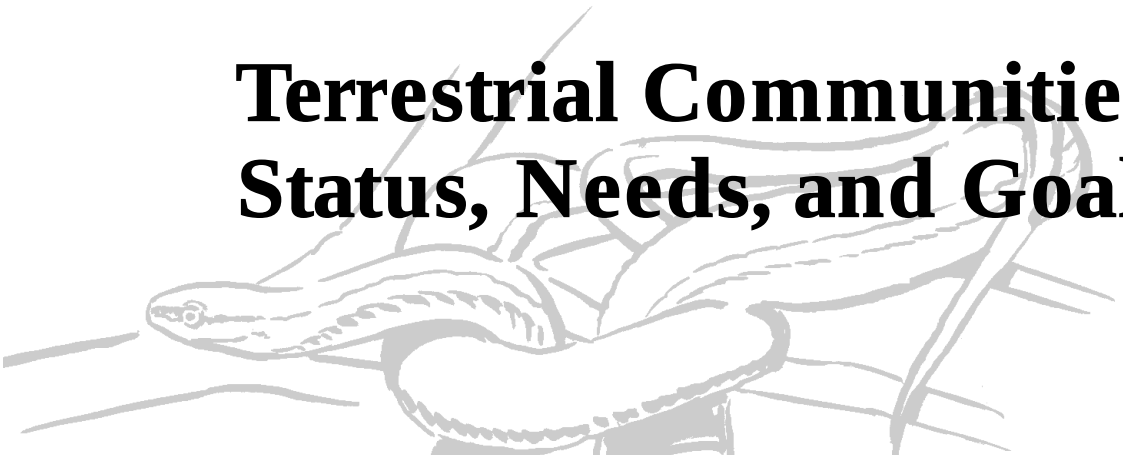
Chapter 5

Terrestrial Communities: Status, Needs, and Goals



5.1 Introduction

This chapter describes the status and significance of each community type and gives a vision of the condition of the community class in the long term in order to sustain biodiversity. Following this are sections on threats, recommended actions, and research needs. Many community types suffer from similar stressors, and actions are needed at the landscape level. For this reason, discussions on threats, actions, and research needs are grouped together for all community types.

The information presented in this chapter is based on the opinions of Science and Land Management Team members, gathered through a number of workshops and review processes. Many statements are based on professional experience, rather than published literature, and are presented to give an indication of priority and direction for future conservation work. Complete workshop reports from which this chapter was written can be found on the Chicago Wilderness Web site (www.chiwild.org).

5.2 Forested communities—status and recovery goals

5.2.1 Description of communities

The forested community class includes all the community types that are dominated by trees, with an average canopy cover of greater than 50%. Forested communities have a multi-layered structure composed of the canopy, sub-canopy, shrub, and herbaceous layers. Historically, this multi-layered structure was maintained through fire and other natural disturbances. Within the forested community class there are four community types: upland forest, floodplain forest, flatwoods, and woodlands.

Upland forest has a canopy cover of 80–100%. Canopy tree species are well represented in varying age classes from seedling to canopy-sized individuals. The fire return period is presumed longer for this community type than for woodlands or savannas. The longer fire return period and lower fire intensities would result from fire barriers provided by woodlands, savannas, and large rivers or lakes on the south and west sides of these communities. Three subtypes of upland forest are based on soil moisture: dry-mesic, mesic, and wet-mesic.

Floodplain forests are located on the floodplains of rivers and streams. These communities are shaped by the frequency and duration of flooding, by nutrient and sediment deposition, and by the permeability of the soil. The canopy cover (80–100%) is similar to that of upland forests, but the understory is more open due to the frequent flooding. The subtypes, based on soil moisture, range from wet-mesic to wet.

Flatwoods have a canopy cover of 50–80% and occur on level or nearly level soil that has an impermeable or slowly permeable layer that causes a shallow, perched water table. Because soil moisture fluctuates so widely by the season, the moisture gradients do not define the subtypes. Rather, the two subtypes are defined by geography and soil type. Northern flatwoods are associated with the Valparaiso, Tinley, and Lake Border morainal systems, while sand flatwoods have a meter or more of acidic sand over silty clay and are found in the more southern parts of the region.

Woodlands developed under a canopy cover of 50–80%, intermediate between that of savanna and forest. Today,

many original woodlands have canopy cover greater than 80% due to years of fire suppression. Such sites can be recognized by the failure of the canopy tree species to reproduce, with few, if any, canopy species represented in the seedling or sapling layer. Based on soil moisture, woodland subtypes are dry-mesic, mesic, and wet-mesic.

More detailed descriptions of the forested community types may be found in Appendix 1. Associated animal assemblages may be found in Table 4.3.

