The 2007-08 Cook County Land Audit

Results and Summary to Date

April 13, 2010

In July and August, 2007-08, ninety monitors collected detailed vegetation data at 200 sample plots within the priority conservation lands of the Forest Preserve District of Cook County. The goals of the 2007-08 Cook County Land Audit were to:

1. Determine the condition of priority conservation lands within the District;
2. Identify changes in health or threats since the 2001 Land Audit; and
3. Pilot a vegetation monitoring protocol that has been proposed by the Illinois Natural History Survey for use as the standard Chicago Wilderness protocol.

Scientific assessments such as the Land Audit help the District to fulfill its core mission to acquire, restore, and preserve its lands in their natural state. The District can more effectively plan and implement ecological management by assessing the condition of the preserves countywide, tracking progress over time, and determining the health of individual preserves. Scientific assessments provide accountability to the public on how well management is protecting the value of public conservation lands. The 2007-08 Land Audit was the second district-wide audit of conservation lands, with the first audit conducted in 2001.

The 2001 Cook County Land Audit found widespread degradation among District conservation lands and was instrumental in helping to bring about many positive changes for the District and its lands. New resource management teams were formed, with ecosystem restoration their top priority. The District renewed its commitment to volunteer program development and established a volunteer management team housed in a volunteer resource center. A previous moratorium on habitat restoration activities was progressively lifted; the District initiated restoration management on much larger parcels (notably Bartel Grassland, Orland Grassland, Salt Creek Woods and the Spring Creek preserves); and more acres are now under active management.

In the upcoming years, the District has determined to focus primarily on the areas that have the highest conservation potential. These include areas with highest ecological integrity and natural quality (as indicated by floristic quality) and those that are important for animal populations. The 2007-08 Land Audit assessed the condition of these priority conservation lands. With some limitations due to differences in methods, we also have been able to assess trends since the 2001 Land Audit. The new study design by the Illinois Natural History Survey will make it easier to determine trends in future years as the audit is repeated.

An additional purpose for the 2007-08 Land Audit was to pilot a monitoring protocol for potential use as the standard vegetation monitoring protocol for the Chicago Wilderness region. Developed by scientists from the Illinois Natural History Survey, Audubon-Chicago Region, and the Forest Preserve District of Cook County, this protocol provided a comprehensive means of sampling the herbaceous, shrubby understory, and canopy tree strata within a single sample plot. Simultaneous monitoring of breeding bird populations at many of the same sites will help correlate plant community health with avian (and perhaps in time other animal) community health. These will be considered in a separate paper. It is envisioned by the Chicago Wilderness consortium that this protocol would allow future studies to provide increasingly sophisticated analyses of the state of the region's natural communities, as more studies begin using this sampling method.

The 2007-08 Cook County Land Audit sampled randomly located plots throughout the District's priority conservation lands. We included in the sample universe all areas that were deemed by expert judgment (backed up by data when available) to be the most intact natural communities of at least fair floristic quality, excluding areas of open water. Additionally, we included areas that consist of primarily non-native vegetation or unassociated woody growth, but that serve as important habitat for birds, amphibians, reptiles, or other animals. The goal was to include all priority conservation lands containing the most important communities of plants or animals.

Monitors collected data on the herbaceous understory, shrubs and saplings, and canopy trees within a single 500 m^2 circular plot at each of 200 randomly-located points. A detailed description of sample methods is provided in Appendix A.

The State of the Land in 2007-08

The priority conservation lands of the Forest Preserve District of Cook County are not doing well, with some notable exceptions. The lands overall contain many areas of poor floristic quality and are threatened by aggressive invasive species. Oak savannas and woodlands show little regeneration of the oak trees, on which such communities depend. Invasives prevalence has increased since 2001, suggesting that increased efforts are needed to stem the spread of these destructive species.

Looking at floristic quality within intact natural communities (i.e., excluding those areas that were sampled in this study because of their animal communities alone), we found 25% to be of good or excellent floristic quality, with 42% fair and 32% poor quality (see Figure 1). Thus, even within the District's priority conservation lands, many areas continue to show severe degradation. Looking at different community types, savannas and prairies showed greater floristic quality than oak woodlands (see Figure 2).

