several indices including species richness, diversity, and dominance of native, non-native, and threatened and endangered (T&E) species. They also

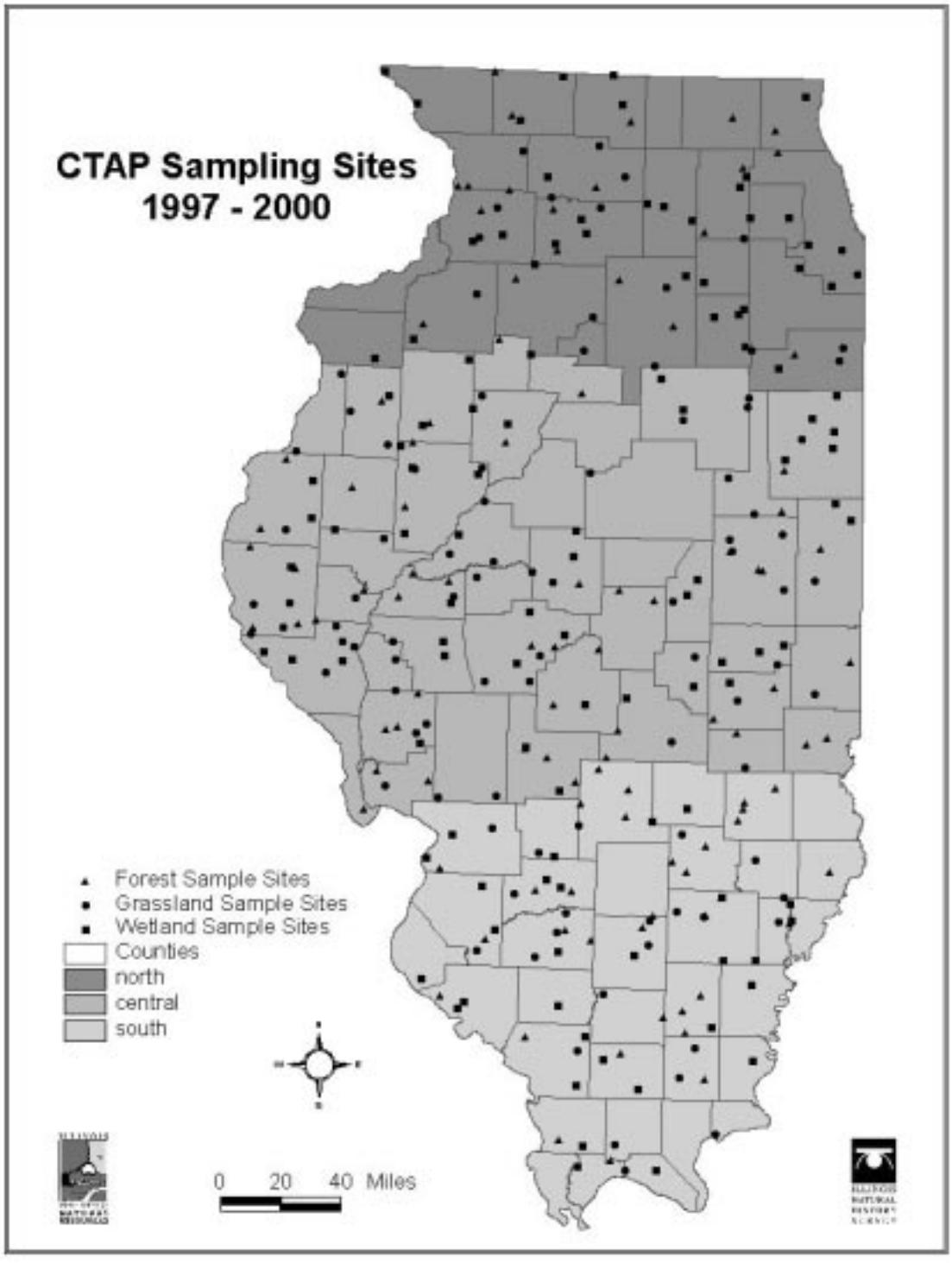


Figure 1. Location of monitoring sites across Illinois from 1997-2000.

Table 1. Examples of sites sampled by CTAP per habitat type (sampling time*).

Forest (May-June)	Grasslands (August)	Wetlands (July)
• Dry to mesic upland • Floodplain • Mature pine plantation with natural succession • Deciduous closed canopy (= to 75% canopy cover)	• Old fields • CRP • Prairies • Ungrazed (abandoned) or lightly grazed pastures • Overgrown or un-mowed rights-of-way	• Marsh • Sedge meadow • Wet meadow • Wet shrubland (< 50% woody cover) • Other (fens, seeps)

*Sampling time may differ for CTAP ornithologists (see Ornithological Report)

collect data on birds and insects at each site, but only data related to herbaceous and woody vegetation are presented here. (See Ornithological Report for information on the bird data.) Finally, to facilitate regional comparisons, because of north to south climatological and geological differences, the state has been roughly divided into thirds (north, central, and south).

Results

In all habitats overall species richness of native species is greater than that of non-native species (Fig. 2). Forest sites across the state have the highest number of native species among the three habitat types (Fig. 2). In addition, on average, forest sites have greater ground cover of native species than non-native species (Fig. 3). In grasslands, on the other hand, non-native species often dominate natives in the ground cover (Fig. 4). Wetlands did not show a clear pattern except in the case of southern Illinois sites where they seem to have a relatively low coverage of non-natives compared to northern and central sites (Fig. 5).

Tables 2-4 show a list of the most common non-native species found in forests, wetlands, and grasslands. In the case of forests, multiflora rose (*Rosa multiflora*) is the most common non-native species found on CTAP sites. This species is found in more than half of the sites (53 out of 103 [51%]), however its dominance is generally low (Table 2). Multiflora rose seems to be a significant problem mostly in central Illinois. Out of 49 sites it can be found in 30 and is dominant in six. Shrub honeysuckle species (*L. tatarica, L. morrowii, L. maackii, L.* x *bella*) are more prevalent in the north and vine honeysuckle (*L. japonica*) is more prevalent in the south. Garlic mustard (*Alliaria petiolata*) and buckthorns (*Rhamnus cathartica* and *R. frangula*) were not found in southern Illinois sites (Table 2), but are often the dominant species in northern Illinois sites.

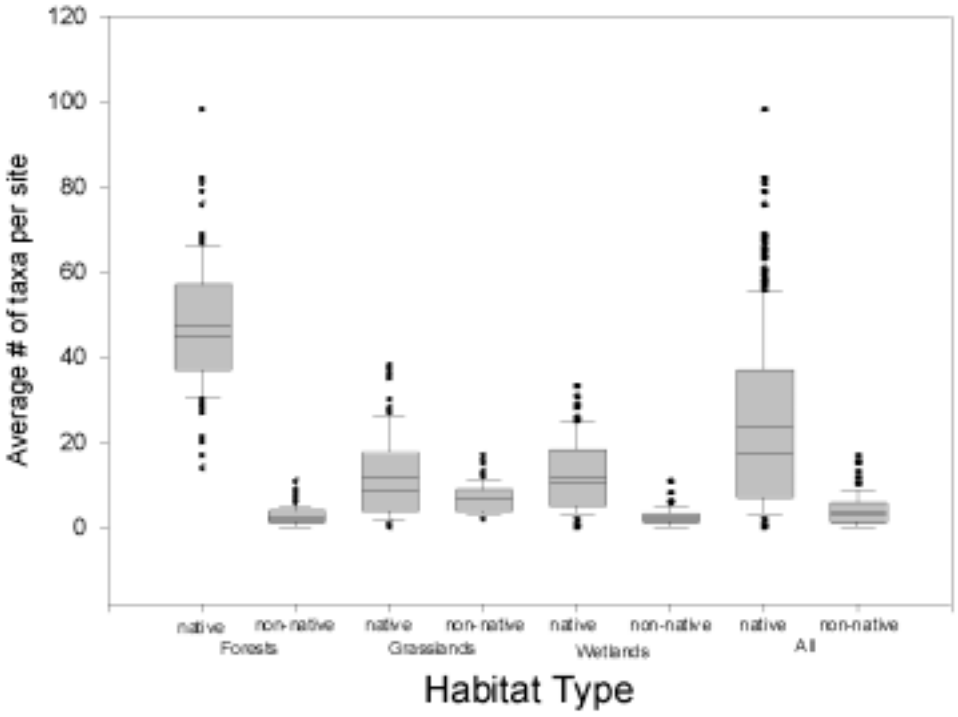


Figure 2. Species richness across all sites and all strata, 1997-2000.
(Bar = standard deviation)

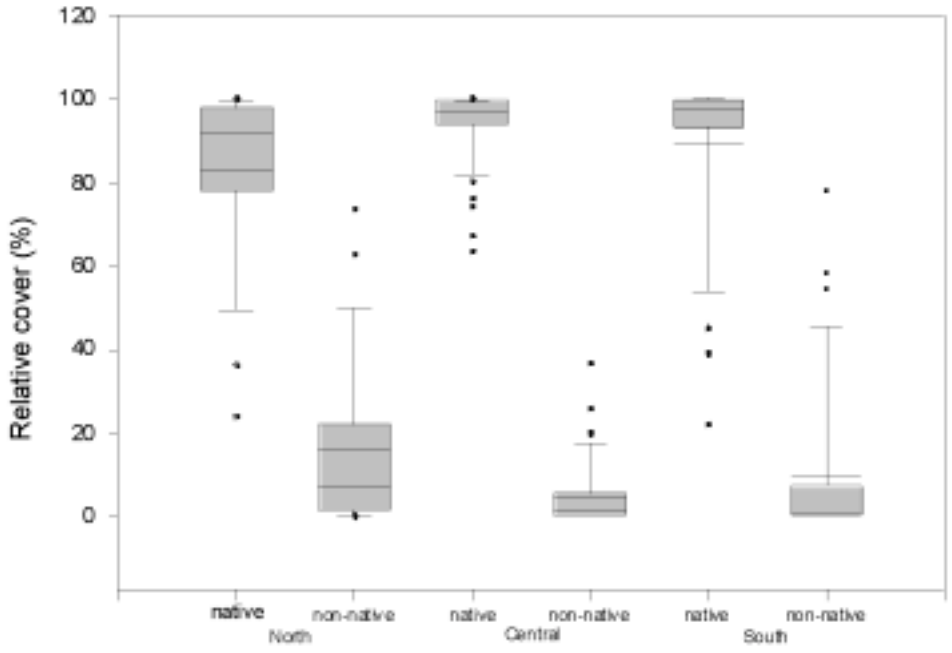


Figure 3. Ground cover strata for forests by region, 1997-2000.
(Bar = standard deviation)

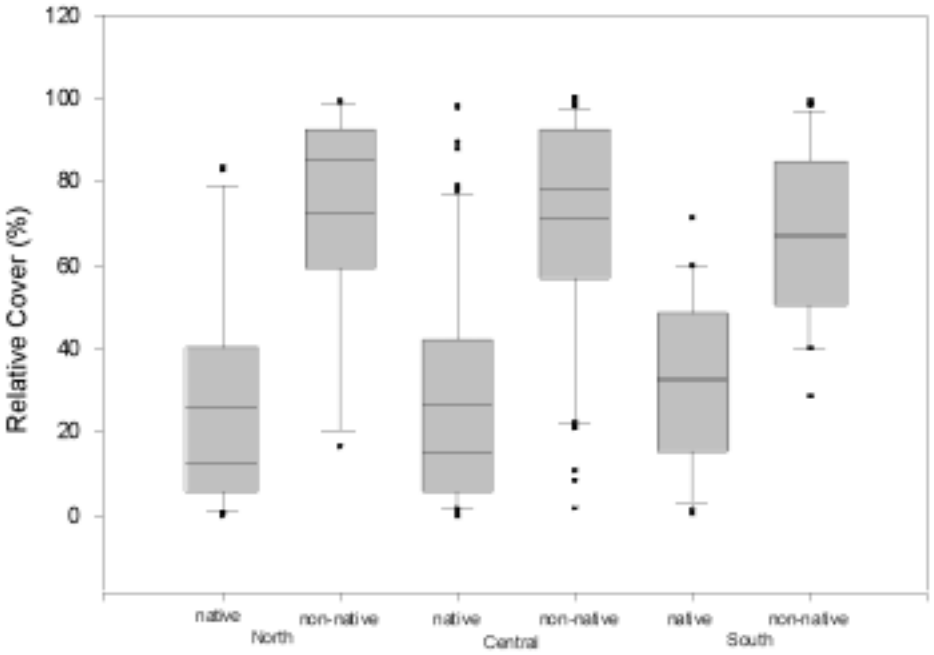


Figure 4. Ground cover strata for grasslands by region, 1997-2000. (Bar = standard deviation)

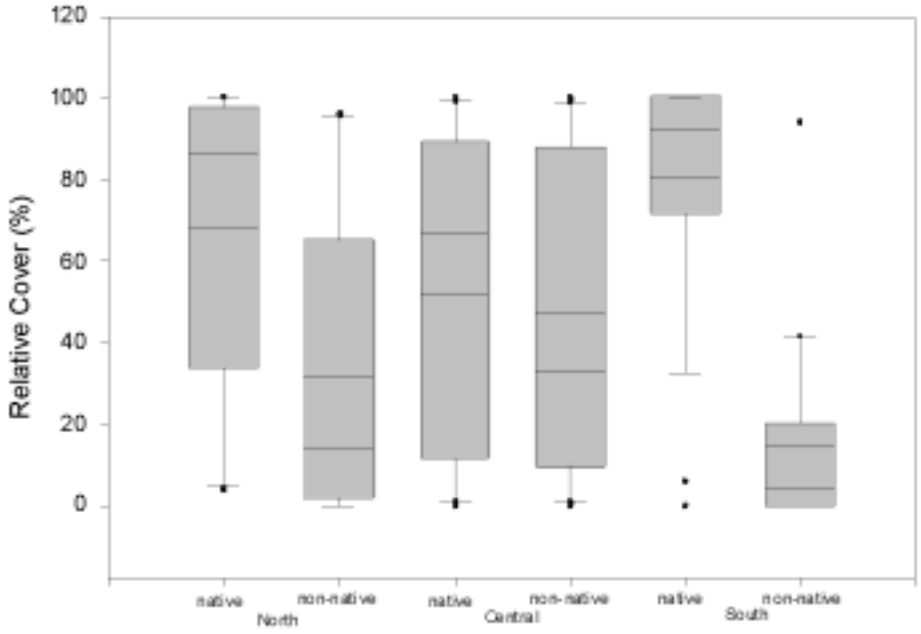


Figure 5. Ground cover strata for wetlands by region, 1997-2000. (Bar = standard deviation)

Table 2. Non-Native Species in CTAP Forest Sites by Region (number of sites monitored is in parentheses).