5.2.2 Findings and priorities

Of the forested community types, the woodlands are of the highest conservation concern. All moisture classes of woodland are in the first tier of conservation targets for the Chicago Wilderness region. Wet-mesic woodland is considered critically imperiled at the global level (G1) by The Nature Conservancy (which calls this community swamp white oak woodland). A substantial number of acres of woodlands remain, providing opportunities for their conservation, but remaining sites are generally in very poor condition. The healthy woodlands in the Chicago Wilderness region tend to be species-rich, indicating that they are biologically important. The Chicago Wilderness region also has a unique landscape setting of woodlands, including those originally interspersed with prairies.

The flatwoods of the region are of high concern, because the remaining examples are both degrading rapidly and disappearing due to development or conversion to other land uses. In The Nature Conservancy's global ranking system, both northern flatwoods and pin oak-swamp white oak sand flatwoods, which correlate to Chicago Wilderness's sand flatwoods, rate as imperiled globally (G2). The primary conservation concern for upland forest and floodplain forest is their current degraded condition. All of the forested communities are important as wildlife habitat, and they are key areas for human recreation. The primary requirement for their conservation is significantly increased management efforts.

FORESTED COMMUNITIES
Conservation targets in top tiers

First tier
Woodland (all subtypes)

Second tier
Northern flatwood

Third tier
Sand flatwood

5.2.3 Status

Upland forests

Upland forest, particularly areas not dominated by oak, was probably much less common historically than woodland, savanna, or floodplain forest (Bowles et al. 1998a).

There are comparatively greater amounts remaining of dry-mesic upland forest than of other subtypes. Dry-mesic upland forest is mostly fragmented, but some large blocks still exist, such as in Busse Woods. There has been much less loss of both dry-mesic and mesic upland forest than of other community types.

Upland forests are more secure because a relatively high percentage of their original acreage has been protected. Mesic upland forest was an initial target of the Forest Preserve Districts when they first started acquiring land. However, many occurrences are still in private hands, and others are threatened by development. Management options are more limited on upland forests on private property.

In general, drier upland forests are considered to be in better condition than wetter upland forests due to less impact from invasive species. There are few or no remaining high-quality examples of wet-mesic upland forest. However, the quality of drier sites is declining rapidly, primarily through the ongoing loss of the shrub layer. Many of the remaining acres of mesic upland forest have significantly impaired ecosystem function, including quality of wildlife habitat. Different types of upland forest are affected differently; oak stands are currently deteriorating more rapidly than maple stands (Bowles et al. 1998b). In some parts of the region, both are rapidly deteriorating. It would be valuable to have more inventory and monitoring to determine the full extent and rate of degradation. Significant threats to upland forests include lack of fire, fragmentation, browsing by deer, and invasive species, particularly buckthorn.

Historically, moisture gradients and community types varied with subtle changes in the landscape. Today, we mainly have fragmented remnants that do not incorporate these landscape-scale variations. Complexity in the landscape is important for animals, as they respond to structure and community mosaics, not to one community type. Succession toward more closed forests is occurring due to the lack of fire, and species diversity is being lost in the process. In the remaining fragments, most animal communities are not doing well, primarily due to the effects of isolation and loss of key habitat features. Amphibians, in particular, are doing very poorly and are declining precipitously in places, due to fragmentation. Individual populations are at risk because they are no longer functioning as part of metapopulations, with gene flow between separate subpopulations (Mierzwa 1998).

Floodplain forests

Floodplain forests have always been relatively rare in the Chicago Wilderness region, occurring along the major river courses. The region has lost some original floodplain forests to conversion to agriculture and other development, but many acres are protected in forest preserve holdings. Because of lack of fire, trees are appearing in some floodplains that were sedge meadow and wet prairie historically. Additionally, with increased hydrological inputs, areas along rivers now experience longer and more frequent flooding. This combination of hydrological change and lack of fire has allowed certain species to become more abundant, changing the structure and species make-up of floodplains. These more recently developed floodplain forests do not seem to have high levels of floristic diversity, although they do have some limited wildlife values.

The quality of original floodplain forests suffers from altered hydrology and increased sedimentation. The sensitive amphibian species have been lost, and those that remain are tolerant of flooding. Further study of the cause-and-effect relationships in the development and degradation of floodplain forests would lead to a better assessment of their status.

Flatwoods

Both types of flatwoods occurring in the Chicago Wilderness region, sand and northern flatwoods, are extremely rare and are considered globally imperiled (G2). Unlike the other forested community types, the differences between the two subtypes are substantial and are not based on moisture. Overall, both flatwood types are in fair condition compared to other forested communities, but they are degrading rapidly in the absence of management. Lack of fire, invasive species, and overabundant deer are primary threats. Flatwoods have a very delicate moisture balance, so their condition is sensitive to changes in hydrology. Surrounded by development, flatwoods can experience raised water levels, which damages them through excess flooding. Thus, the lower-lying flatwoods are more prone to loss. Conversely, in some areas, flatwoods are drying up as water in their watershed is diverted away from them.