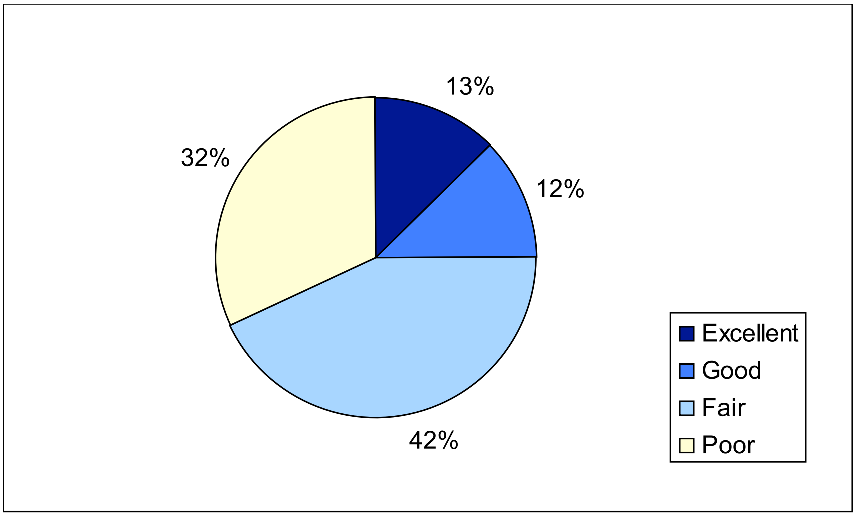

Figure 1. Floristic quality of intact natural communities within the District's priority conservation lands.

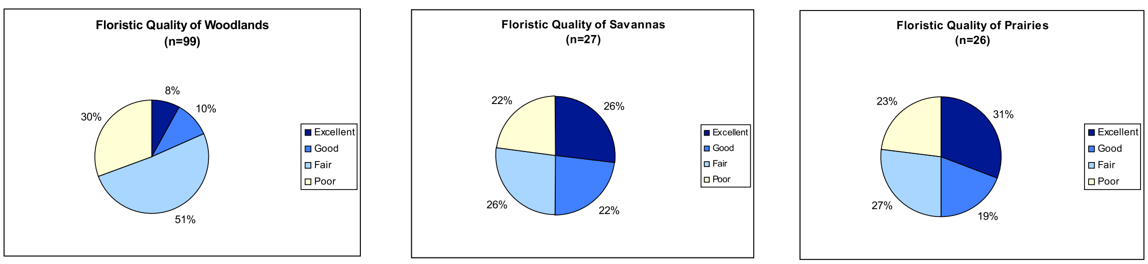

Figure 2. Floristic quality of woodland, savanna, and prairie communities.

In the 2007-08 Cook County Land Audit, we recorded 329 native species, which represents 23% of the native species known in the Chicago Region. This diversity suggests good potential for restoring these lands to a healthy state. However, aggressive, invasive species continue to be a serious threat to the District's conservation lands. Two-thirds of all quadrats contained at least one invasive species. Four of the ten most common species recorded in herbaceous quadrats are aggressive invaders in one or more Chicago Wilderness habitat type. Six out of ten species in shrub sub-plots were invaders (see Figure 3). Common buckthorn (*Rhamnus cathartica*) was by far the most common seedling and shrub recorded. Since 2001, the prevalence of buckthorn and other invasive species has increased within the District's priority conservation lands (see Figure 4; see Appendix A for trend analysis methods). Common buckthorn creates dense shade and inhibits the growth of most native species of our ecosystems. Poison ivy (*Rhus radicans*), while a natural component of some native ecosystems, is not a substantial component of fire-dependent communities such as prairies, savannas, and oak woodlands; but it is invasive in these ecosystems in the absence of fire (Anderson 1997). Thus, its increase since 2001 is an indicator of insufficient controlled burns on priority conservation lands.

Figure 3. The ten most commonly recorded species for intact natural communities within the District's priority conservation lands. Asterisks indicate species that are aggressive invaders in one or more Chicago Wilderness habitat type[1].

Species in Herbaceous Quadrats	Number of Occurrences (out of 2,208)	Common Name
*Rhamnus cathartica**	687	Common buckthorn
*Fraxinus pennsylvanica subintegerrima**	312	Green ash
Polygonum virginianum	306	Woodland knotweed
Parthenocissus quinquefolia	226	Virginia creeper
Rhus radicans	224	Poison Ivy
Circaea lutetiana Canadensis	221	Enchanter's nightshade
*Alliaria petiolata**	208	Garlic mustard
Leersia virginica	173	White grass
Geum canadense	172	White avens
*Solidago altissima**	167	Tall goldenrod
The Oaks:		
Quercus rubra	18	Red oak
Quercus velutina	5	Black oak
Quercus alba	3	White oak

Species in Shrub-Sapling Sub-Plots	Number of Occurrences (out of 736)	Common Name
*Rhamnus cathartica**	292	Common buckthorn
*Fraxinus pennsylvanica subintegerrima**	86	Green ash
*Rosa multiflora**	79	Multiflora rose
Ulmus americana	47	American elm
*Lonicera maackii**	44	Amur honeysuckle
*Lonicera tatarica**	44	Tartarian honeysuckle
Carya ovata	39	Shagbark hickory
Ostrya virginiana	38	Hop hornbeam
Vitis riparia	35	Wild grape
*Rhamnus frangula**	32	Glossy buckthorn
The Oaks:		
Quercus alba	8	White oak
Quercus bicolor	3	Swamp white oak
Quercus macrocarpa	1	Bur oak