	North (21)		Central (49)		South (33)		State (103)
	# sites	dominant	**# sites**	dominant	**# sites**	dominant	**# sites**
Multiflora rose	**12**	0	**30**	6	**9**	1	**53**
Shrub honeysuckle	**11**	1	**8**	0	**2**	0	**21**
Japanese honeysuckle	**0**	0	**4**	1	**13**	4	**17**
Garlic mustard	**6**	3	**7**	1	**0**	0	13
Buckthorn	**6**	4	**2**	0	**0**	0	**8**

Table 3. Non-Native Species in CTAP Grassland Sites by Region (number of sites monitored is in parentheses).

	North (19)		Central (55)		South (23)		State (97)
	# sites	dominant	**# sites**	dominant	**# sites**	dominant	**# sites**
Hungarian brome	**15**	5	**26**	9	**1**	1	**42**
Fescue	**13**	0	**25**	18	**21**	18	**59**
Kentucky bluegrass	**7**	5	**30**	6	**15**	0	**52**
Canada bluegrass	**8**	1	**10**	1	**6**	0	**24**
Orchard grass	**7**	1	**15**	5	**4**	0	**26**

Table 4. Non-Native Species in CTAP Wetland Sites by Region (number of sites monitored is in parentheses).

	North (31)		Central (47)		South (30)		State (108)
	# sites	dominant	**# sites**	dominant	**# sites**	dominant	**# sites**
Fescue	**2**	0	**7**	4	**3**	0	**12**
Narrow-leaved cattail	**4**	2	**0**	0	**5**	0	**9**
Reed canary grass	**17**	9	**27**	19	**6**	3	**50**
Barnyard grass	**2**	0	**11**	1	**10**	0	**23**
Common reed*	**0**	0	**1**	0	**5**	5	**6**

* Species locally native in Illinois, but becoming invasive out of its original range

In grasslands, the three most common non-native species that were found across Illinois are: fescue (*Festuca* sp.), Kentucky bluegrass (*Poa pratensis*), and Hungarian brome (*Bromus inermis*) (found in 61%, 54%, and 43% of all sites visited respectively) (Table 3). However, only in central and southern Illinois is fescue the dominant species. This species was dominant at 72% of the sites in central Illinois and at 86% of the sites in southern Illinois.

In wetlands, reed canary grass (*Phalaris arundinacea*) is the most often encountered species (Table 4). This species was found in 50 out of 108 (46%) visited sites and was the most dominant species in 62% of those sites. In northern Illinois, this species was dominant in 53% of the sites and in central Illinois in 70%. It should be pointed out that at many of these sites this species exits as a near monoculture.

Finally, from 308 sites visited in four years only two T&E plant species (*Cyperus grayioides* [Mohlenbrock's umbrella sedge] and *Mimulus glabratus* var. *fremontii* [yellow monkey flower]) were found at two different sites.

Discussion and Conclusions

From the data collected by CTAP biologists we have determined that although the number of non-native plant species are few in forests, wetlands, and grasslands, their dominance is a problem, particularly in grasslands, less so in wetlands and least in forests. Also, regional differences between presence and dominance of non-native species occur across the state for each habitat.

The prevalence of non-native species can be explained mostly by the anthropomorphic changes that have occurred in the state. For example, fescue and Kentucky bluegrass dominate most Illinois grasslands because today nearly all grasslands are not native prairies but are planted areas used mostly for pasture. Forests have been affected by a lack of ecological management and land uses such as grazing and logging. The invasion of non-native species in wetlands can be explained by changes in hydrology (e.g., ditching wetlands, channelizing streams), intentional planting, siltation, and biology of the invasive species. For example, the dominance of reed canary grass can be explained by its rhizomatous growth forming monotypic stands, thereby allowing few other plant species to grow. Interestingly, purple loosestrife (*Lythrum salicaria*) has not been detected as a major problem in any of the CTAP wetlands, although this species has become a major invader of wetlands especially in northern Illinois.

In addition, only two out of 322 Illinois T&E plant species were found in CTAP sites. This information in association with the prevalence of non-native species suggests that suitable habitat for many of these species has disappeared and underscores the necessity to preserve high quality undisturbed natural communities. It should be pointed out that because CTAP sites are selected at random in this program, only a small number of what can be considered pristine habitats are visited by CTAP biologists, potentially explaining the few T&E species encountered.

Although our findings are showing that grasslands and wetlands may have a greater problem with non-native species than forests, and, that few T&E species have been found at CTAP sites, these findings have to be taken with caution. For example, although we have only detected garlic mustard in northern and central Illinois forests, this species is also known to occur (on a small scale) in the southern portion of the state.

It must be noted that while this program provides one of the most complete statewide studies in the USA, some trends may escape detection. However, by collecting data from permanent plots over the long-term, CTAP will allow us to have a better understanding of the changes that these habitats are undergoing.

ForestWatch Report: Forest Quality Indicators in Year 2000 and Cumulative Review

Matt Buffington

Introduction

Forest ecosystems are complex and identifying one or two indices to describe forest conditions is quite difficult. The ForestWatch program uses several indices to describe the current condition of the forests. Some of these indices typically change very slowly over time, such as tree trunk diameter, whereas others may change quickly, such as the amount of invasive ground cover. Data from year 2000 are summarized below, followed by a brief discussion of all ForestWatch data collected to date. ForestWatch spring monitoring examines various features that are best observed before the tree canopy fills, while fall monitoring involves features that generally require trees in full leaf. The following are the indices used to analyze ForestWatch data in each season:

Spring Indices	Fall Indices
• percent cover of indicator ground cover species	• tree species abundance and basal area
• ratio of disturbance-sensitive to non-native, invasive species	• tree species importance value
• frequency of occurrence disturbance-indicator and non-native, invasive plants	• tree species richness
• canopy height	• ratio of sugar maple, to oak and hickory by diameter class
• amount of downed wood	• ratio of non-native to native shrub species
• type of human use	• amount of sunlight reaching the forest floor
	• presence/absence of gypsy moths and dogwood anthracnose

Spring Results

Forty sites were monitored in spring 2000, 38 of which were also monitored in the fall. Two surveys are conducted in the spring to examine the presence and coverage of disturbance-sensitive and non-native invasive ground cover species. The presence-absence survey examines whether the indicator plants are present in each of the thirty 5m by 10m plots on a ForestWatch site, while the quadrat survey measures the actual coverage of these plants in fifteen $^1/_4$ m^2 quadrats. Table 1 lists the taxa considered in the surveys and their indicator category.

In the presence-absence survey, disturbance-sensitive species were encountered at 22 sites, while non-native species were at 18 sites. Of the 1,140 total plots in the presence-absence survey, 248 (22%) had disturbance-sensitive species and 325 (29%) had non-native species. Bleeding hearts were the most frequently encountered disturbance-sensitive species while garlic mustard was the most commonly encountered non-native. Non-native species tended to be encountered more frequently in the northern third of the state.

Table 1. List of spring ground cover species by type.

Disturbance-sensitive	Common Native	Non-Native, Invasive
Blue Cohosh	Virginia Bluebells	Garlic Mustard
Maidenhair Fern	Wild Columbine	Dame's Rocket
Doll's Eyes	Blue Phlox	Moneywort
White Trillium	Blue-eyed Mary	Ground Ivy
Large-flowered Bellwort	Red Trillium	
Bleeding Hearts	Wild Geranium	
Virginia Spiderwort	Swamp Buttercup	
Hepatica	Sensitive Fern	

In the coverage survey (quadrats) at least one disturbance-sensitive species was present at 11 sites and non-native species were present at 15 sites. Despite this relatively small difference in number of sites, non-natives covered about 10 times as much area as disturbance-sensitive species and twice as much area as common natives (Table 2). The presence-absence and quadrat data combined indicate that when non-native, invasive species are present, they tend to be widespread.

Table 2. Spring ground cover.

Cover Type	Cover (m^2/ha)
Herbaceous cover	2181.71
Woody cover	790.29
Disturbance-sensitive	32.97
Common native	129.01
Non-native invasive	330.63

The majority of the downed wood recorded was in the smallest diameter class (Figure 1). This suggests the following: 1) Illinois forests are fairly young, with few large trees falling over as the result of old age; 2) many pieces of downed wood are branches which are numerous and tend to be small in diameter; and 3) people are collecting larger pieces of downed wood for various uses, including firewood. The relative role of these three factors will become more obvious after repeated monitoring from the same sites.

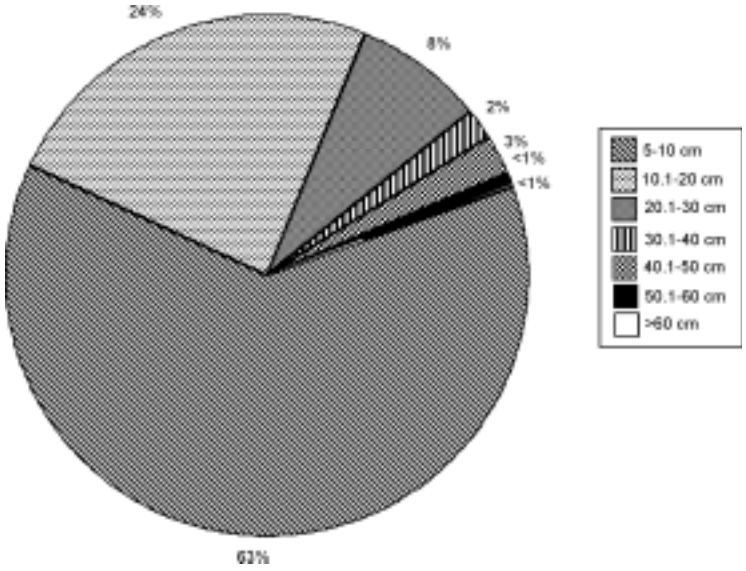


Figure 1. Amount of downed wood from ForestWatch sites, spring 2000.
Values are diameter in centimeters.

All ForestWatch sites receive some degree of human use. Many have trails (nine sites) and cut tree stumps (11 sites), indicating two fairly different types of use. The most common use, or abuse, was trash strewn (18 sites) around the site. This may be as simple as a single glass bottle along a transect or various objects scattered about the site. Seven sites are undergoing restoration, such as prescribed burning, removal of trees or exotic plants, and herbicide use. While many volunteers were uncertain about the complete history of their sites, several mentioned their sites had a history of grazing or relatively recent tree harvesting. Finally, the average height of the tallest canopy trees was 21.1 meters, or about 70 feet, and the average diameter of the trees measured for height was 34.6 centimeters.

Fall Results

Fifty-one sites were monitored in fall 2000. Each site averaged about 11 tree species and 126 trees. A total of 76 taxa were recorded in the tree survey. Average canopy cover was 78.5%. Most of the sites monitored were oak-hickory uplands (53%) — the most common forest type in Illinois — and the tree species often found in oak-hickory forests were among the most common species recorded, including white, red, and black oaks, several species of hickory, slippery elm, black cherry and sugar maple (Figure 2). One of the more abundant species was white pine as a result of one site that is located next to a pine plantation. This site is an oak-hickory forest that is being overrun by pines — it currently has more than 300 small white pines in the ForestWatch monitoring area. Buckthorn is most often recorded in sites from northeastern Illinois. The fact that it is in the top 10 of more than 70 species statewide underscores the buckthorn problem in that region. It is also a problem in the shrub layer, discussed later in this report.