Most sand flatwoods in the region occurred in southeastern Cook County and in Indiana around the edge of Lake Michigan. Occurring primarily in the Lake Plain Division, sand flatwoods are naturally rare in the region. Many sand flatwoods have been lost to agriculture, and others have succumbed to development and drainage.

A few good-quality examples of northern flatwoods remain today, and more remnants are of degraded quality. Northern flatwoods are generally found in and amongst upland forests and woodlands and occur in the drainage ways and depressions associated with glacial moraines. Therefore, northern flatwoods survive better when they are imbedded in a large preserve. In the smaller preserves, altered hydrology will remain a significant problem.

Woodlands

In the absence of fire, canopy cover in woodlands increases and biodiversity declines. Before large-scale suppression of fire, woodlands were extensive in the region. Unfortunately, good-quality examples are hard to find today. All of the woodland subtypes are suffering the same threats, most significantly lack of fire, invasive species, impacts from overabundant deer, and loss due to development.

A fairly large amount of degraded woodland still remains on protected land, providing opportunities for restoration and conservation. The woodlands that were originally interspersed with prairies in the southern and western areas of the region have been lost to a greater extent than woodlands more closely associated with forest communities. Woodlands, along with forests, are found more often in protected areas than other community types, because originally they were a focus of Forest Preserve District acquisition. However, much woodland that was not protected has been lost to development. Historically, across the landscape, woodlands were a part of a shifting mosaic of communities; this dynamic has been lost in our fragmented landscape.

Virtually all of the woodlands remaining in the Chicago Wilderness region are in very poor condition. In some areas, considerable management is devoted to woodlands, and in these areas their condition is improving. However, the majority of woodland acres are not managed. The last twenty years have seen significant improvement in management attention for these communities, but considering the significance of this community type to the region's biota, and its rarity elsewhere, there is still a long way to go.

Woodlands can maintain some of their values better than upland forests in a fragmented state, since they have always occurred in smaller patches interspersed with other community types. This provides greater opportunities for successful restoration of this important community type.

5.2.4 Biological significance

Upland forests

Because of the degraded state of upland forests, it is likely that the current richness of plant species is comparatively low, although comparisons to historical conditions have

not been made. In most upland forests, much of the original floral diversity has certainly been lost, especially the summer and fall herbaceous species, the shrubs, and the graminoid fuel matrix. Oaks historically dominated most of our upland forests, but now maple and ash are becoming more common.

For the region's mammals, upland forests and woodlands are the most important community types, although these mammals benefit most from a complex of different communities in an area. Many mammals depend on both forests and woodlands. Mammals of concern found in forests include the federally endangered Indiana bat, the eastern pipistrelle (a type of bat), and the woodland vole.

Upland forests, along with the other forested community types, provide important habitat to amphibians and reptiles, including the eastern box turtle, the eastern newt, the eastern rat snake, and the spring peeper. The overall assemblage of forest and woodland reptiles and amphibians is considered to be in decline. Upland forests also serve a critical need as migratory pathways for migrating birds. The remaining forest blocks in the region are likely too small to sustain viable breeding populations of forest-interior birds. This is due to greatly increased rates of predation (from raccoons, feral cats and other animals) and nest parasitism (from brown-headed cowbirds) in the fragmented forests of the region (Robinson et al. 1995). It is most important to protect the largest blocks of remaining forest from additional fragmentation to increase the chance of some successful reproduction by these species.

Floodplain forests

Floristic diversity in floodplain forests is maintained by regular patterns of flooding. Floodplain forests have always been dominated by disturbance-tolerant species. Along with other forest types, floodplain forests are important for mammals, particularly as feeding areas, and they serve as important migratory corridors for birds. Breeding birds, including Cerulean warbler, red-shouldered hawk, American redstart, and prothonotary warbler, also depend on floodplain forests.

Floodplain forests of the Chicago region are important as insect habitat because of the rich assortment of plants. Pawpaw, yellow birch, black walnut, sycamore, and many others are typically found only in high-quality floodplain forests. Insect species depending on these trees for food will, therefore, be dependent on remnants of high-quality forest. Examples include the zebra swallowtail butterfly, the sycamore sallow moth, and the pawpaw sphinx moth.

Floodplain forests also provide benefits to river systems by trapping sediment and improving water quality, as well as slowing floodwaters.