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[1] Native invasive species are mostly of two types. Some are "weeds" – early successional species that have a valuable role to play in healing natural disturbance, but which under current conditions more typically indicate broad scale degradation; tall goldenrod is an example of this type. The second type consists of species that are members of one or more relatively stable natural communities but these days can overrun other community types; green ash in a savanna or sugar maple in an oak woodland are examples of the second type. In this study, more than 90% of the occurrences of this second type of species were in the communities where they are invasive. There are also many species that are not generally thought of as invasive but behave somewhat similarly in degrading communities. Examples listed here include American elm (in wet prairie), enchanter's nightshade and poison ivy (in savannas and woodlands). Note that these latter species may be better thought of as 'symptoms' rather than 'causes' of the degradation.

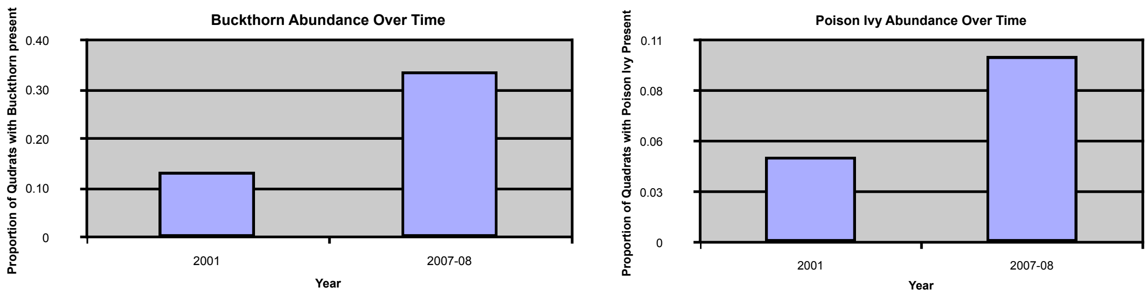

Figure 4. Frequency of buckthorn (*Rhamnus cathartica*) and poison ivy (*Rhus radicans*) within herbaceous quadrats over time.

The Oaks

Historic, keystone oaks (*Quercus spp.*) are a critical part of the oak woodlands and savannas. Their dried, tannin-filled leaves form a substantial part of the fuel that allows frequent low-intensity fires; their acorns are a major food for many types of wildlife; their dappled shade provides the conditions for most of the community's plant and animal biodiversity (Chicago Wilderness 2003; Leach and Ross 1995). Most plant and animal species of oak woodlands gradually die out in the deeper shade made by ash, maple, box elder, basswood, and other dark forest species (Curtis 1959).

Figure 5 illustrates the pattern of oak reproduction that we should expect for a compositionally stable community, where the dominant canopy trees are replacing themselves over time (based on data from Taft and Solecki 1990).

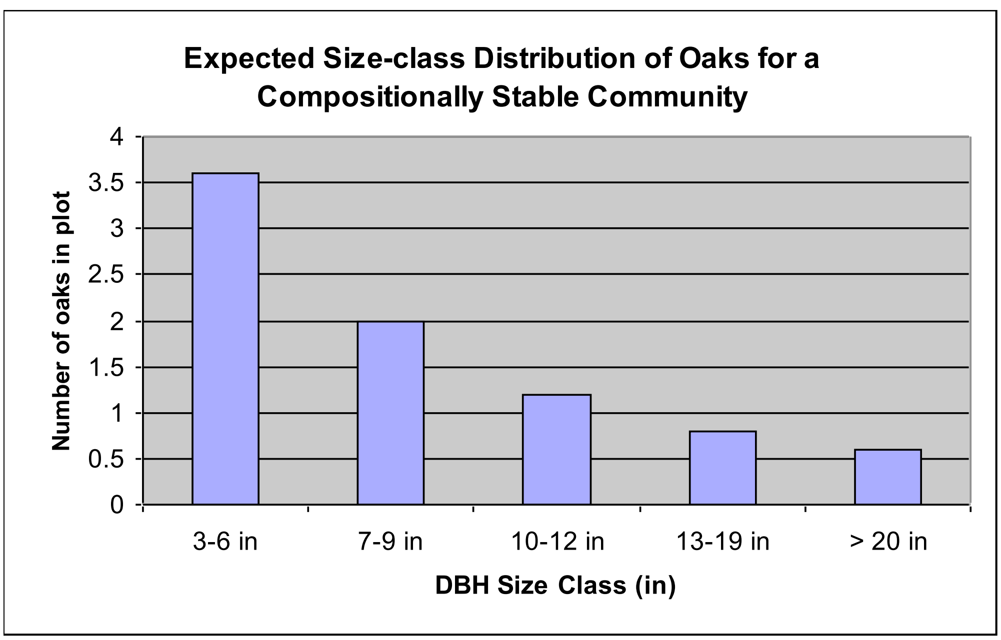

Figure 5. Expected size class distribution for a compositionally stable wooded community (based on data from Taft and Solecki 1990).