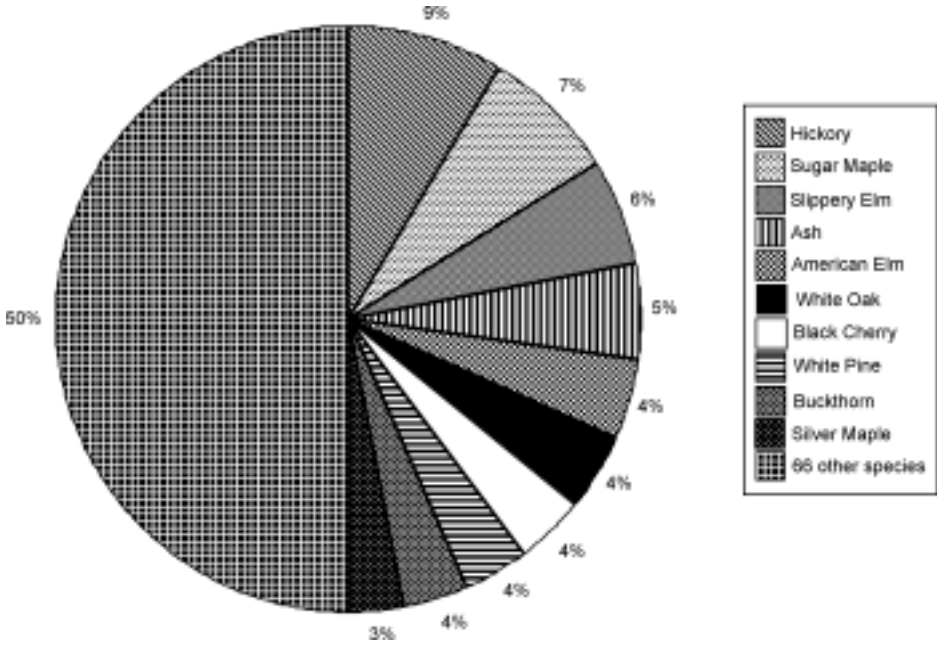


Figure 2. Abundance of top 10 trees from ForestWatch sites, fall 2000.

Another important measure of ecological dominance is basal area, the cross-sectional area of a tree trunk at 1.3 meters. The top 10 trees in terms of basal area are similar to the top 10 most abundant, although a few species moved up or down (Figure 3). Some species that are highly abundant, like slippery elm, are generally understory trees and thus have a relatively low total basal area compared to larger but less abundant species. White pine ranks 16th in basal area and buckthorn is 24th, while both are in the top 10 for abundance.

In Illinois, oak trees are much larger than many other species. All of the oak species combined account for just 14% of the abundance but 40% of the basal area. When volunteers are unsure of the correct species name for tree, they identify it to either genus or group, for example, the white oak group. Trees recorded as being in the white oak group were 22nd in abundance but 7th in basal area. Volunteers placed these trees in this group because they were unable to identify them to species. This suggests that some of the more difficult trees for volunteers to identify to species are very large trees that do not have leaves within easy reach to aid in identification. In addition, many oaks are difficult to identify because of variation in leaves on individual trees.

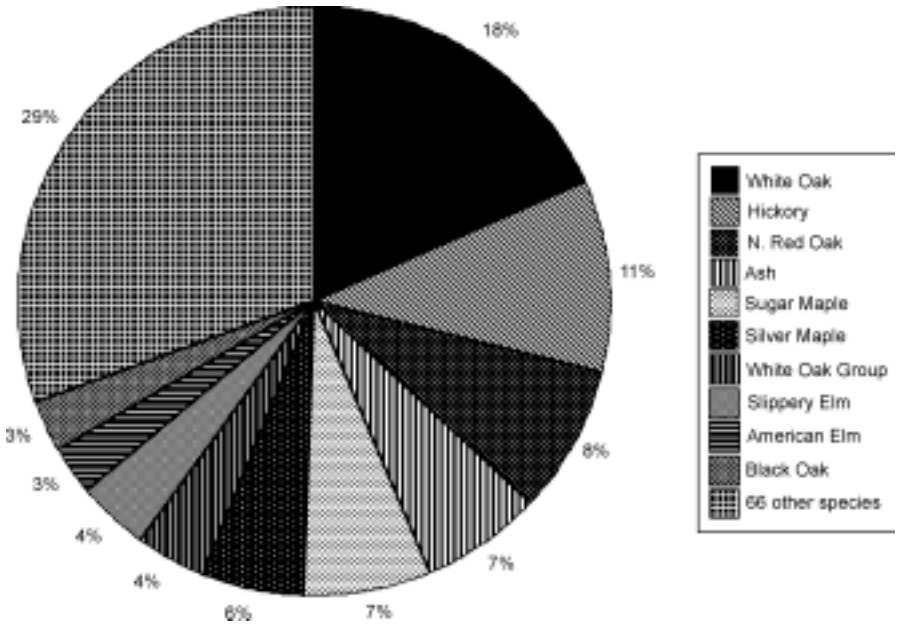


Figure 3. Basal area of top 10 trees from ForestWatch sites, fall 2000.

An importance value (IV) of each tree species was determined based on relative abundance and relative basal area to get an overall score of the species' dominance. The top six in terms of IV were white oak, hickory, sugar maple, ash, northern red oak, and slippery elm (Figure 4). These six species comprise 50% of the total IV. The top species and their percent of the total IV are very similar to those from 1998 and 1999.

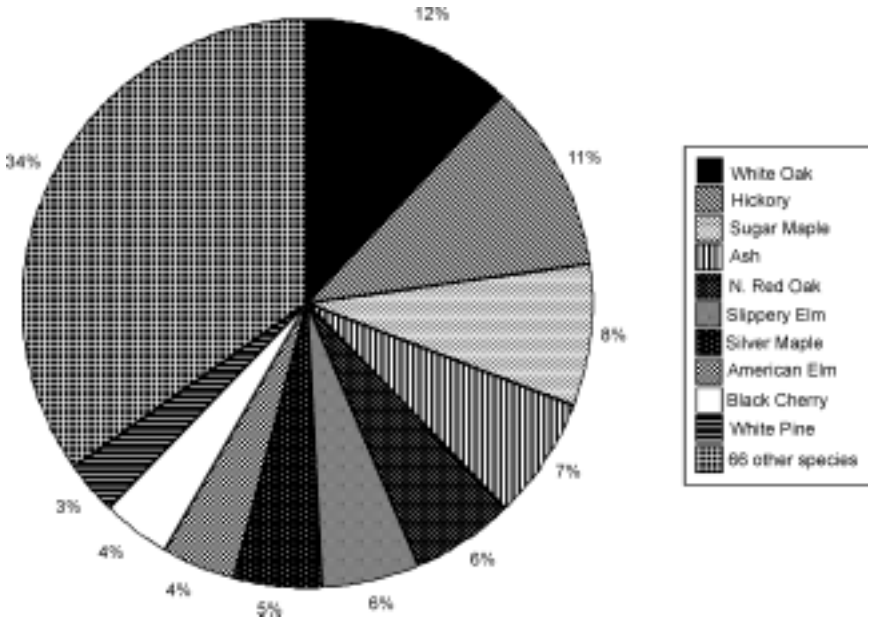


Figure 4. Importance values of top 10 trees from ForestWatch sites, fall 2000.

The IV is also used to classify each site into a forest type, such as oak-hickory or beech-maple (Table 3). Eight different types of upland forests were encountered in 2000, ash-maple-basswood and sugar maple being the most common after the ubiquitous oak-hickory. Three types of bottomland forest were monitored, with ash-elm-maple the most common. The species listed in the Forest Type typically include the most dominant species in the forest but some sites may lack one of the species (i.e., black cherry may not be in a forest classified as Sassafras-Persimmon-Cherry). The Forest Types loosely follow those of the Society of American Foresters and are based on their procedure of using species dominance to make a determination.

Table 3. Classification of all 122 ForestWatch sites to date.

Forest Type	Upland/Bottomland	# Monitored in 2000	# Monitored to Date
Oak-Hickory	Upland	27	70
Ash-Maple-Basswood	Upland	5	14
Sugar Maple	Upland	3	5
Sassafras-Persimmon-Cherry	Upland	1	3
Tulip Poplar	Upland	0	3
Bur Oak	Upland	0	1
Loblolly Pine	Upland	1	1
White Pine	Upland	1	1
Maple-Beech	Upland	1	1
Scrub	Upland	1	1
Ash-Elm-Maple	Bottomland	8	16
Oak	Bottomland	2	4
Ash-Elm-Cottonwood	Bottomland	0	1
Silver Maple	Bottomland	1	1

Invasive shrubs appear to be a problem at many of the ForestWatch sites. In 2000, sites averaged 64% invasive shrubs, with 30 of the 51 sites having at least one species of invasive shrub. Some sites have an extensive amount of invasive shrubs while others have a relatively small amount. Several sites in northeastern Illinois are dominated by buckthorn while some in central Illinois have large amounts of honeysuckle, multiflora rose, or gooseberry. Many sites in the southern counties have few invasive shrubs, although invasives are regularly encountered along forest edges, if not yet in the forest interiors.

Of the six invasive shrub taxa monitored in ForestWatch, multiflora rose averaged the most stems per hectare per site (369 stems/ha) and was found at the most sites, 16 (Figure 5). Honeysuckle was the second most common in terms of sites, 15, and stems per hectare per site (234 stems/ha) and buckthorn was third at 14 sites and 183 stems/ha per site. The fact that buckthorn is third in statewide density but is primarily found only in the northern third of the state indicates how much of a problem it is in many northern sites. For example, the Fox and Des Plaines River Watersheds had data from 14 sites and 11 of these had buckthorn. Japanese honeysuckle was found only at two sites, both in the southern half of the state. ForestWatch monitoring procedures have been modified to include this species during spring monitoring because the shrub monitoring procedure was likely underrepresenting it.

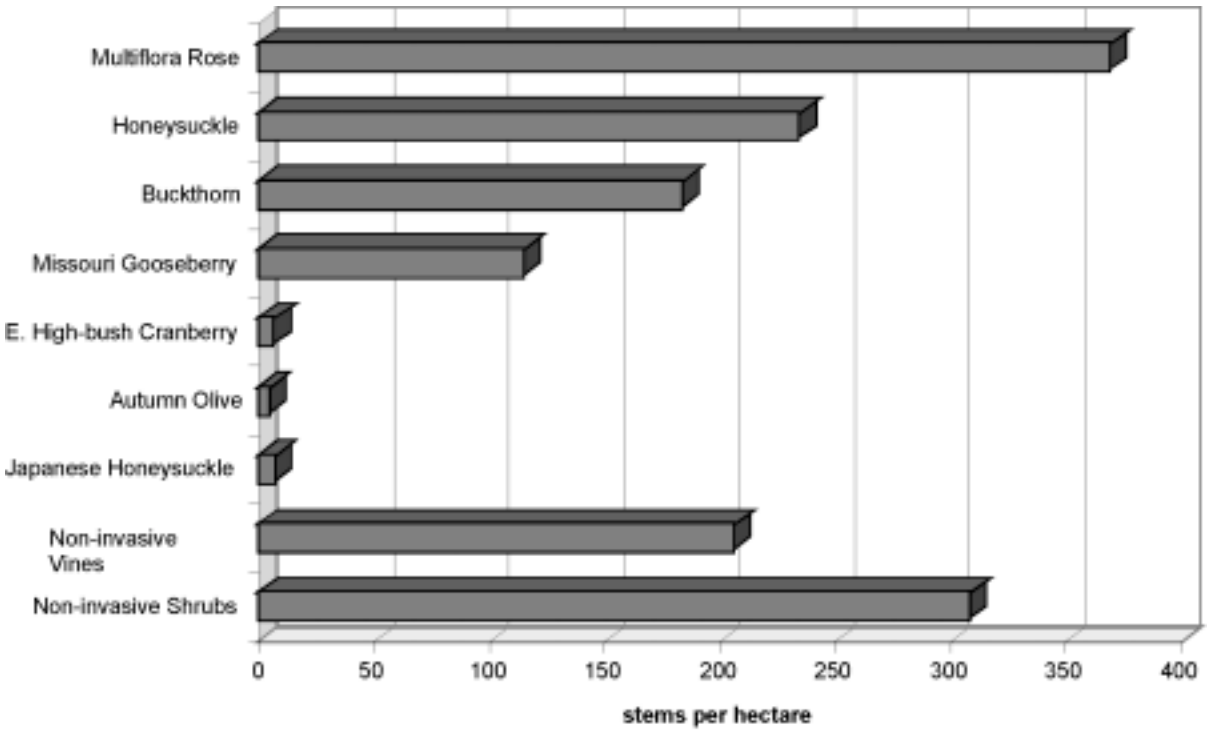


Figure 5. Amount of invasive and non-invasive shrub and vine stems found at 51 ForestWatch sites, fall 2000.

One of the major threats to forest integrity is the gypsy moth, a non-native moth that has been spreading from the northeastern U.S. for more than 100 years. The caterpillars of this moth defoliate many species of trees in a very short time. While gypsy moths have been captured in northeastern Illinois and there is a quarantine in Lake County, they have not fully established themselves in the region yet and ForestWatch provides a means of keeping an eye on them. While there were no reports of gypsy moth egg masses in 2000, continued monitoring for egg masses will bolster efforts of the Illinois Department of Agriculture to stop the spread of the moth.

Another forest pest that is monitored is dogwood anthracnose. This non-native fungal disease is usually fatal to flowering dogwoods, which are an understory tree found in the southern half of the state. Signs of dogwood anthracnose were recorded at three of the nine sites with flowering dogwoods — in Jersey, Union, and Vermilion counties. This proportion of sites is similar to previous years. So far, there have been reports from these three counties and Williamson, St. Clair, Massac, Clark, and Madison counties. Based on other evidence from the Illinois Department of Natural Resources, anthracnose is a widespread and growing problem; ForestWatch should be able to track its spread in the future.