Flatwoods

Flatwoods are key amphibian breeding grounds. In particular, the blue-spotted salamander is abundant in good-quality flatwoods. Additionally, massasauga and Kirtland's snake may rely on flatwoods, although both species occur only in the more open parts. Flatwoods provide habitat for a number of endangered and threatened plant species. Plant species of concern include purple-fringed orchid and dog violet. Good-quality flatwoods generally have higher levels of plant diversity than other forests and harbor a number of conservative species. As for insects, species such as the mouse-colored lichen moth, fern moths, the royal fern borer, sensitive fern borer, the northern fern geometer, and a variety of millers and cutworms appear to be associated with flatwoods. The temporary ponds have unique communities of aquatic invertebrates since they are fishless and seasonal.

Woodlands

Woodlands are particularly important for biodiversity. The larger and better examples of woodlands can be species-rich in amphibians, reptiles, birds, and mammals. The more diverse sites are those in larger savanna / woodland / forest complexes or woodland / wetland complexes. Woodlands provide important habitat for many species of conservation concern, such as the declining red-headed woodpecker. Forest and woodland reptiles and amphibians are in decline overall.

For birds, the woodlands are the most important of the region's forested communities. Sensitive bird species include yellow-billed cuckoo and whip-poor-will. The open-woodland bird assemblage is in suboptimal condition and is considered globally important. Woodlands, like the other forested communities, also serve as important pathways for migratory birds.

Woodlands harbor a number of endangered and threatened plant species of concern, including northern cranesbill, shadbush, false bugbane, pale vetchling, and buffalo clover.

The woodland and savanna insect communities are potentially globally significant, yet more remains to be learned about these communities. The insect assemblage of dry blacksoil savanna and woodlands is of concern. Sensitive insects found in woodlands and savannas include Appalachian eyed-brown, silvery checkerspot, hobomok skipper, silvery blue, and pipeline swallowtail.

5.2.5 Global significance and conservation importance

According to The Nature Conservancy's global ranking system, both types of flatwood communities are glob-

ally imperiled (G2). The Chicago Wilderness region contains a number of good-quality examples of flatwoods. The region might include the majority of remaining high-quality northern flatwoods. The upland forests of Chicago Wilderness are unusual in their pattern of occurrence on the landscape. These forested communities were once naturally fragmented by prairies and other community types, creating a unique mix of species. Chicago Wilderness has the best and possibly the only extensive examples of this landform—oak forests in the middle of the prairie. Floodplain forests are found along most of the major river valleys, but in general they are rarer than other forested community types. Although woodlands are widespread, this region is very important for two reasons: 1) much conservation attention has been and is being paid to woodlands here, and 2) the dynamic interaction of prairie and forest that creates woodlands could be restored here.

5.2.6 Long-term vision and recovery goals

This plan's vision for the region's forested communities is to improve conditions and restore natural processes to allow canopy tree species to regenerate (in viable numbers) and to maintain an appropriate continuum of canopy cover across the region to sustain viable populations of rare species and community assemblages. A focus for achieving this goal will be on natural areas where disturbance is essential for ecological health and for allowing natural regeneration to occur. Natural disturbances include fire, disease, storms, and sustainable levels of animal browsing. Viable management options, including prescribed burns and selective or patch cutting, should mimic natural disturbance. Forested sites should be managed to maximize structural and biological diversity and to maintain a continuum of canopy from open to closed, reflecting historical proportions of canopy cover. An important goal, and an indicator of system health, will be to restore understory layers of shrubs and saplings and ground layers of native herbaceous species throughout all forested communities.

Large-scale planning and restoration should attempt to create opportunities for landscape-scale processes that create healthy forested communities. These efforts should also seek to maintain a variety of juxtapositions between woodland and forest, and between woodland and grassland, to sustain the species dependent on these dynamic interactions. Flatwoods, for example, are always contained within other forested community types. A goal is to move forested communities into more self-sustaining conditions, which will reduce the management effort needed over time. Some forested community types, such as flatwoods and true floodplain forests, are rare, and a goal should be to sustain the rare species they support through appropriate management and additional land protection where still possible.

Additional indicators for evaluating the long-term health of the forested communities are the reptile and amphibian assemblage and some wide-ranging mammal species, such as the gray fox. The region's woodlands should support sustainable populations of woodland amphibians and reptiles with opportunities for gene flow among separate sub-populations. Because amphibians have complex life cycles, conservation of this assemblage requires a variety of breeding wetlands within woodland sites. Amphibian species of concern associated with forested communities include spotted salamanders, spring peepers, and wood frogs, which are currently threatened by fragmentation of upland forests and the lack of breeding wetlands within forested blocks. It should be a goal to properly protect and manage flatwoods to sustain large populations of blue spotted salamanders.