Our oak communities showed a very different pattern (see Figure 6), suggesting that in most habitats sampled the oaks are not regenerating at the levels necessary to sustain their populations over time. Not a single seedling of bur oak (*Quercus macrocarpa*) was found within herbaceous quadrats, and only a single sapling of bur oak was found in shrub sub-plots (see Figure 3). Bur, white, and black (*Q. velutina*) oak communities are the major types of woodlands and savannas that historically occur within Chicago Wilderness (Chicago Region Biodiversity Council 1999). Some have argued that oaks reproduce only after major disturbance events (Leach and Ross 1995). If so, these data suggest that restoration of such events is not part of the current disturbance regime in the Cook County forest preserves. As is suggested below, adequate oak reproduction seems to be occurring in some areas that are under standard restoration management.

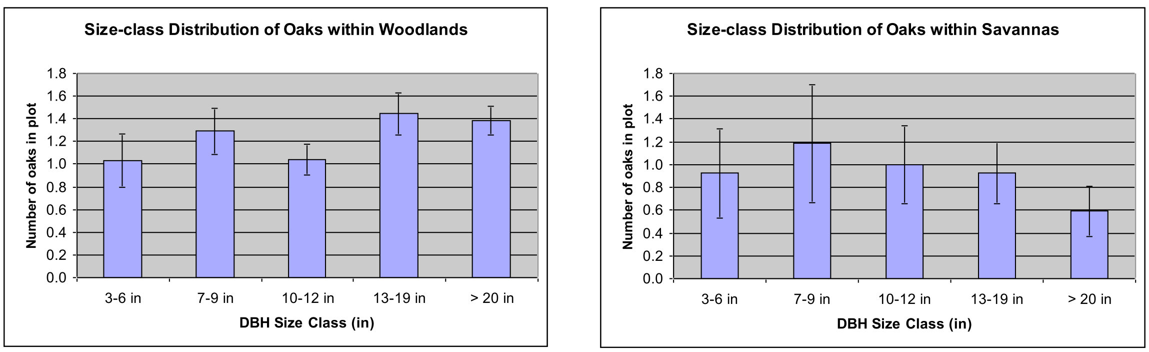

Figure 6. The number of oak trees within different size classes, for oak woodland and savanna communities. Error bars represent the standard error of the mean.

Looking at the proportionate representation of oaks within different size classes, we found that, while oaks are a dominant component of the larger size classes, they represent a much smaller proportion of each successively smaller size class; non-oak species are dramatically more common in the smaller size classes (see Figure 7). This pattern suggests that the larger, historic oaks that constitute the dominant species within the tree canopy are not regenerating sufficiently and, without intervention, will not be a part of the canopy's future.

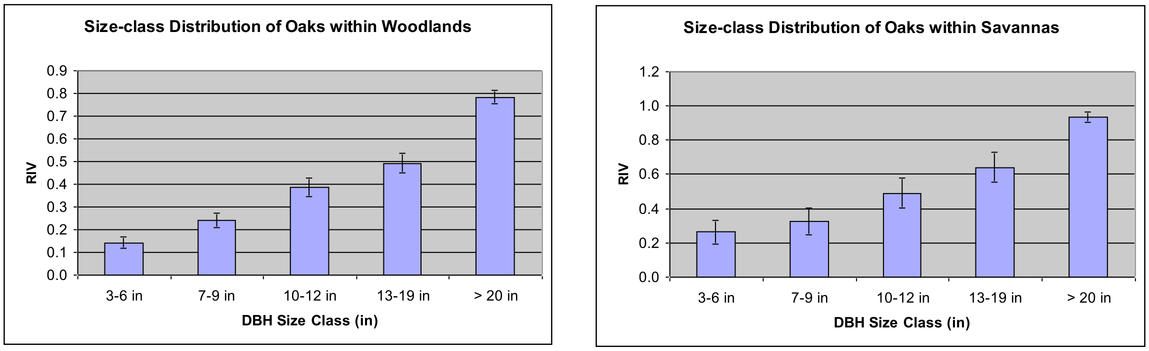

Figure 7. The relative importance value (RIV) of oak trees within different size classes, for oak woodland and savanna communities. Relative importance value is the mean of relative density (number of stems of oaks relative to the total number of stems for all species) and relative dominance (basal area of oaks relative to total basal area for all species). Error bars represent the standard error of the mean.