Statewide Data: 1998 - 2000

Having three years of data enables analysis of stratified data, for example comparing invasive shrub and ground cover species in uplands and bottomlands. A total of 137 sites have been monitored at least once from spring 1998 to fall 2000. Some of the 137 sites only have data from the fall or spring for various reasons, such as sites were flooded in one season.

Spring 1998 - 2000:
Three years of data support what was seen each year — non-native invasive species are a problem at many sites. Though they were found at slightly fewer sites than disturbance-sensitive species (47 versus 52, respectively), non-native, invasive species covered much more area, 214.12 m^2/ha, compared to disturbance-sensitive species which covered 32.66 m^2/ha. Common native species were recorded at about the same number of sites as invasives (48) but were intermediate in terms of amount of cover, 156.45 m^2/ha. Table 4 breaks out the coverage for each species within these three categories. The frequency data provided by the presence-absence survey support the differences in cover data, as 16% of the 5m by 10m plots had disturbance-sensitive species while 24% contained non-native, invasive species. The data confirm that when invasive species are present, they tend to dominate the site.

The greatest non-native culprit continues to be garlic mustard. This species covers an area nearly equal to that of all disturbance-sensitive and common native species combined. ForestWatch citizen scientists recorded garlic mustard in eight northern counties — Cook, Du Page, Kane, Kendall, McHenry, Will, Lake, Stephenson, Winnebago, and LaSalle County — and one southern county, Jackson. Garlic mustard is known from many locations in Illinois, especially in central Illinois, but it clearly has a foothold in northern Illinois.

Based on limited information, bottomlands appear to have a greater problem with non-native plants than uplands. Six of 16 bottomlands had at least one of the non-native, invasive indicators while only two sites had disturbance-sensitive taxa. Thirty upland sites had non-native taxa and 25 had disturbance-sensitive taxa. In bottomlands, an average of 80% of the indicator plants (disturbance-sensitive and non-native, invasive) are non-native, invasive ground cover species, while in uplands the average percent of non-native plants was 57.8%. Although the difference in invasive plant cover is fairly large, it is not statistically different ($P=2.0057$, $t=0.2374$) and more sites are needed to make better comparisons.

The tallest canopy trees on ForestWatch sites averaged 21.4 meters, or 71 feet. The average diameter-at-breast-height (DBH) of the trees used to determine tree height was 34.5 cm, or 14 inches. Tree height in uplands and bottomlands was nearly identical. Bottomland canopy height averaged 20.3 meters and the trees had an average DBH of 30.5 cm while upland canopies averaged 21.6 meters tall and 35.5 cm DBH.

Table 4. Detection of spring indicator ground cover species at ForestWatch plots, 1998-2000

Disturbance-sensitive Species	Detection by Plot (% of plots, N=3180)	Detection by site (% of sites, N=105)	Ground Cover (average m^2/ha)
Blue cohosh	2%	10%	0.76
White trillium (all species)	3%	12%	1.85
Doll's eyes	2%	11%	1.85
Large-flowered bellwort	2%	10%	1.85
Bleeding hearts (both species)	7%	20%	23.76
Maidenhair fern	2%	5%	1.09
Virginia spiderwort	2%	11%	1.06
Hepatica (both varieties)	0.4%	6%	0.15
Common Native Species	na	na	0.30
Virginia bluebells	na	na	2.76
Wild columbine	na	na	8.24
Blue phlox	na	na	13.58
Red trillium	na	na	0.45
Blue-eyed Mary	na	na	117.09
Wild geranium	na	na	12.64
Swamp buttercup	na	na	1.39
Sensitive fern			
Non-Native Species			
Garlic mustard	21%	32%	174.61
Dame's rocket	1%	2%	0.15
Moneywort	3%	6%	19.00
Ground ivy	3%	20%	20.36

* na = not available

As with the 2000 data, the majority of the downed wood encountered at ForestWatch sites is in the 5-10 centimeter diameter class (Figure 6). The average amount of downed wood in uplands and bottomlands was very similar, with uplands averaging 24 pieces and bottomlands 23. The average area of the downed wood per site, based on basal area, was slightly greater for uplands (0.448 m^2) than bottomlands (0.399 m^2).

Fall 1998 - 2000:

ForestWatch volunteers have monitored more than 100 sites and recorded 93 tree taxa thus far. Since some tree species are lumped into genera (i.e., ash, hickory, hawthorn), the actual number of species encountered is probably closer to 100. The average number of trees per site was 117. Uplands and bottomlands did not differ in terms of tree abundance (P=0.8046,

t=1.9762), averaging 116 and 119 trees, respectively. The average richness was just over 11 taxa per site, with no difference between uplands and bottomlands (P=0.9259, t=1.9762). Eighty-eight tree species were recorded from uplands, 60 from bottomlands. Average basal area per tree was 0.0323 m^2 (or the average tree is 20 cm in diameter) for all sites and was identical for uplands and bottomlands. Bottomlands averaged slightly more basal area per site (3.85 m^2/ha) compared to uplands (3.76 m^2/ha) but the difference was not significant (P= 0.7827, t= 2.0345). Average canopy cover for all forest sites was 82%. Uplands and bottomlands were very similar, with bottomlands averaging 84% cover and uplands 82%. All taxa recorded in the tree survey are shown in Table 5 and are in descending order of importance value.

Table 5. Location of tree species and their importance values.

Species	Bottomland	Upland	IV
White Oak	x	x	26.60
Hickory species	x	x	21.24
Ash species	x	x	15.54
Sugar Maple	x	x	14.74
N. Red Oak	x	x	11.81
Slippery Elm	x	x	11.51
Black Cherry	x	x	8.44
American Elm	x	x	6.95
Basswood	x	x	6.19
Hackberry	x	x	4.81
Buckthorn	x	x	4.66
Silver Maple	x	x	4.04
Hawthorn species	x	x	3.99
Black Oak	x	x	3.52
Black Walnut	x	x	3.18
White Oak species	x	x	2.91
Bur Oak	x	x	2.81
Sassafras	x	x	2.73
Flowering Dogwood	x	x	2.66
White Pine	x	x	2.43
Box Elder	x	x	2.31
Ironwood	x	x	2.14
Swamp White Oak	x	x	2.07
Tulip Poplar	x		1.93
Red Oak species	x	x	1.86
Post Oak	x	x	1.81
Elm sp.	x	x	1.80
Persimmon	x	x	1.66
Pin Oak	x	x	1.51
Maple species	x	x	1.31
Sycamore	x	x	1.30
Unknown	x	x	1.23
Honey Locust	x	x	1.15
Shingle Oak	x	x	1.11

Table 5. Continued.

Species	Bottomland	Upland	IV
Winged Elm	x		1.09
Redbud	x	x	1.05
Cottonwood	x	x	1.00
Oak sp.	x	x	0.99
American Beech	x		0.96
Black Locust	x	x	0.88
Chinquapin Oak	x	x	0.75
Sugarberry	x	x	0.74
White Mulberry	x	x	0.66
Blackjack Oak	x		0.63
Osage Orange	x	x	0.62
Loblolly Pine	x		0.58
Tupelo species	x		0.58
Prunus species	x	x	0.55
Red Mulberry	x	x	0.42
Other Vine	x		0.41
Musclewood	x		0.37
Red Maple	x	x	0.36
Celtis sp.		x	0.29
Dogwood species	x		0.27
Sweetgum	x	x	0.27
Southern Sugar Maple	x	x	0.26
Catalpa	x	x	0.24
Norway Maple	x		0.21
Pawpaw	x	x	0.19
Mulberry species	x	x	0.15
Walnut species	x		0.13
White Poplar	x		0.13
Swamp Chestnut Oak	x	x	0.11
Red Pine	x		0.11
Red Cedar	x		0.11
Apple species	x		0.10
Ohio Buckeye	x	x	0.08
Southern Red Oak	x		0.07
Rock Elm	x		0.07
Buckeye species	x		0.07
Kentucky Coffee Tree	x		0.07
Siberian Elm	x		0.06
Willow sp.		x	0.06
Alternate-leaved Dogwood	x		0.05
Serviceberry	x	x	0.05
Other Shrub	x	x	0.05
Paper Birch		x	0.03
Rough-leaved Dogwood	x	x	0.03
Witch Hazel	x		0.03
Smooth Serviceberry	x		0.03
Scarlet Oak	x		0.02
Pine species	x		0.02
Birch sp.	x		0.02

Table 5. Continued.

Species	Bottomland	Upland	IV
Shumard Oak	x	x	0.01
European Beech	x		0.01
Tree of Heaven			0.01
River Birch	x	x	0.01
Cucumber Magnolia	x		0.01
Quaking Aspen	x		0.01
Wafer Ash			0.01

One major concern among many land managers is the apparent changing of oak-hickory forests to a forest dominated by sugar maples, a process coined "maple takeover." In the past, occasional prairie fires that entered the woods regenerated these forests. Now, in the absence of fire, sugar maples thrive, growing larger and increasing in number at the expense of oaks and hickories. This situation is unfortunate for many native plants and animals that are adapted to living in oak-hickory dominated forests.

Several ForestWatch sites appear to have marginal levels of maple takeover; some appear to have low-level takeover; others have more obvious takeover.* Sixteen of the 70 sites classified as oak-hickory forests show some degree of maple takeover. Figure 6 shows an example of a lower degree of takeover at a site in Kane County while Figure 7 shows strong maple takeover at a Pope County site. It appears that some oak-hickory forests in northeastern Illinois are not experiencing maple takeover because the maples cannot compete with buckthorn, a non-native, invasive shrub species.

* There is no hard and fast rule as to what constitutes maple takeover. The major factor considered here was the ratio of sugar maples to oaks and hickories by size class for forests classified as oak-hickory. If sugar maples were more numerous than the oaks and hickories in the smaller diameter classes and if there were no large sugar maples, then the site was judged to be experiencing some degree of maple takeover.

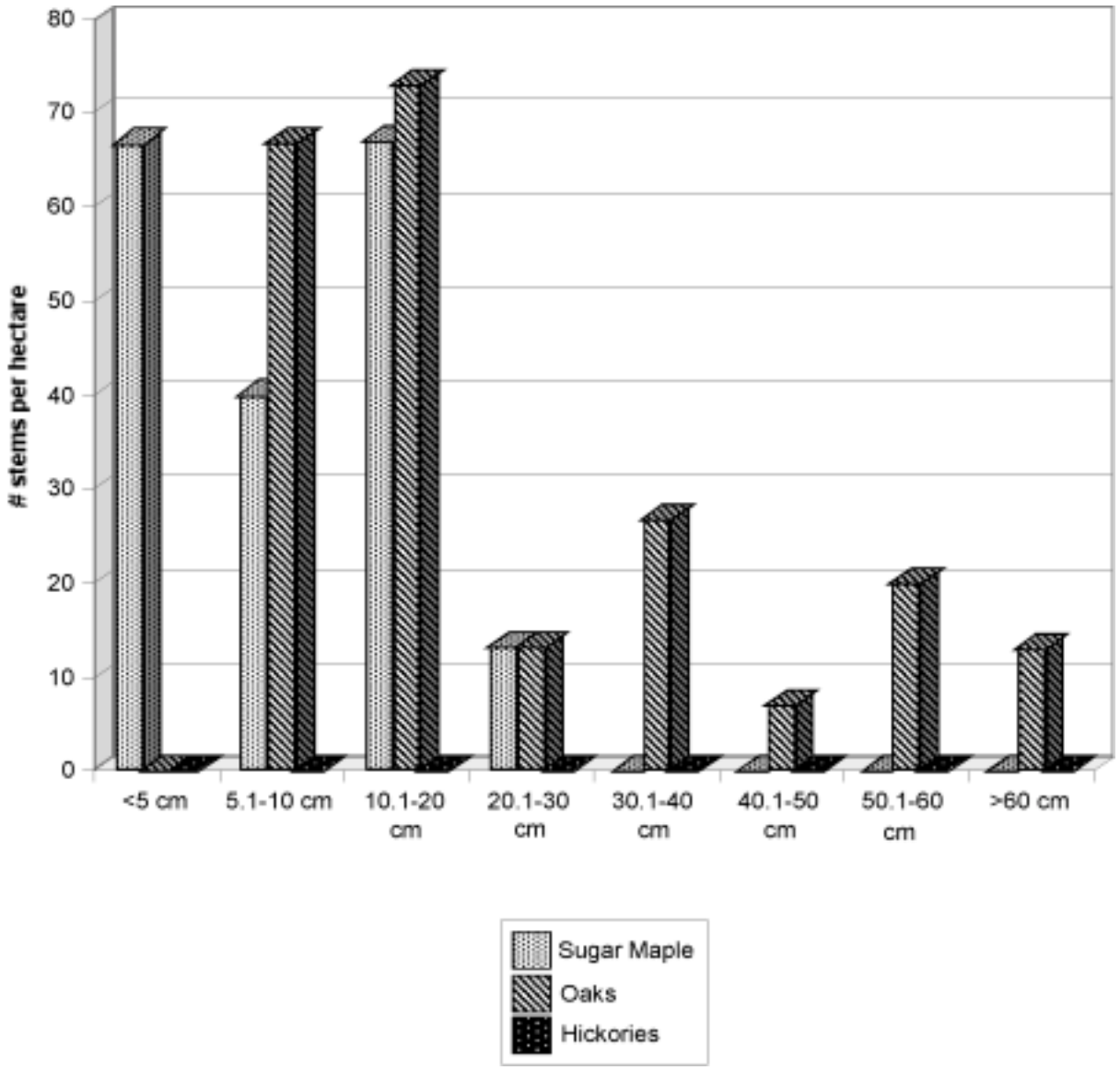


Figure 6. Low-level maple takeover in Kane County.