Maintaining viable populations of woodland bird species, particularly sensitive species such as the red-headed woodpecker, is another goal. Due to habitat types and shapes of habitat occurrences, the Chicago Wilderness region has never provided major breeding grounds for most forest-interior bird species. However, a goal should be to maintain a number of locations that provide the structural habitat required for these species. Chicago Wilderness's forested communities play a significant role for migrating birds, and these communities should be maintained to provide these fundamentally important stop-over sites.

Another goal is to expand populations of rare plant species to ensure their continued existence on our landscape. Flatwoods, in particular, harbor a large number of rare plant species, and more open-canopy examples are needed for their continued existence. Recovery plans for key species are needed to identify priority actions.

In total, it is thought that approximately 50,000–100,000 acres of healthy forest and woodland complexes are needed in the region to meet these goals. To maintain the diversity and richness of amphibian species, it is recommended that we maintain enough sites to provide for a wide range of quality breeding habitat. Ideally, as many as 20 good-quality sites larger than 500 acres would provide a rich diversity of amphibians and other species. Several 800- to 1000-acre sites, with appropriate landforms (slope, soils, and hydrology), are needed to maintain a variety of plants and woodland types.

While size is more important than quality for some species, most species that depend on forests and wood-

lands need good-quality sites for their survival. To achieve a healthy state of the forested communities in the region, it is recommended that at least 90% of the highly fire-dependent communities be managed with prescribed burns on a rotating schedule. In addition, the density of deer should be reduced to a level that, in combination with prescribed burns, will allow the herbaceous and understory layers to return to a healthy condition. Active restoration, including cutting, burning, weeding, and planting, should take place on many more sites to increase the overall health of forested communities in the region.

5.3 Savanna communities—status and recovery goals

5.3.1 Description of communities

Savannas are wooded communities with a graminoid groundcover and with an average tree canopy cover of less than 50% but greater than 10%. A savanna may have shrubby areas, and the tree canopy may locally be greater or less than the above limits. Savannas often have soils that are transitional between forest and prairie, and they have distinctive plants and animals. These communities were maintained by fire before European settlement. They were among the most widespread and characteristic communities in Illinois and Indiana, but few high-quality stands remain. Most remnants have changed extensively. The least-disturbed remnants are on sandy land that still is frequently burned and on the very driest slopes, where woody encroachment has been slowest. The two different types of savanna are fine-textured-soil savanna and sand savanna. Savanna subtypes are distinguished by soil moisture. The subtypes of fine-textured-soil savanna are dry-mesic, mesic, and wet-mesic. The subtypes of sand savanna are dry, dry-mesic, and mesic. A more complete description of savanna communities is in Appendix 1. Associated animal assemblages are shown in Table 4.3.

5.3.2 Findings and priorities

Savannas were once common across the landscape in the Chicago Wilderness region. Today, much of the savanna has been lost, although of greater concern is the poor condition to which the region's remaining savannas have degraded. Due to their degraded condition, and their global conservation significance, savannas are one of the highest priorities for additional conservation attention in the region. The Nature Conservancy considers fine-textured-soil savannas critically imperiled at the global level (G1). Mesic sand savanna is also a first-tier conservation target for Chicago Wilderness, due to the small number of remaining examples. Dry and dry-mesic sand savannas and are in the second and third tiers of conservation priority, as remaining examples are in somewhat better condition overall. Many acres of savanna are so degraded that they are barely recognizable as savannas. At the same time, savannas are very important due to their biological richness. Savannas are often a transitional community between woodlands and prairies or wetlands, which leads to their high diversity of species.

SAVANNA COMMUNITIES
Conservation targets in top tiers

First (highest) tier
Fine-textured-soil savanna (all subtypes)
Mesic sand savanna

Second tier
Dry sand savanna

Third tier
Dry-mesic sand savanna

5.3.3 Status

For all types of savanna, the region has lost most of what was once here, but across the region more fine-textured-soil savanna has been lost than sand savanna. In Indiana, very little fine-textured-soil savanna remains. In Illinois, mesic and dry-mesic fine-textured-soil savannas are still the most common types of savanna. Much of the savanna in the region was lost in the conversion of land to row crops and pasture. The wetter savannas of both types are the rarest today. Many of the wetter fine-textured-soil savannas were drained through tiling and converted to agriculture.

Of the remaining savanna, most of the known high-quality sites are protected. Savannas were often included in the original public land purchases along with woodlands. Due to the aesthetic appeal of savannas, many have been incorporated into golf courses and college campuses, which has helped to protect them to a certain extent, although such examples have lost most of their original species diversity. Sand savannas, particularly in the eastern and southern parts of the region, have been preserved in moderately large blocks, whereas the fine-textured-soil savannas have been severely fragmented.