The data show red oaks and ashes replacing bur and white oaks over time within bur oak and white oak woods (see Figure 8). The historically dominant oaks are losing their dominance in the smaller size classes, where shade-tolerant maples, cherries, and ashes are prevalent. Black cherry has had little success establishing itself as a canopy species in our woods and thus may never replace the canopy trees. Yet this species, along with buckthorn, ash, maple, and others, creates a dense shade that is gradually choking off the biodiversity of our oak woodlands and savannas (Chicago Region Biodiversity Council 1999; Curtis 1959). These species represent a serious threat to the reproduction of oaks and the hundreds of species of animals and plants that have evolved under a much more open canopy. Both sugar maple and green ash will likely become major components of the canopy of depauperate communities that will replace our historic oak woods without management intervention

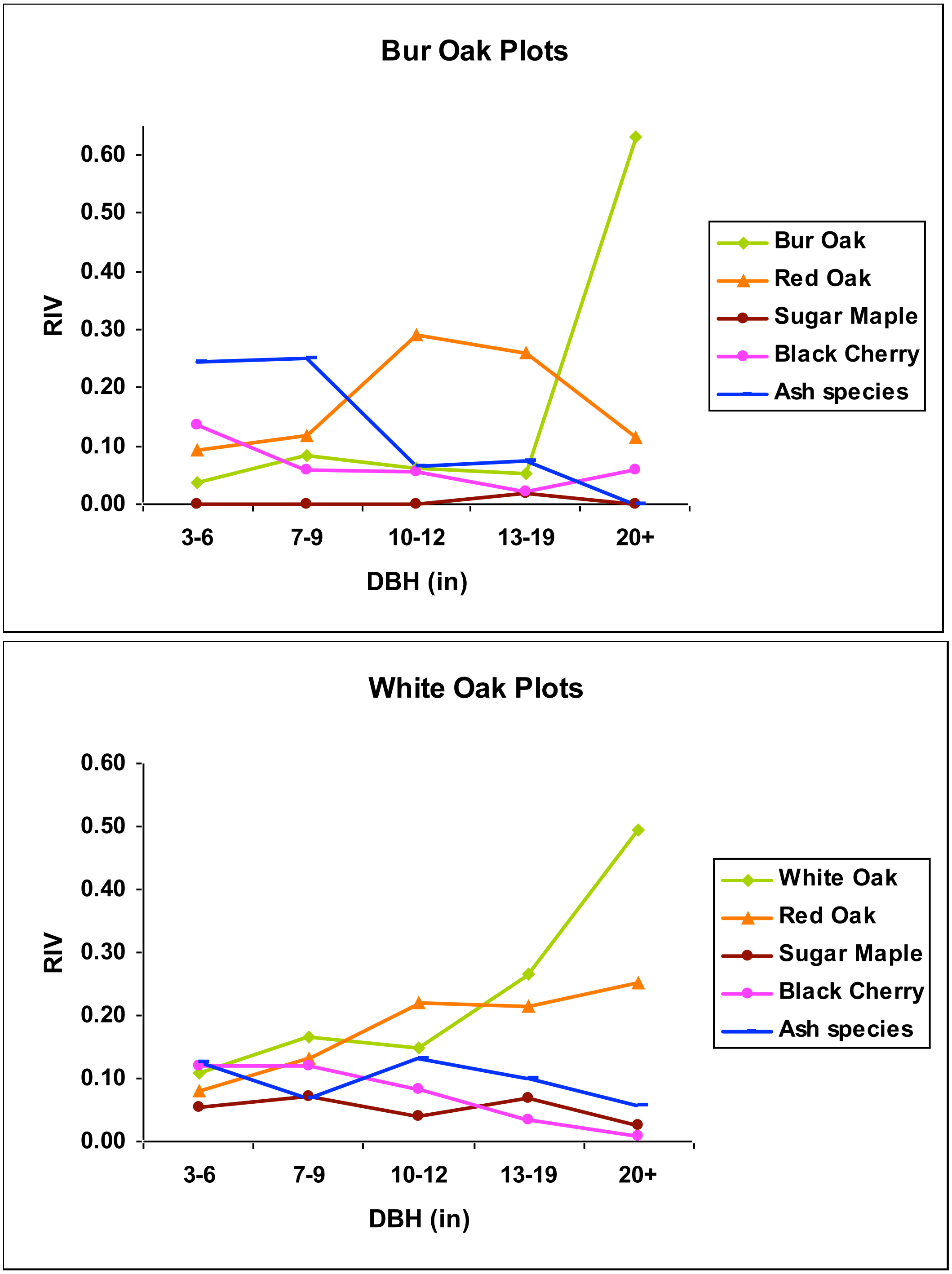

Figure 8. The relative importance value of five principal tree species within five size classes, for bur oak and white oak wooded communities (including both woodlands and savannas). Relative importance value is the mean of relative density (number of stems of target species relative to the total number of stems for all species) and relative dominance (basal area of target species relative to total basal area for all species).