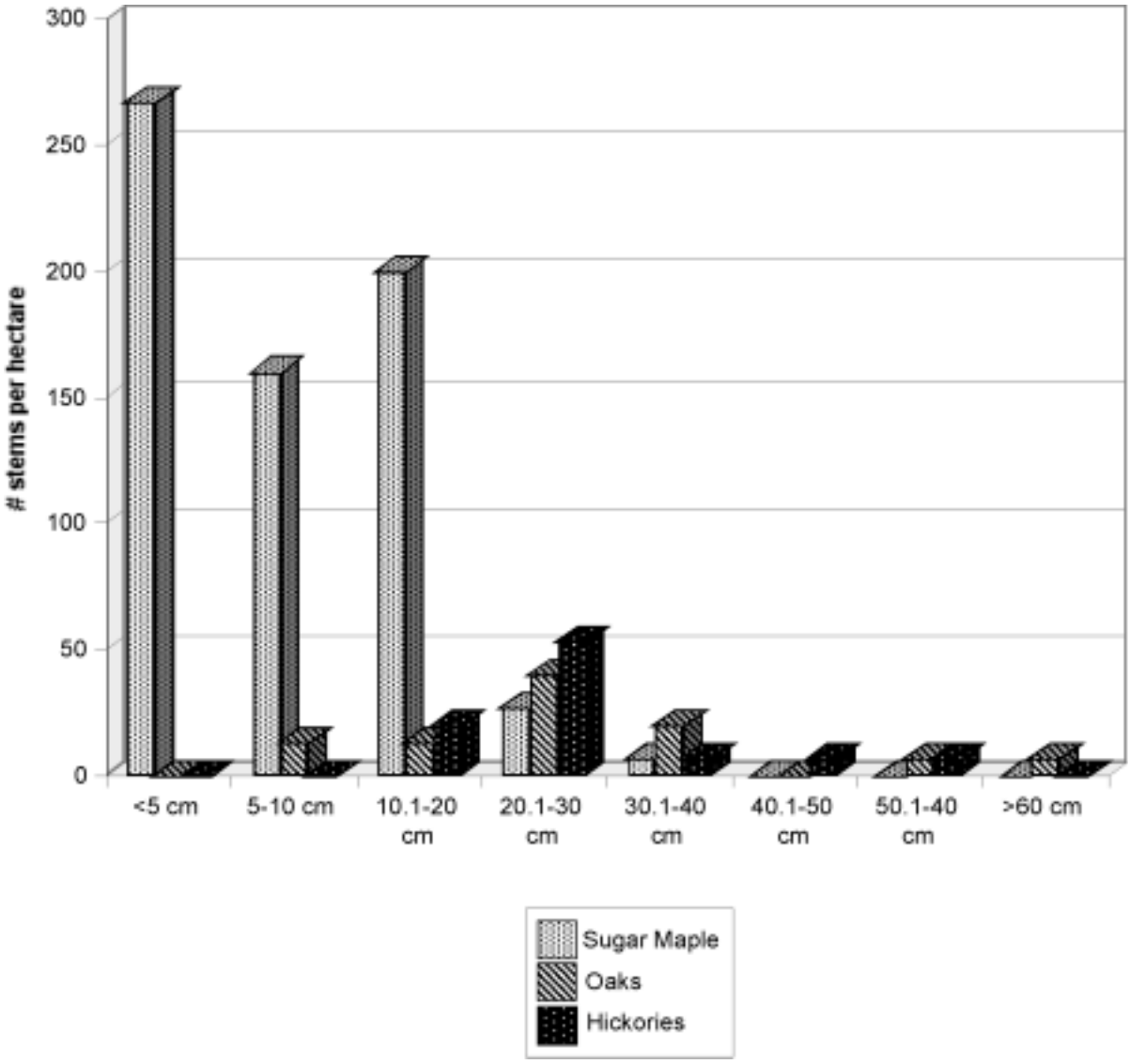


Figure 7. High-level maple takeover in Pope County

The data from 1998-2000 underscore the problem with invasive shrubs around the state. Figure 8 shows the amount of shrub cover of six invasive shrubs, one invasive vine, and other shrubs and vines that are considered to be non-invasive. The non-invasive taxa are numerous and include viburnums, dogwoods, coralberry, and grape vines. At an average ForestWatch site, invasive shrub stems comprised 56.4% of the total. The 86 upland sites averaged a slightly higher percentage than the 24 bottomlands (59% versus 46%) but the difference was not significant (P=0.1248, t=1.9822). This situation is opposite from spring groundcover in which uplands had less invasive plants than bottomlands.

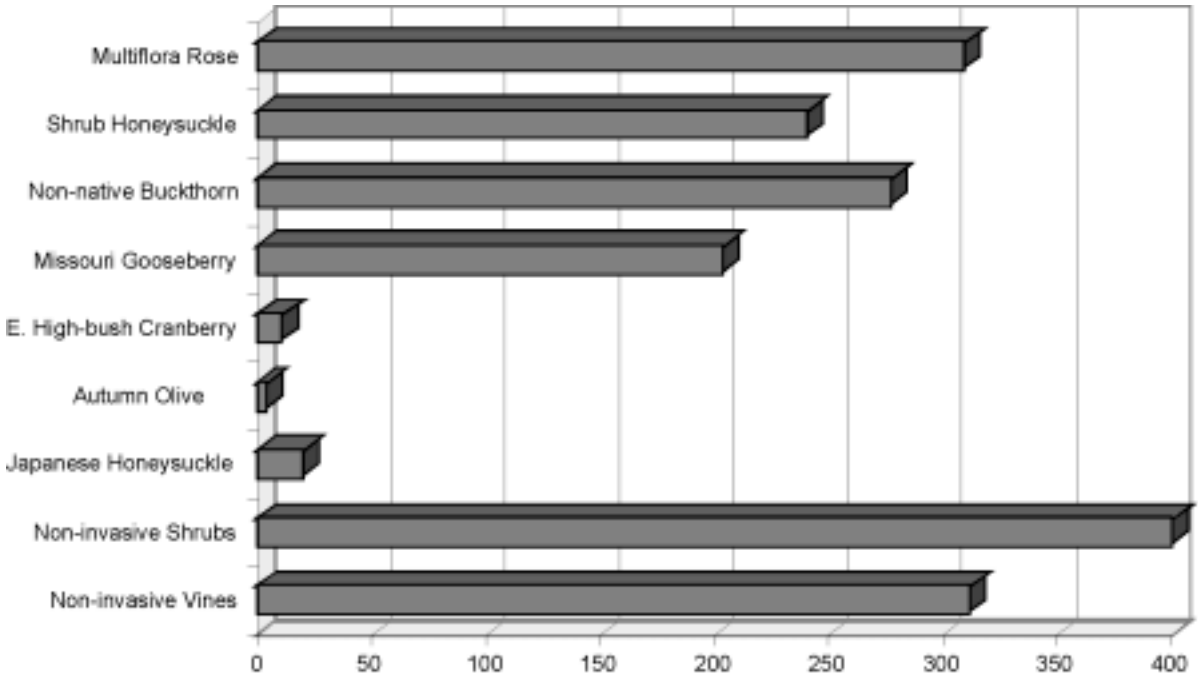


Figure 8. Number of invasive and non-invasive shrub and vine stems found at 151 ForestWatch sites, 1998-2000.

Summary

ForestWatch is designed to monitor the interior portions of Illinois forests and the data should be looked at with this in mind. Many forests, both within the ForestWatch database and others not yet monitored, have a problem with invasive species along the edge of the forest but may not necessarily have a problem in the interior. Management should be considered to control invasive species wherever they grow to improve biodiversity and improve conditions for native species. When invasive species start occurring in interior portions of forests there is likely a serious problem and it is especially important that a management plan be created to correct the problem.

ForestWatch has monitored a little more than 130 sites across the state. We consider this a major accomplishment and are proud of all the work volunteers have done. It appears that many, but not all, forests have problems with invasive species in the shrub and/or ground layer. However, many forests have not been monitored — including those of entire watersheds — so interpreting the data needs to be done with some caution. All results are based on the sample of forests in the ForestWatch database.

Ornithological Report: Habitat use and area sensitivity of birds in a highly fragmented Illinois landscape

Brenda Molano-Flores, Rhetta Jack, and Steven Bailey

Introduction

Most of the original vegetation of Illinois has vanished as the result of agricultural use during the 19th century and urban development during the 20th century. This has created a very fragmented landscape, where only relatively small isolated patches of native vegetation can be found. Because of these changes in the landscape, many bird species have been negatively impacted over large segments of their ranges. This habitat fragmentation has resulted not only in habitat loss, but also in habitat degradation for many bird species. In addition, several studies have found that fragmentation, especially in forested habitats, is contributing to nest parasitism by Brown-headed Cowbirds (i.e., they lay their eggs in other birds nest).

The Critical Trends Assessment Program (CTAP) was established in part to understand how these changes in the Illinois landscape are affecting bird species in forests, grasslands, and wetlands. Since 1997 CTAP ornithologists from the Illinois Natural History Survey have been monitoring on these habitats (see Introduction of Botanical Report). Here we present preliminary results on the status of area/habitat dependent bird species in forests, wetlands, and grasslands across Illinois.

Methods

A total of 450 sites representing forests, grasslands, and wetlands (150 of each: 30 sites per habitat per year) were randomly selected from across the state on both public and private land using the Illinois Land Cover Map and Illinois Wetland Inventory. In four years (1997-2000) CTAP ornithologists visited a total of 110 forest, 109 wetland, and 97 grassland sites (see Fig. 1 in Botanical Report). Table 1 in the Botanical Report shows some of the types of forests, wetlands, and grasslands where staff monitor birds between the last week of May to the end of July.

Habitat areas vary in size, but to be sampled for both birds and plants, forest sites must have a minimum area of 20 acres of suitable habitat and grasslands/wetlands a minimum area of 500 m^2. INHS ornithologists conduct from one to 15 point counts (PC) per site, 150 m apart in forests and 300 m apart in grasslands/wetlands. One of these PCs overlaps with the center point of the vegetation monitoring portion of the CTAP program. (See Botanical Report for information on the vegetation data). At each point the scientists carry out 10 minute counts. In each count, they note the 3, 5, 6, 8, and 10 minute marks to facilitate data comparisons

with other data sets. During each counting they list all bird species. In the case of wetlands the ornithologists also play a tape with the calls of 14 wetland dependent species after the PC for 30 minutes.

Bird species are classified as area sensitive species (ASSp), habitat dependent species (HDSp), and threatened and endangered (T&E) species. Highly, moderately, and low ASSp refers to the tolerance of bird species to habitat fragmentation. For example, if a species is highly area sensitive then it will require large tracts of habitat for nesting. Habitat dependent species are those that can only be found in a particular habitat. For example, forest dependent species are those found primarily in forests. For each species, the detection rate (total number of times a given species is detected divided by total number of visited sites) was determined per habitat for each year and for all years combined.

Results

In forests, CTAP monitoring detected an average of 7.5 forest dependent species at each site. Detection rates for highly ASSp across Illinois were relatively low, ranging from 0.9% to 25% (Table 1). Only four of these species were detected at a rate greater than 3.6%. The highest rate for a highly ASSp was only 24.5% (Yellow-throated Vireo), with moderately ASSp detected at much higher rates (up to 88.2% for White-breasted Nuthatch). However, one of the greatest detection rates in forests was for the nest parasite, the Brown-headed Cowbird, at a rate of 76.3%. One of the two state forest T&E species was found in the visited forests (Table 1).

Table 1. Detection rates (%) of area sensitive species in forests (1997-2000).

Highly Area Sensitive	Detection rate	Moderately Area Sensitive	Detection rate
Yellow-throated Vireo	24.5	White-breasted Nuthatch	88.2
Ovenbird	16.3	Eastern Tufted Titmouse	80.0
Pileated Woodpecker	15.4	Yellow-billed Cuckoo	70.9
Yellow-throated Warbler	4.5	Red-eyed Vireo	68.2
Brown Creeper*	3.6	Scarlet Tanager	49.1
American Redstart	2.7	Blue-gray Gnatcatcher	47.0
Worm-eating Warbler	2.7	Acadian Flycatcher	43.6
Broad Winged Hawk	0.9	Wood Thrush	43.6
Cerulean Warbler	0.9	Kentucky Warbler	31.8
Veery	0.9	Hairy Woodpecker	27.2
Black-and-White Warbler	0	Northern Parula	22.7
Hooded Warbler	0	Louisiana Waterthrush	16.3
		Summer Tanager	14.5
Nest Parasite			
Brown-headed Cowbirds	76.3		

*State threatened

In grasslands, CTAP monitoring detected an average of only 1.8 grassland dependent species. Only 26 of the 180 encounters of grassland dependent species were of highly ASSp. Many of the highly ASSp such as Short-eared Owl, Northern Harrier, and Upland Sandpiper have never or rarely been detected at the CTAP sites (Fig. 1). In addition, some of the moderate and low ASSp such as Vesper Sparrow and Western Meadowlark have very low detection rates (Fig. 1). The most frequently encountered species in Illinois grasslands are Dickcissel and Eastern Meadowlark. It should be noted that there is a lot of variation between years for ASSp (Fig. 1). This might be related to habitat quality and size. Similar to forests, detection rates for Brown-headed Cowbirds were very high (average 61.8% for all years, Fig. 1).