Of the sand savannas, most of what remains in the region is dry-mesic sand savanna, particularly in southern Will County, in Lake County, Illinois, and in Indiana. In these

areas, management is being applied to good-quality sites. Due to these efforts, dry-mesic sand savanna is in the best condition of all the savanna community types. Yet, possibly as much as 50% of the remaining dry-mesic sand savanna is not being managed and is declining in quality.

Little of the dry sand savanna remains. With lack of management, these areas become overgrown, which alters the moisture gradient and leads to a loss of community structure and diversity. Mesic sand savanna has always been extremely rare in this region, because it occurs in a specific type of hydrology within a specific topography. The remaining examples in the Chicago Wilderness region are at Illinois Beach State Park and Indiana Dunes National Lakeshore.

There is a high level of concern about the amount of remaining mesic and wet-mesic fine-textured-soil savanna and its fragmented condition. The hydrology of wet-mesic fine-textured-soil savannas has very rarely been left intact, and hydrological change is a threat to all savannas. If the hydrology is lost, it is extremely difficult to restore this community type to original condition.

Savannas are fire-dependent communities, and the lack of burning leads to their rapid degradation. Many acres of fine-textured-soil savanna are not managed at all. A natural, healthy savanna is as easy to manage as a prairie or woodland, and much easier to manage than a lawn or garden. Invasive species are a significant threat to savannas, and degraded savannas often require large-scale mechanical management at first, which can be expensive. During restoration, some species of trees, shrubs, and herbaceous plants may need to be reduced in number or eliminated. Additional threats to savannas include overabundant deer and recreational pressures.

5.3.4 Biological significance

All types of savanna are biologically significant due to their species richness and numbers of rare species. Savannas were once very widespread and now generally occur only in small pockets, which raises concerns about the genetic viability of some remaining savanna species.

Sand savannas in the region have high species diversity, since the dunes systems where many occur contain a mosaic of community types. The species richness in fine-textured-soil savannas is also very high, because they contain a mixture of woodland, prairie, and wetland species. Many species, particularly plants and insects, depend on savannas. State-listed endangered and threatened plant species found in savannas include redroot, savanna blazing star, pale vetchling, and veiny pea.

The assemblages of insects found in fine-textured-soil savannas differ from that of sand savannas, and there are differences depending on moisture gradients as well (Table 4.3). All of the savanna insect assemblages appear to be in decline and are of conservation concern (Table 4.8). Additionally, the sand-savanna insect assemblage of the region has been identified as globally important (Table 4.9). The fine-textured-soil insect communities may also be globally important, but not enough is known about these species.

Characteristic insects associated with sand savannas include the federally endangered Karner blue butterfly and American burying beetle. The phlox flower moth, originally described from the dune-and-swale complexes of northwest Indiana, was thought to have been extirpated from Indiana until its recent rediscovery. Additional globally rare, but often overlooked, species include the persius duskywing skipper, the cobweb skipper, the Indian skipper, the frosted elfin butterfly, Grote's dart moth, and numerous other moths and leafhoppers. Grasshoppers, bees, wasps, beetles, and flies also have many species restricted to sand prairies and open sand savannas.

Insect species of concern recorded from fine-textured-soil savannas include the rare silvery blue, which feeds as a larva exclusively on the equally rare veiny pea. Various additional woodland and wetland butterflies and skippers are found primarily (or in greatest numbers) in high-quality remnants of these savanna types. These include the silver-bordered fritillary, silvery checkerspot, and Appalachian eyed-brown.

The savanna bird assemblage is in suboptimal condition and is considered globally important. The red-headed woodpecker is found predominantly in savannas and responds well to management of the habitat. Some other savanna bird species, such as eastern kingbird, are declining.

Assemblages of reptiles and amphibians differ between fine-textured-soil and sand savannas. The amphibians and reptiles of fine-textured-soil savanna appear to be declining due to lack of management of their habitat. Plains leopard frog and smooth green snake are sensitive species. The Chicago Wilderness region is very important to the conservation of this assemblage. The reptile and amphibian assemblage of sand savanna and sand prairie also includes declining species. Sensitive species belonging to this assemblage include Fowler's toad, eastern racer, bull-snake, and western ribbon snake. Finally, it is difficult to determine the habitat requirements of the endangered massasauga and Kirtland's snake, as a number of factors are contributing to their decline. Savannas are, however, potentially important to these species.

5.3.5 Global significance and conservation importance

Fine-textured-soil savannas are in as much trouble throughout their range as they are in the Chicago Wilderness region. Fine-textured-soil savannas are fragmented throughout their range and are considered critically imperiled (G1). Chicago Wilderness is very important for the global conservation of these savannas, because large amounts of restorable savanna remain. It is possible that the Chicago Wilderness region has the best chance anywhere of conserving the fine-textured-soil savannas.