Conditions on Managed and Restored Lands

Despite the challenged state of the District's conservation lands overall, several bright spots among these samples show that in areas managed by the District, quality may be maintained and degraded areas may be restored to good health.

Wolf Road Prairie is a remnant high quality prairie and degraded savanna near Salt Creek in the west central part of the county. It has been managed by District staff and volunteers for 25 years. Plots here showed high floristic quality, with only 36% of quadrats containing invasive species. While threats such as reed canary grass and excessive densities of young "pole trees" remain, the staff and volunteer commitment to the site are likely to result in the removal of these threats and the continued thriving of these remnant communities.

Somme Prairie Grove is a degraded savanna remnant that is now a mosaic of oak savanna and woodland near the North Branch of the Chicago River; it has been under management by District staff and volunteers for 28 years. Plots within Somme Prairie Grove showed very high native floristic quality and high numbers of native species within each quadrat. However, nearly 80% of quadrats contained invasive species, and oak reproduction was low within most sampled plots. An exception was a plot from the southern part of the site, where the pattern of oak size classes suggests a compositionally stable oak community (see Figure 9). A separate study has found floristic quality steadily increasing at this site since data were first taken in 1986 and has found higher floristic quality in managed woodland and grassland areas compared to unmanaged areas (Packard, personal communication).

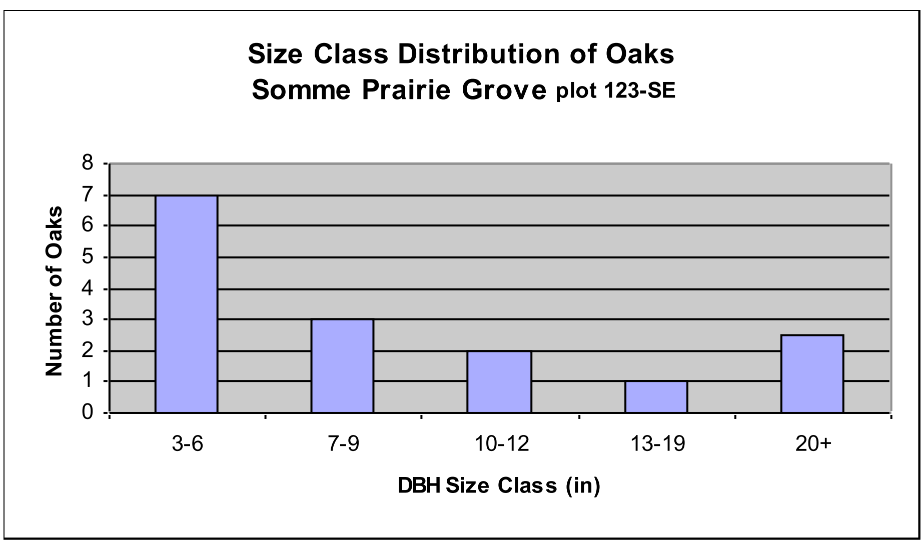

Figure 9. The number of oak trees within different size classes for one sample plot at Somme Prairie Grove. Both the canopy trees and the smaller trees included a mix of bur oak (*Q. macrocarpa*) and scarlet oak (*Q. coccinea*) species.

Zanders Woods, Powderhorn Prairie, and Calumet Prairie are ridge and swale, sandy woodlands, savannas, and prairies in the southeast corner of the county. These communities contain some of the rarest, most diverse biota in our region, due to their sandy soils and varying site topography. Plots within these sites showed high floristic quality. Oaks, mainly black oaks (*Q. velutina*), are faring better in these habitats than in the rest of the District's lands. The sandy soils here are more resistant to invasives species than are non-sandy soils. These habitats also are more prone to drought and wildfire, both of which lend increased resistance to invasive species that would shade out oak seedlings. Until recently, these sites had been without management for more than a decade, and invasives were found in 30-70% of the quadrats. Fortunately, these and nearby areas are high priorities for conservation management and have received increased management attention in recent years.

Sampled plots in Dam #1 Woods indicated another bright spot. Located along the Des Plaines River, this site showed high floristic quality and species conservatism. However, with no recent oak reproduction and nearly 90% of quadrats containing invasive species, this site needs management if it is to retain its diverse biota.

The Way Forward

Conservation management of priority lands as practiced by the District is the only proven way to maintain high quality ecosystems and return damaged ecosystems to their natural, healthy state. Diverse communities of native plants and animals, thriving in a functioning, interwoven community, require substantial resources and expertise. Conservation management may include removal of invasive species, controlled burns, re-seeding appropriate areas with local native species, deer control, or restoration of natural hydrology.

The District plans to focus efforts in the coming decade on major restoration of the approximately 10,000 acres of its priority conservation lands that remain in at least fair condition. With effective focus, a decade is sufficient for measurable improvement of these 10,000 acres – setting them on a course toward a deserved healthy state, for generations to maintain, enjoy, study, and protect for years to come.