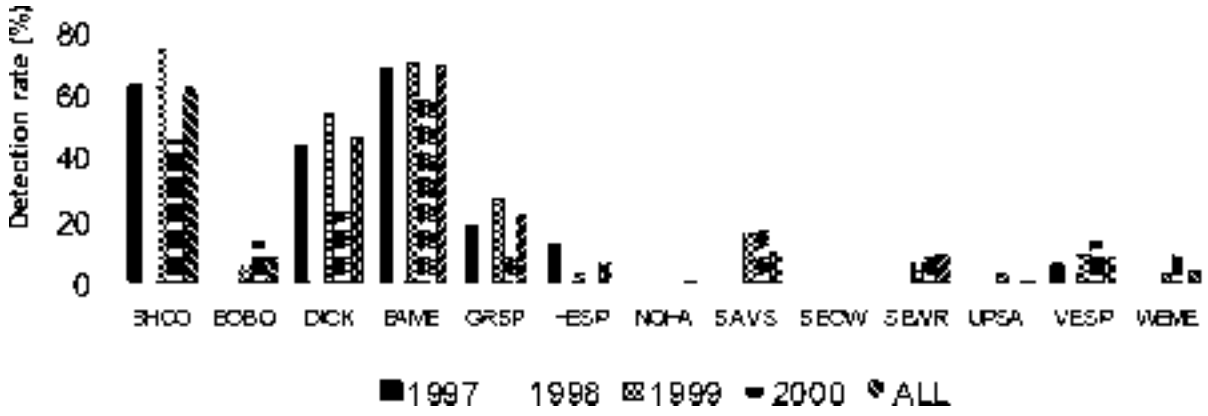


Figure 1. Detection rates for grassland dependent species from 1997-2000. (BHCO = Brown–headed Cowbird; BOBO = Bobolink; DICK = Dickcissel; EAME = Eastern Meadowlark; GRSP = Grasshopper Sparrow; HESP = Henslow's Sparrow; NOHA = Northern Harrier; SASP = Savannah Sparrow; SEOW = Short-eared Owl; SEWR = Sedge Wren; UPSA = Upland Sandpiper; VESP = Vesper Sparrow; WEME = Western Meadowlark)

In wetlands, 49% (51 out of 109) of the sites have wetland dependent species (WDSp). Of these sites 66% (35 out of 51) contained more than one such species (Fig. 2). As in the case of forests and grasslands, the detection rates vary by year (Fig. 2). Twenty-two wetland dependent species were detected, with only 1.3 of these species found per wetland site. Detection rates for wetland dependent species were very low, ranging from 28% (Great Blue Heron) to 0.9%, even though many of the species have a statewide distribution (Table 2). Table 3 shows a group of wetland dependent species that have not been detected during the timed counts at our sites. Finally, 12 out of 35 T&E bird species in Illinois are wetland dependent and only five of them have been found in the CTAP sites.

Table 2. Detection rates (%) of wetland dependent species from 1997-2000.
(E = endangered, T = threatened)

Bird Species	Detection Rate	Distribution
Great Blue Heron	28.0	Statewide
Mallard	17.4	Statewide
Green Heron	15.6	Statewide
Wood Duck	14.7	Statewide
Willow Flycatcher	13.8	Statewide
Great Egret	9.2	Statewide
Swamp Sparrow	8.3	N IL
Canada Goose	6.4	Statewide
Marsh Wren	4.6	N IL
Least Bittern[T]	3.7	Statewide
Blue-winged Teal	2.8	Statewide
Pied-billed Grebe[T]	1.8	Statewide
Double-crested Cormorant	1.8	Statewide
Black-crowned Night-heron[E]	1.8	Statewide
Common Moorhen[T]	1.8	N IL
American Coot	1.8	N IL
Spotted Sandpiper	1.8	Statewide
Little Blue Heron[E]	0.9	S IL
Cattle Egret	0.9	S IL
Hooded Merganser	0.9	Statewide
Virginia Rail	0.9	N IL
Sora	0.9	N IL

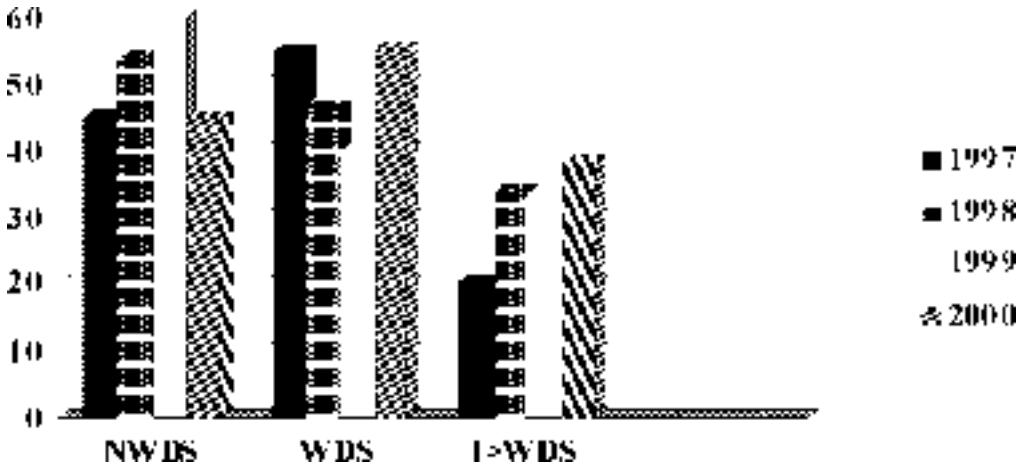


Figure 2. Percent of sites with wetland dependent species detected per year. NWDS = sites with non wetland dependent species; WDS = sites at least one wetland dependent species; 1> WDS = sites with more than one wetland dependent species.

Table 3. Wetland dependent species that were not detected from 1997-2000.
(E = endangered, T = threatened)

Bird Species	Distribution
American Bittern[E]	N IL
Snowy Egret[E]	S IL
Yellow-crowned Night-heron[E]	S IL
Mute Swan	N IL
King Rail[E]	N IL
Black Rail[E]	N IL
Sandhill Crane[T]	N IL
Common Snipe	N IL
Black Tern[E]	N IL
Yellow-headed Blackbird[E]	N IL

Discussion

From the data collected by CTAP ornithologists, we have determined that for the most part highly area/habitat dependent species in forests, wetlands, and grasslands have very low detection rates across Illinois. This suggests the degraded and fragmented nature of these habitats. For example, many grassland species which are highly area dependent are never detected in our sites. In forests, the detection rates of Brown-headed Cowbirds greatly surpass those of highly ASSp. Forty-two wetland dependent species can be found in Illinois (15 in southern Illinois and 27 in northern Illinois), but we have detected only half of them (22). The data suggest that most forests, grasslands, and wetlands in Illinois are not big enough to support many of the highly area or habitat dependent species. Even moderate or low area/habitat sensitive species have low detection rates.

Not only do many of these area/habitat sensitive species have to deal with the degree of habitat fragmentation that is found in Illinois, but they must also deal with the problems associated with fragmentation such as nest predation and parasitism. We are finding very high detection rates of Brown-headed Cowbirds in both forests and grasslands. This finding is of special concern because of the potential impact that this species has on the reproductive success of area/habitat sensitive species. Female Brown-headed Cowbirds lay up to 40 or more eggs per year and place them in the nest of other birds.

While our findings do not show an encouraging picture for many of the area/habitat sensitive bird species found in Illinois we cannot yet determine if this will become the long-term general trend. CTAP was established to detect changes over a long period of time. It is only by re-visiting sites that information can be provided to accurately establish whether these species will continue to decline.

Comparison of Publicly-Owned and Privately-Owned Monitoring Sites

David Baker, Alice Brandon

Introduction

The Critical Trends Assessment Program (CTAP) measures the condition of Illinois ecosystems over time through citizen scientist and professional scientist monitoring. Analyses of the CTAP data to date have focused on regional/watershed differences in ecosystem quality. However, an important issue for the Department of Natural Resources (DNR) and other public land managers is the quality of publicly managed sites. The CTAP program can directly address this issue because a significant subset of the monitoring sites is located on public lands. A preliminary analysis of the CTAP data indicates some significant differences in the quality of ecosystems based on ownership. As a more analysis is completed, CTAP could play an important role in gauging the success of Department and other public programs to manage and restore ecosystems.

Ownership

Nearly two-thirds of CTAP/EcoWatch monitoring sites are located on private land. The remaining third are owned by state, federal, county, or local governments. Generally public ownership is more common on the volunteer sites since it is easier to gain access to public sites. Nearly 70% of ForestWatch sites and 45% of RiverWatch sites are publicly owned. (PrairieWatch is just getting under way, but the majority of sites monitored thus far are under public ownership.) Since the professional CTAP sites are selected randomly, a lower percentage are publicly owned – about 16% of the terrestrial sites (forest, grassland, wetland) and 9% of stream sites.

Table 1. CTAP/EcoWatch Sites by Ownership

Ownership	Volunteer Sites*		Professional Sites				Total	
	River	Forest	Forest	Grassland	Wetland	Stream**	Sites	Percent
Private	333 (34)	47 (16)	87	90	84	147	788	64%
State	59 (6)	29 (6)	11	8	10	3	120	10%
Federal	31	10 (4)	2	0	1	4	48	4%
County	73 (12)	59 (32)	1	3	6	5	147	12%
Local	104 (12)	10 (2)	2	2	2	2	122	10%
Total	**600 (64)**	**155 (60)**	**103**	**103**	**103**	**161**	**1,225**	**100%**

* Number in parentheses is the number that were randomly selected, as opposed to selected by the volunteers.

** Includes Chicago Wilderness reference sites and RiverWatch comparison (red study) sites.

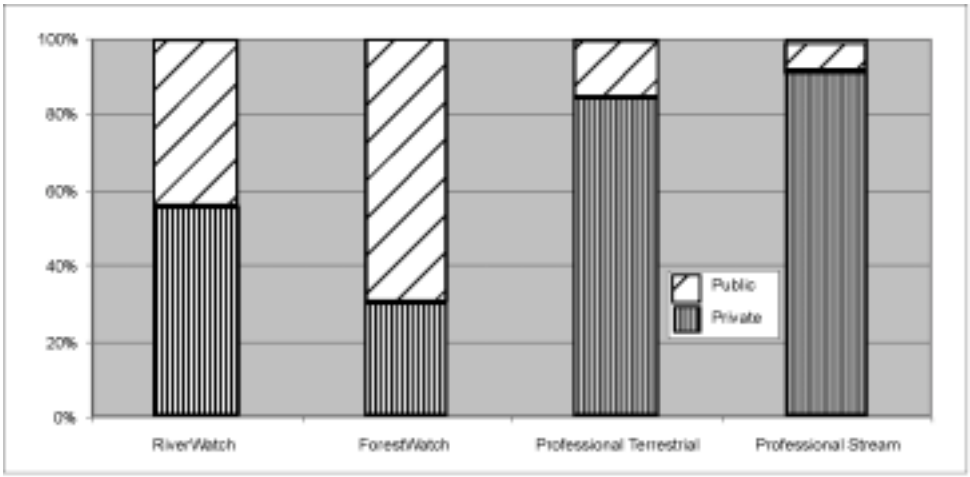


Figure 1. Percent Public and Private Ownership

State-owned sites represent about 10% of the total monitoring sites. A few are owned by the Illinois Department of Transportation or the state universities (e.g. Allerton Park), but the majority are DNR sites. EcoWatch volunteers or CTAP scientists monitor 102 sites on 65 DNR properties. Some properties are monitored under more than one program and larger properties may contain several sites. Pere Marquette State Park, for example, has three RiverWatch and four ForestWatch sites. (See appendix for a detailed list of the sites.)

Table 2. CTAP/EcoWatch Sites on State Property

	Properties	Sites
DNR	65	102
Universities	8	12
IDOT	5	6
TOTAL	**78**	**120**

More than half of the 48 federally-owned sites are located in the Shawnee National Forest. In addition, scientists and citizen scientists monitor several sites at Midewin, U.S. Fish and Wildlife Service properties, and Army Corps of Engineers properties.

Table 3. CTAP/EcoWatch Sites on Federal Property

	Sites
Argonne Lab	1
Fermi Labs	1
NRCC	1
US Army Corp of Engineers	7
USFS – Midewin	5
USFS – Shawnee National Forest	28
USFWS – Crab Orchard	4
USFWS – Cypress Creek	1
Total	**48**

The 147 county sites are generally owned by forest preserve or conservation districts. The forest preserve districts in the Chicago area are particularly well-covered by sites. Scientists and citizen scientists monitor 13-18 sites in each of the forest preserve districts of DuPage, Kane, Lake, and Will counties and more than 50 sites in Cook County Forest Preserves. The 122 local government sites are generally owned by cities, townships, and school districts.