There are significant biological differences between the sand savannas that occur in the Lake Plain Division and those that occur elsewhere. The Chicago Wilderness region is very important for the sand savannas in the Lake Plain Division. Sand savannas along Lake Michigan are ranked as globally threatened in The Nature Conservancy's system. Lake County, Illinois, and Porter and Lake Counties, Indiana, have the best examples of this type of sand savanna.

5.3.6 Long-term vision and recovery goals

This plan's vision for the region's savannas is to dramatically improve the condition and integrity of remaining savanna communities within the region. This globally imperiled ecosystem can again be a vibrant component of the region's natural landscape and can contribute significantly to the survival of all the species existing within the mosaics of prairie, savanna, woodland, and wetland that constituted the original landscape of the region. As part of this goal, Chicago Wilderness members recognize North American savanna communities as among the rarest community types on earth and will aim to fulfill a responsibility and opportunity to significantly contribute to their global preservation. Goals for savannas should focus on the health of the communities, their ability to regenerate, the restoration of natural ecological processes, and their role in a matrix of other natural community types. Savannas should function as structurally and compositionally dynamic communities in time and space, especially in conjunction with shrublands and woodlands.

With restoration of fire and other natural disturbances as a goal, sites need to be large enough that landscape-scale processes can occur. Development of relatively complete savanna communities will be most cost-effective on larger sites, though smaller sites are also valuable and can be healthy if well managed. The Karner blue butterfly is a sensitive species and, where it occurs, it can be helpful in defining management goals for sand savannas. The Karner blue depends on large, fire-maintained savannas or on complexes of smaller, high-quality savannas without much distance between them. The key to long-term survival for insect species that depend on sand savanna lies in the quality of the habitat and how it is managed over time.

While fewer animal species depend only on savannas than depend on other community types, savannas do have distinctive inhabitants, particularly birds, reptiles, and amphibians. These species serve as a target for conservation. Savanna birds require appropriate structural conditions. Currently, the region has many savannas in poor condition. Management should be undertaken in these savannas in order to improve their quality and structure. Based on a general understanding of the habitat requirements of reptiles and amphibians, it appears that viable amphibian populations require sites of 200 to 500 acres in size. As with all amphibian and reptile assemblages, multiple sites with functional connections for dispersal to sustain metapopulations are recommended.

5.4 Prairie communities—status and recovery goals

5.4.1 Description of communities

Prairies are communities dominated by grasses on organic or mineral soils. Trees may be present, but less than 10% of the area has tree cover. Four natural communities are recognized based on soil type: fine-textured-soil prairie, sand prairie, gravel prairie, and dolomite prairie. Soil moisture gradients for each of these prairie types range from dry to wet (except that gravel prairies range only from dry to mesic). More complete descriptions of all types are in Appendix 1. Associated animal assemblages are shown in Table 4.3.

5.4.2 Findings and priorities

Given how much has been lost and the generally poor condition of what remains, we regard all prairie types with a high level of concern. The region's fine-textured-soil prairies, dolomite prairies, and the sand prairies in the dune-and-swale topography are in the first tier of conservation targets. Gravel prairies, some subtypes of sand prairies, and dolomite prairies are considered globally imperiled (G2). Prairies once dominated the landscape but now mainly exist in small, isolated remnants. Few high-quality prairies remain. More examples of fair- to poor-quality prairie exist, but as of yet they are receiving little management attention and thus are

degrading. Prairie communities have high biological importance, and the prairie communities within the Chicago Wilderness region are important to global prairie conservation, because the region contains some of the best remaining examples. The dune-and-swale topography is rare for sand prairies elsewhere, and therefore this region is important to the global conservation of this type of sand prairie.

PRAIRIE COMMUNITIES
Conservation targets in top tiers

First (highest) tier
Sand prairie (all subtypes in dune and swale topography)
Dolomite prairie (all subtypes)
Fine-textured-soil prairie (all subtypes)

Second tier
Gravel prairie (all subtypes)
Sand prairie (other than those in dune and swale topography)

5.4.3 Status

Along with fine-textured-soil savannas, fine-textured-soil prairies were once the most widespread community type in the Chicago Wilderness region. They were certainly the most extensive of all the prairie types, although all prairie types occurred in a mosaic at the landscape level. Unfortunately, a tremendous amount of these prairies has been lost, more than any other community type. Historically, the threat was conversion of prairie to agriculture; this threat has shifted to development. Development, particularly suburban sprawl, severely affects hydrology and limits the amount and types of management that can be done. Both of these factors threaten prairies and other natural communities.