The 2007-08 Cook County Land Audit capitalized on the enormous expertise among citizens and professional botanists within the Chicago Wilderness community. These people devoted impressive amounts of time and enthusiasm to ensure the success of the Land Audit. As a result, we now have a detailed dataset that tells us the current state of the priority conservation lands and will be used for many decades to come as a benchmark against which to measure our progress at restoring these lands.

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Appendix A: Study Methods

The sample universe included all areas within the District's conservation lands that were deemed by expert judgment to be intact, natural communities of at least fair floristic quality. We avoided areas of open water or open marsh, as the sampling protocol was designed for upland habitat (but included wet areas such as sedge meadows, wet woods, and floodplains). These conservation lands totaled 14,345 acres, or 27% of the District's natural lands. The polygons that were drawn around these higher quality areas also contained some pockets of severely degraded land (as evidenced by the data showing 27% of plots with poor floristic quality). These degraded areas are considered part of the priority conservation lands despite their low quality for two reasons. First, they are having a negative impact on the high quality lands that surround them (through invasive species dispersion, erosion, habitat fragmentation, and other ways). Second, they are managed with their high-quality surroundings and with good management should be expected to improve profoundly over time. Therefore, we sought to err on the side of lumping rather than splitting when drawing polygons around the intact natural areas of the preserves. Throughout this report, we have referred to the entire area within the polygons as "intact, natural communities" for ease of discussion.

We also included in the sample universe areas that consist of primarily non-native vegetation or unassociated woody growth, but that serve as important habitat for birds, amphibians, reptiles, or other animals. In other words, we included some areas that contained priority animal communities but did not contain priority plant communities. These areas are not referred to as "intact natural communities" in the text and were analyzed separately from the areas mapped as priority plant communities. The goal was to include in the sample universe all priority conservation lands that contain important communities of plants or animals. Appendix B shows a map of all areas included in the sample universe.

The first Land Audit, conducted in 2001, sampled randomly within all of the District's upland natural areas. The reasons for the difference in sample universe between the 2001 and 2007-08 Audits are:

1. Areas that were of very poor quality in 2001 are unlikely to have changed significantly since then;
2. These poor quality areas are lower priorities for management and are thus unlikely to change significantly in the near future; and
3. The Forest Preserve District and collaborating conservationists were eager to have better baseline data for the District's ecologically most important land.

We used ArcView software to randomly select sample points throughout these priority conservation lands. We stratified the randomization by size, with the number of points proportionate to site area up to a maximum of five points, and each parcel greater than 15 acres receiving at least one sample point (equivalent to one triad, see below). Smaller parcels were thus overrepresented relative to their contribution to total acreage. However, many of these small parcels contribute significantly to the biodiversity of county lands, and this stratification ensured that their biota were included in the dataset and avoided the problem of large sites taking most of our effort. Re-randomizing using the same stratification system in future years will ensure that studies are accurately depicting the trends on priority District lands. Re-sampling the 2007-08 plot locations will reveal the trends at these locations, although the plots may not remain representative of the District lands, as known plot locations may receive increased management attention compared to unsampled areas.

Sample points were mapped on topographic maps and aerial photos, which were provided to monitors for location of points in the field. Monitoring teams consisted of one expert botanist and one data recorder. Monitors located a center point by pacing the distance from distinct landmarks (such as street corners, buildings, or streams) to the center point marked on the aerial photo. For non-wooded areas, some monitors also used GPS units to locate the center point. Each such point marked the center of a triad of sample plots for that location. Upon locating the center plot in the field, monitors pounded permanently into the ground a 1-inch diameter metal pipe (stake) of approximately 1-foot length and identified at least three long-term landmarks (usually a distinctive tree) for use in relocating the stake. The distance and direction to the landmarks were recorded, as well as distinguishing features such as tree species, size, and shape. After locating the triad center point, monitors proceeded 50 meters north, inserted a second stake, and began taking data in this first of three sample plots (see Figure a). After completing sampling within the north plot, monitors then proceeded to the remaining two plots, inserted stakes, and collected data. Each circular sample plot represented the sample unit for statistical analysis (see Crocker et al. 2007).

Triad configuration:

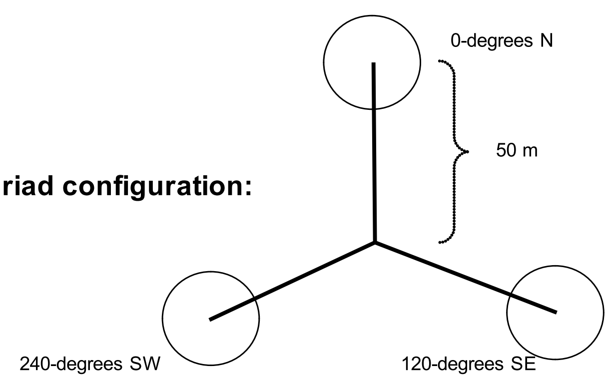

Figure a. Layout of sample plots within each triad.