Table 4. CTAP/EcoWatch Sites on County Property

	Sites
Cook County Forest Preserves District	52
DuPage County Forest Preserve District	18
Kane County Forest Preserve District	13
Lake County Forest Preserve District	13
Will County Forest Preserve District	14
Others (16 counties)	37
Total	**147**

Preliminary Analysis

It is perhaps too soon to use the CTAP data to determine trends in the quality of publicly and privately owned sites, but the data are sufficient to compare the quality of ecosystems by ownership. The CTAP scientists have collected four years of biological data from randomly selected stream, forest, grassland, and wetland sites across the state. Citizen scientists have monitored RiverWatch sites for five years, ForestWatch sites for two years, and PrairieWatch sites for just a year. A preliminary analysis of RiverWatch and ForestWatch data does in fact indicate some significant differences by ownership.

RiverWatch

More than 1,300 RiverWatch datasets were analyzed for the years 1996-2000.[1] Generally, the publicly-managed sites were found to have higher stream quality. The federal sites, in particular, are significantly higher in quality than any other sites. For each of four stream quality indicators derived from RiverWatch data – macroinvertebrate biotic index (MBI), EPT taxa, total taxa richness, and taxa dominance – federal sites score better than private and other publicly-owned sites.[2] In each case, the results are statistically significant.[3]

Table 5. RiverWatch Stream Quality Indicators by Ownership

Owner	MBI	Taxa richness	EPT taxa	Taxa dominance
Private (volun. selected)	5.60	9.2	2.81	80.1%
Private (randomly selected)	6.31[p]	9.1	2.31	80.0%
Local govt.	6.09[p]	8.7	1.94[p]	81.6%
County	5.56	8.9	2.53	81.1%
State	5.48	8.6	2.67	80.4%
Federal	5.38	10.0[h]	3.71[h]	75.4%[h]

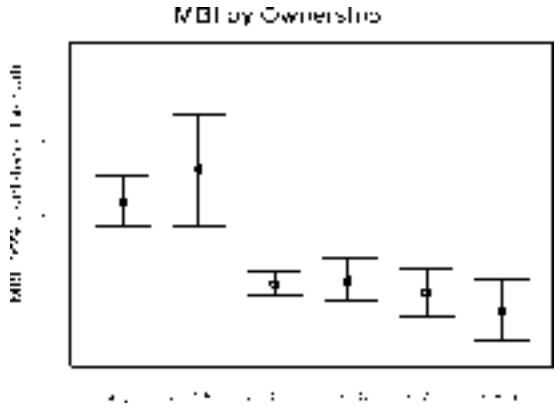
[p] Poorer score, statistically significant at .05 level (95% confidence).
[h] Higher score, statistically significant at .05 level (95% confidence).

The state and county-owned sites are next in level of quality. Surprisingly, volunteer-selected private sites are statistically indistinguishable from them. However, there is a strong selection bias for these sites, meaning volunteers have generally picked high quality sites to monitor. When randomly-selected sites are examined, it is clear that the typical privately-owned site is distinctly lower in quality than the federal, state, and county-managed sites. The higher quality of volunteer-selected sites does show that there are high quality sites in private ownership, however, and that landowners and volunteers are committed to preserving them.

Generally the sites that are lowest in quality are those owned by local governments and the randomly selected private sites. These sites scored particularly poorly on measures of organic pollution – MBI and EPT taxa. The local government sites are those most likely to be affected by urban run-off and other sources of pollution, while the private streams are mostly rural sites that may be affected by surrounding agriculture.

The charts below graphically illustrate the differences among the ownership categories. The charts seem to indicate a gradient of disturbance. Urban sites and the rural private sites are the most disturbed; state and county-owned sites are exposed to an intermediate level of disturbance; federal sites are least disturbed.

[1] Approximately 300 samples were excluded from the analysis: those that contained fewer than 25 organisms and all samples from 1995 due to organism identification problems in first year of the program.
[2] Note: for MBI and taxa dominance, lower values are better, while for taxa richness and EPT taxa, higher is better.
[3] EPT taxa and taxa dominance were transformed to improve the normality of the distribution



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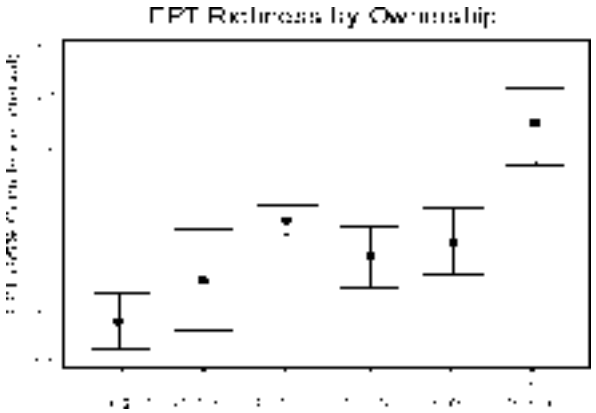

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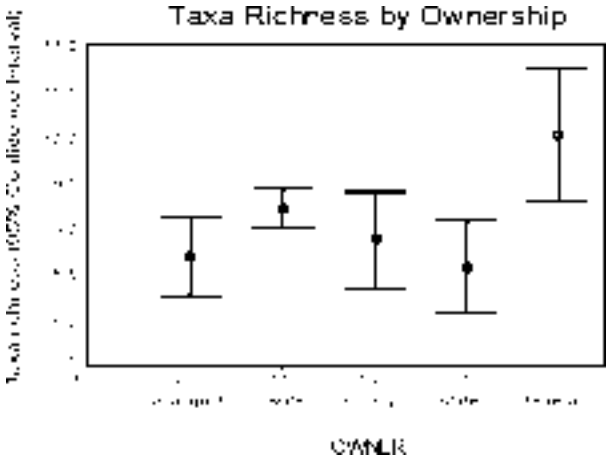

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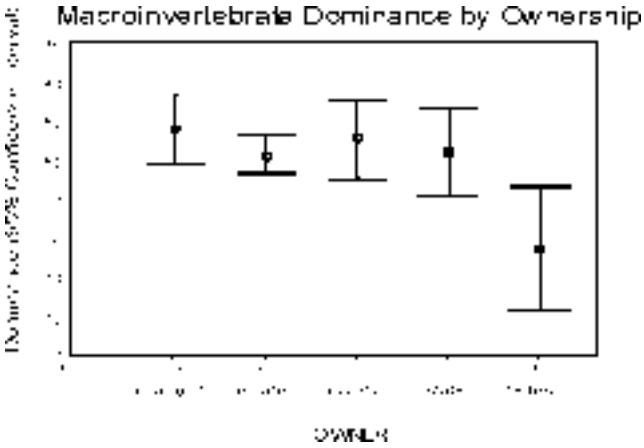


Figure 5.

ForestWatch

Some clear patterns are evident at ForestWatch sites as well. The federal sites have the lowest amount of invasive shrubs, although even in those sites 25% of shrub stems are invasives. State sites are next in quality with 44% invasives. County and local sites have the greatest problem – more than two-thirds of shrub stems are such invasives as buckthorn, multiflora rose, and honeysuckle. Clearly, across the state invasive shrubs are a serious problem. Even in the Shawnee Forest, where the large forest patch size provides some protection, invasive shrubs are being found.

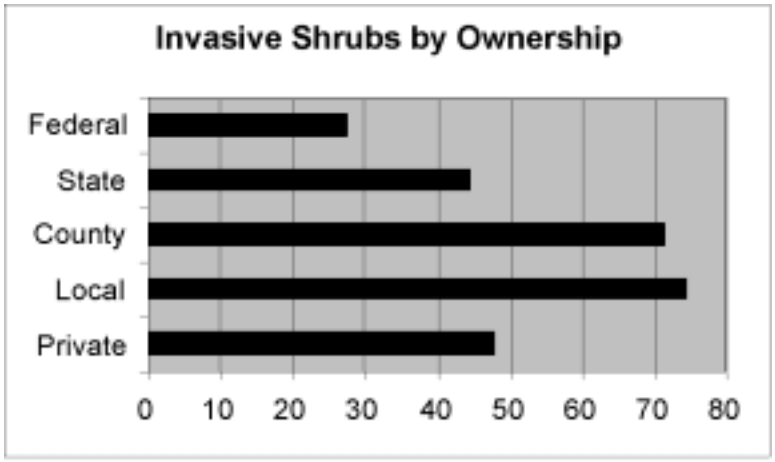


Figure 6. Invasive Shrubs by Ownership.

State-managed sites have been most successful in retaining disturbance sensitive groundcover plants. Nearly 60% of the indicator groundcover plants found are indicators of high quality, such as white trillium and Dutchman's breeches. Less than 10% are non-natives. The federal sites, as expected, also have a relatively high amount of disturbance-sensitive groundcover (25%), but more than 30% of the groundcover is non-native plants. Overall, state and federal sites have a less dense groundcover, indicating the greater maturity of the forests. The city and county-owned sites generally have a much denser ground cover and a significant problem with non-natives. County sites in particular, the majority of which are located in Chicago area forest preserves, are dense with such invasives as garlic mustard and ground ivy. Nearly three-fourths of the ground cover is non-native and only 1% disturbance sensitive.

Table 6. ForestWatch Indicators by Ownership

Owner	Sites	Shrubs	Groundcover Plants		
		% invasive	disturb.-sensitive	common-native	non-native
private	36	48%	17%	25%	58%
local	9	74%	7%	60%	33%
county	35	72%	1%	24%	74%
state	20	45%	59%	33%	7%
federal	8	28%	25%	41%	33%
all sites	108	66%	12%	33%	55%

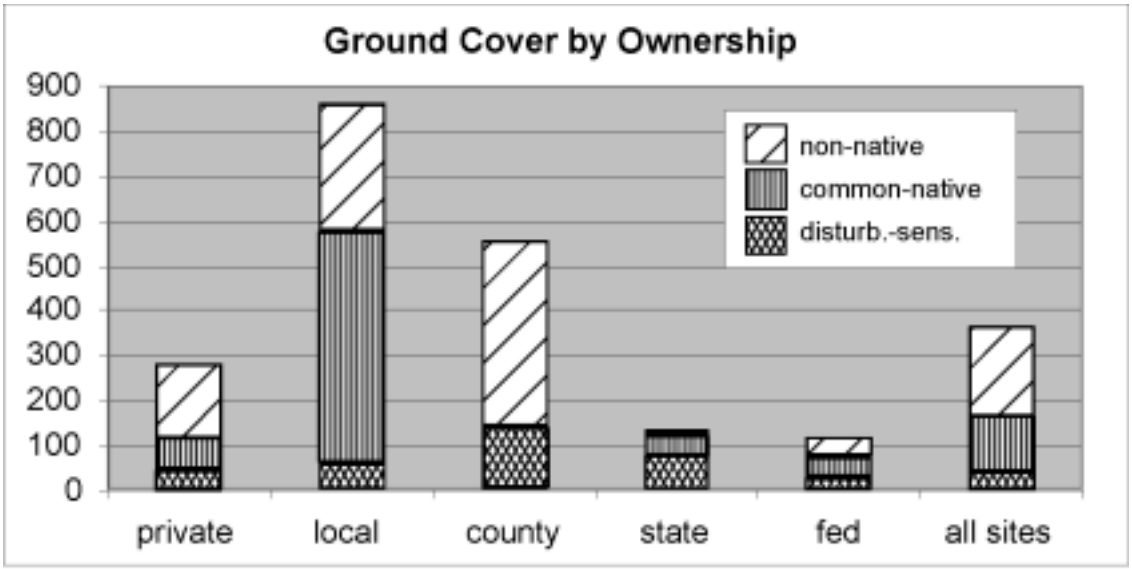


Figure 7. Ground Cover by Ownership.

Conclusions

The preliminary analysis of RiverWatch data indicates that publicly managed sites located outside of cities are higher in quality. Federal sites, in particular, have a high macroinvertebrate diversity, due to the relatively large tracts of forest or grassland where most of the sites are located. The sites in private or local government ownership are at the other extreme; they show clear evidence of low macroinvertebrate diversity due to organic pollution. The state and county forest preserve sites are of intermediate quality.

The ForestWatch analysis indicates both Federal and State sites have the highest quality. Federal sites show a relatively low amount of invasive shrubs and non-native groundcover plants. State sites indicate the most success in keeping down invasive groundcover plants and in preserving disturbance-sensitive plants. On the other hand, invasive shrubs continue to be a serious problem. Invasive shrubs seem to dominate in the county, local government and private sites in particular.

The CTAP data provide some sense of the success of preserving lands in public ownership. The data also point to problems that need to be addressed (such as invasive shrubs). As additional data is collected and the entire pool of professionally collected and volunteer-collected data is analyzed, CTAP should help to establish goals for restoration and to demonstrate the success of ecosystem management activities at a variety of levels – state-managed lands, ecosystem partnerships, etc.

Analysis of RiverWatch and ForestWatch Monitoring Data in the Chicago Wilderness Area

David Baker

Introduction

The six-county Chicago Wilderness region is one of the areas in which EcoWatch citizen scientists have been most active. Volunteers have monitored 144 stream sites during the last six years and 40 forest sites during the past two years. Volunteers are most active in the area's forest preserves, particularly those of Cook County, where EcoWatch citizen scientists monitor nearly 50 sites, half of them streams and half forest sites.

Table 1. EcoWatch Sites on County Properties

	RiverWatch	ForestWatch	Total
Cook County Forest Preserves District	25	24	49
Du Page County Forest Preserve District	10	6	16
Kane County Forest Preserve District	5	5	10
Lake County Forest Preserve District	8	3	11
McHenry County Conservation District	2	2	4
Will County Forest Preserve District	5	7	12
Total	**55**	**47**	**102**

Note: Approximately 15 of the sites have been evaluated, but not yet monitored.

The Chicago area contains several Ecosystem Partnerships that were formed under the state's Conservation 2000 program. Most of them are covered fairly well by EcoWatch sites. The Upper Des Plaines, Lower Des Plaines, Du Page, North Branch (Chicago), Fox and Prairie Parklands all have numerous (13-41 each) RiverWatch sites. The Calumet and Thorn Creek partnerships (which are fairly small watersheds) have only a few sites, as do the Kishwaukee and Kankakee (which are only partly in the region). Three of the partnerships have a significant number (more than 10) of ForestWatch sites – the Fox and the Upper and Lower Des Plaines.

Table 2. EcoWatch Sites by Watershed

Partnership/Watershed	Rivers		Forest
	sites	samples	sites
Upper Des Plaines	20	50	10
Lower Des Plaines	22	80	11
Du Page River	17	42	2
North Br Chicago/Lake Shore	23	45	1
Fox River	35	104	11
Calumet	4	11	0
Thorn Creek	2	4	0
Kishwaukee	4	14	2
Prairie Parklands	11	35	1
Kankakee	6*	13*	1

*Includes a few sites also located in Prairie Parklands.

Preliminary Analysis

While not enough years of data have been collected to determine trends in quality, the data are sufficient to detect patterns and compare differences among watersheds. Overall, as would be expected given its urban nature, the streams in the six-county Chicago Wilderness area are lower in quality than the state average. They score particularly poorly in the MBI and EPT, two measures of organic pollution. The first is an index of the tolerance of macroinvertebrates to organic pollution, while the latter is the number of EPT taxa (organisms found more frequently in higher quality streams). Total taxa richness and taxa dominance are no different in Chicago Wilderness than the rest of the state.

Table 3. Average Stream Quality by Ownership
Chicago Wilderness

Ownership	Samples	MBI	Taxa richness	EPT	Dominance
Private	121	5.75	9.6	2.45	80%
Local Govt.	94	6.58	8.5	1.28	83%
County	120	5.66	9.0	2.31	81%
State	8	6.45	8.9	1.75	78%
Federal	20	5.34	12.0	4.30	71%
Chicago Wilderness	363	5.93	9.2	2.18	81%
Rest of State	975	5.54	9.0	2.89	80%
State Average	1338	5.64	9.1	2.70	80%

Note: for MBI and taxa dominance, lower values are better, while for taxa richness and EPT taxa higher is better.

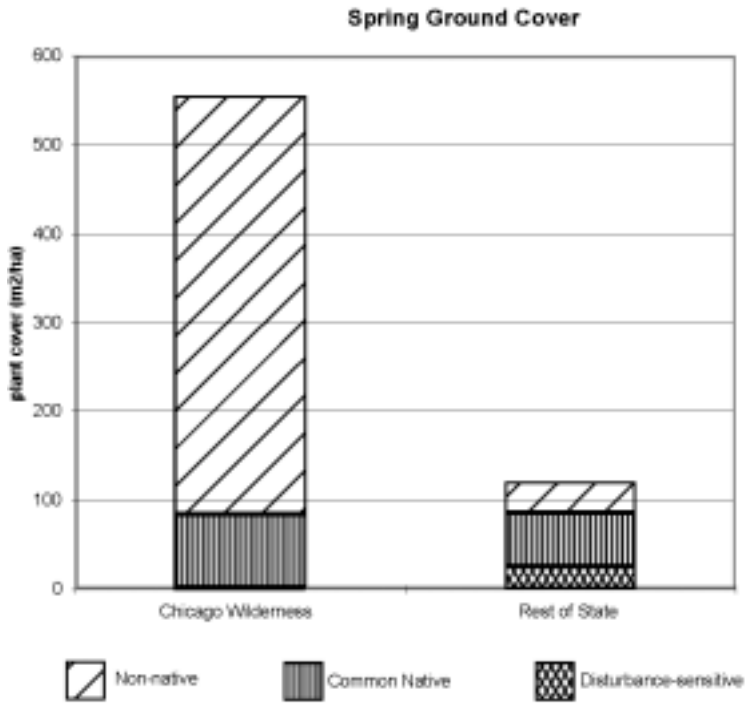
There are some fairly distinct differences among the different watersheds/partnerships in the Chicago area. The Prairie Parklands partnership has the highest quality streams — it scored best on all but one of the indicators and has a high number of EPT and total taxa. It also has less of a problem with dominance, the phenomenon whereby a few taxa dominate a stream, contributing to low diversity. While the sites in this area are the least disturbed and many are protected in the Midewin property, others are at risk from continued suburban growth.

Table 4. Average Stream Quality by Partnership Area
Chicago Wilderness

Partnership	Samples	MBI	Taxa richness	EPT	Dominance
Upper Des Plaines	50	6.42	8.3	1.44	83%
Lower Des Plaines	56	5.99	9.0	1.86	82%
Du Page River	42	5.84	9.5	2.21	78%
No. Br. Chicago River	45	6.47	6.9	0.67	88%
Fox River	104	5.72	9.6	2.58	80%
Calumet	11	6.15	9.4	2.00	81%
Thorn Creek	4	7.17	7.8	2.00	80%
Kishwaukee	14	4.56	9.4	2.64	85%
Kankakee	2	7.85	8.5	1.00	73%
Prairie Parklands	35	5.39	12.6	4.49	69%
Chicago Wilderness	363	5.93	9.2	2.18	81%
Rest of State	975	5.54	9.0	2.89	80%
State	1338	5.64	9.1	2.70	80%

On the other end of the spectrum is the North Branch of the Chicago River. Its stream sites score the poorest on most measures — it averages less than one EPT taxa per site. The nearby Upper Des Plaines is also fairly low in quality. The Lower Des Plaines, Du Page and Fox watersheds fare somewhat better, although they are still somewhat lower than the statewide average. Besides the Prairie Parklands streams, the Kishwaukee watershed, which is partly in the area, has the highest stream quality. Volunteers have collected only a few samples from the Thorn Creek and Calumet areas.

Invasive plants, mostly introduced from overseas, have been found to be a problem throughout Illinois. The ForestWatch sites in the Chicago Wilderness area, however, show these problems to a much more serious degree. In the shrub layer of the forest, honeysuckle shrubs and vines and multi-flora rose are the most common culprits around the state. In the Chicago area, another introduced plant, buckthorn, is most prolific. Outside of the Chicago area, 66% of shrub stems counted by ForestWatch volunteers are non-natives. In the Chicago



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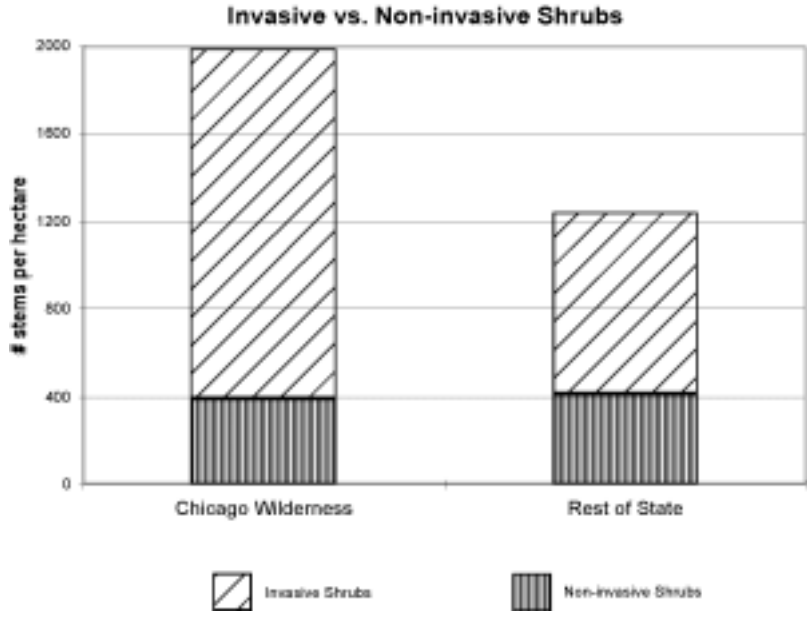


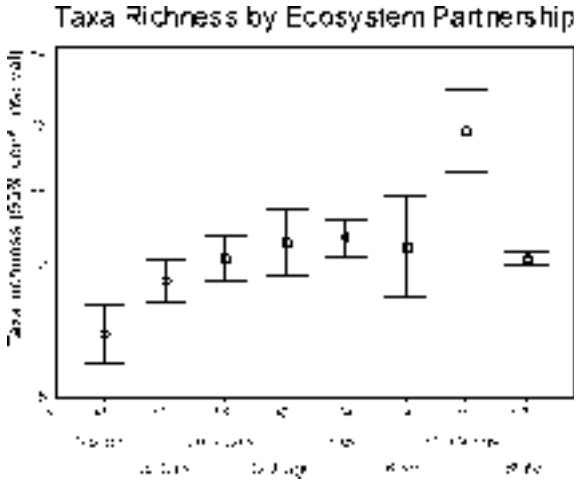
Figure 2.

Wilderness, however, this percentage increases to 80% of the total shrubs. The density of invasive shrubs is actually twice as great in the Chicago area, 1,600 stems per hectare, compared to 800 stems in downstate Illinois.

The difference between the Chicago area and the rest of the state is even more dramatic for spring groundcover plants. Outside of Chicago about one-fourth of the groundcover indicator plants are non-natives, one half are common natives, and one-fourth are disturbance-sensitive native plants (indicators of high quality).* In Chicago Wilderness forest sites, nearly 85% of groundcover indicator plants are non-natives and most of the remaining are common natives. Disturbance-sensitive plants were found here and there, but made up very little of the total groundcover.

Conclusion

In general, the streams in the Chicago Wilderness counties are lower in quality than other streams in the state. Many score poorly on the MBI and EPT indices, two measures of organic pollution. The Chicago River and Upper Des Plaines watersheds are the lowest in quality. The forests of the Chicago Wilderness area likewise reflect the effects of urban disturbance. Non-native invasive plants — such as buckthorn and garlic mustard — plague the area to a greater degree than in other parts of the state.



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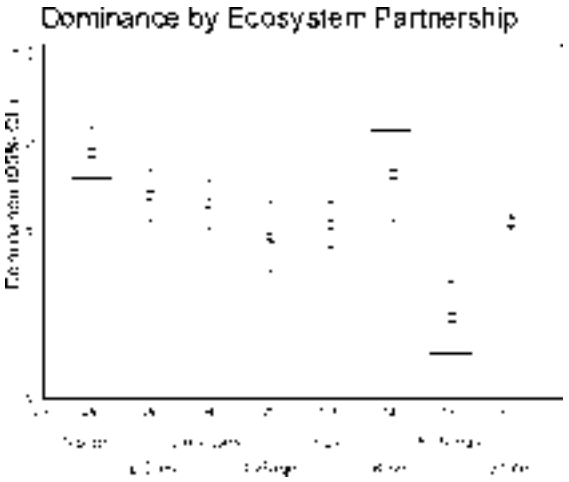

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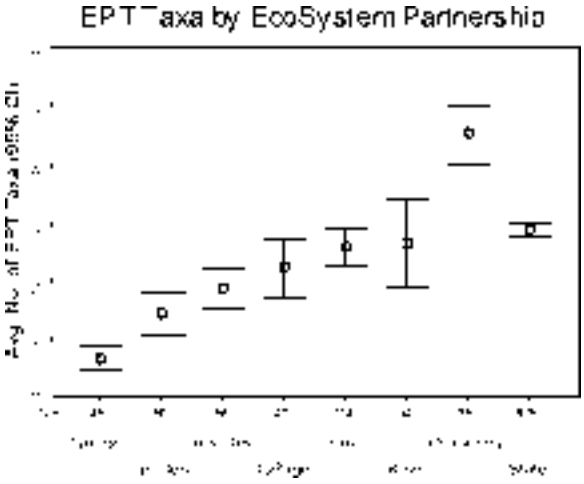

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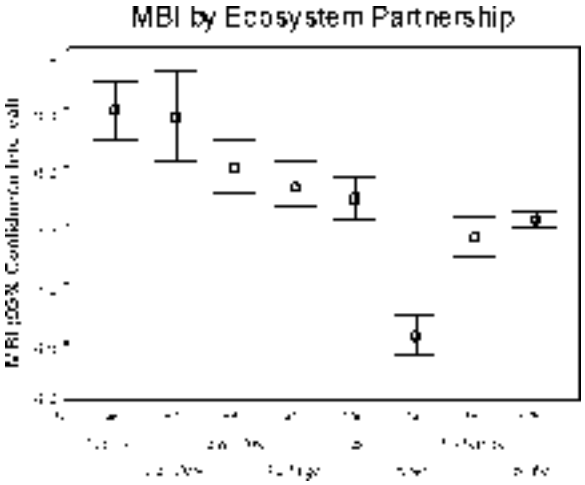

Figure 6.