Within each sample plot, monitors recorded species and percent cover for all herbaceous species and all woody species less than 1 m tall within twelve ¼ m^2 quadrats (see Figure b). They also record percent bare ground (any ground not covered with live vegetation). Data for the twelve quadrats were averaged to get a value for the sample plot. Within each of four 25 m^2 shrub-sapling subplots, monitors recorded species and number of stems at ground level for each shrub, tree, or woody vine less than 31-cm circumference (4-inch DBH) and at least 1 meter tall. We also estimated percent cover of the subplot for each species (2007) or stem number at breast height (2008), for all individuals whose stems were counted. Data for the four subplots were averaged to get a value for the sample plot.

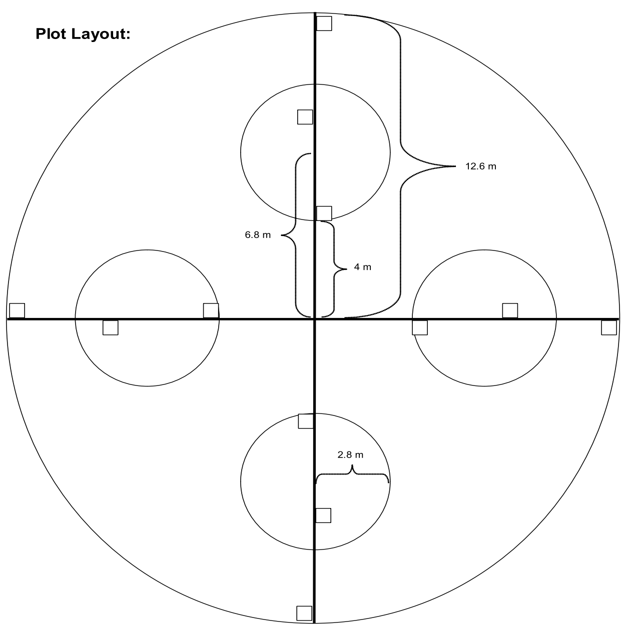

Figure b. Sample plot layout.

Within the entire sample plot (500 m^2 area, or 0.05 ha), monitors recorded species and circumference at breast height for all woody plants of at least 31-cm circumference (about 4 inches DBH). To increase the sample size for very large trees, monitors walked the perimeter of the sample plot and recorded the species and circumference of all trees greater than 157 cm circumference (about 20-inch DBH) within a 5 meter band outside the circle. Thus, the plot area for large trees was 1,000 m^2, or 0.1 ha.

For trend analysis, we overlaid the 2001 points on the 2007-08 polygons (the 2007-08 "sample universe") and included in the trend analysis only those 2001 points that fell within the 2007-08 polygons. Out of 87 transects in 2001, 16 fell within the 2007-08 polygons. Each 2001 transect contained 20 quadrats, for a total of 320 quadrats for comparison with the 2007-08 results.

Quadrat-level measures such as presence of invasives and abundance of specific species were readily comparable between the two studies, as both used ¼ m^2 quadrat frame size. Tree data were more difficult to compare, as the 2001 study used the point quarter method of estimating relative abundance of woody species. While the point quarter method can be used to calculate densities, there are some biases inherent in the conversion that would complicate comparisons with the current, plot-based method. More importantly, the point quarter method risked missing the oaks altogether, if other species were more abundant within each size class, so determining trends in oak reproduction was not possible.

We defined plot quality based on the quadrat-level native floristic quality index (FQI)*, weighted by the cover of each species within the quadrat. Using quadrat-level FQI, rather than plot-level FQI, allows for ready comparisons among any studies that have used a ¼ m^2 size quadrat -- a commonly used size. Plot-level FQI comparisons can be complicated by differences in plot size or transect length, as species number tends to increase with the area sampled. Furthermore, we have found quadrat-level FQI to be more sensitive to change than plot-level FQI, so quadrat-level FQI may be a better means of tracking trends in ecosystem health.

Weighting each species by its percent cover within the quadrat also provides a more accurate measure of plot quality, and we have found this metric to be more sensitive to change than non-weighted FQI.

* FQI is the product of mean C and the square root of species number for the quadrat. Based on quadrat-level native FQI, weighted by the cover of each species within the quadrat, the grading scale was: FQI greater than 9 = Excellent; FQI 7-9 = Good; FQI 4-7 = Fair; and FQI less than 4 = Poor.

Appendix B. Priority conservations lands (blue areas) within the Forest Preserve District of Cook County (gray areas). Sample plots were randomly located within the areas shown in blue.