Only one one-hundredth of one percent (0.01%) of Illinois' original high quality prairie survives (Critical Trends Assessment Project 1994). Although most of the fine-textured-soil prairie has been lost, there are still some good-quality remnants of up to 100 acres. Very few large examples of fine-textured-soil prairie, such as Goose Lake Prairie, remain. However, there is opportunity, particularly at Midewin National Tallgrass Prairie, to create more large prairies. Most of the remaining prairie is in public ownership. In addition to the remnants, there are now a number of re-creation projects, which one hopes will someday become higher-quality prairie.

Of the fine-textured-soil prairies, the dry subtype is probably the rarest today, as it was originally. The region has lost proportionately more mesic fine-textured-soil prairie since European settlement than dry or wet. Wet fine-textured-soil prairie was often drained for agriculture, so today there is less available for restoration unless the hydrology can be restored.

Sand prairies were probably never large and occurred in complexes with dunes and other sand communities. Relatively large remaining examples of these sand prairie complexes can be found at Illinois Beach State Park, Chiwaukee Prairie, and the Indiana Dunes National Lakeshore. Despite these remaining examples, most of the sand prairies have been lost since European settlement. For instance, the Lake Calumet region has lost almost all (95%) of its sand prairies. Lake County, Illinois, today has approximately 20% of the sand communities that once occurred along its portion of Lake Michigan.

The patches of sand prairie were always smaller than the fine-textured-soil prairies. However, there is concern about the increased isolation of sand prairies due to human activities. Sand prairies were interwoven with other sand communities. This loss of community mosaics has affected the diversity of remaining sand prairies. In Indiana, the drier sand prairies have been damaged more than wetter ones, because these areas were developed first. Changes from development have pushed drier conditions into the originally wetter areas. Drier sand prairies do recover with appropriate management.

Gravel prairies are naturally small and rare; this community type has never occurred in the Indiana portion of the Chicago Wilderness region. However, the region has lost almost all of the gravel prairies that were once here. Those that remain today are very small, and very few have been protected. Because gravel prairies are so small, some may still exist that have not yet been identified and protected. They are also favored sites for housing or sand and gravel mining. In the past, when conversion to agriculture was a large threat to prairies, gravel prairies were somewhat protected because they occur on slopes that are difficult to plow. But today these same slopes are targets for housing developments. Once the gravel hills are lost, there is little chance of restoring a gravel prairie.

Dolomite prairie has always been the rarest prairie type, and the region has suffered a tremendous loss. Across the United States, dolomite prairie is a very rare community type. Most of the Chicago Wilderness dolomite prairies occur by the lower Des Plaines River. Dolomite prairies occur as patches within other prairies and thus tend to be very small. It is possible to restore the remaining poor-quality dolomite prairies around the Des Plaines River, because the area has not been plowed. However, most of the other dolomite prairies have been lost to mining and other development.

The overall condition of prairies remaining in Chicago Wilderness is a complex subject for two reasons. First, most measures of quality primarily consider floristic quality, and therefore they may not adequately reflect overall quality, including faunal components. Second, the prairies today have lost a number of their ecological processes, and this compounds the threats facing them. We will now discuss each of these points in turn.

The INAI survey's quality ratings may give a biased picture of the condition of prairies, because it did not rank the status of the faunal communities. For example, there are some places where grassland birds are doing well, but there is poor floristic quality. There may be sites of grade D quality according to INAI that have thriving insect communities, as insect richness does not necessarily correlate to floristic quality. This is probably not a problem unique to prairies, and a different system is needed to measure faunal or overall quality. A system that evaluates the condition of a number of different taxonomic groups would inform management goals for different sites. For instance, in Indiana the largest fine-textured-soil prairie is only about 30 acres, which is not large enough to manage for birds, but this site could be managed for important plant communities. Certain factors cannot be improved with management alone, particularly size and functionality at the landscape level. These factors should be taken into account when assessing conservation value. Even just looking at floristic quality, the number of acres remaining of high-quality prairie is extremely small for all prairie types.

Today, several ecological processes are missing. Some, such as fire, can be returned through management, others can not. Historically, grazers recycled large amounts of biomass in prairies. Parts of the biomass-recycling process are missing today, and it is unclear how this may affect various organisms. An important research problem is identifying the role grazers once played in maintaining structure, because some species, notably birds and insects, rely on short-structured prairies.

Fragmentation and the small size of the remaining remnants are specific problems for fine-textured-soil prairie. Other significant threats include invasive species and lack of fire. In places where prairie remnants are receiving intense management, they are showing signs of improvement. More management and restoration are needed than land managers currently have the financial and human resources to do. For all prairie types, much more land is not being managed than is. In general, land-managing agencies are focusing their resources on the higher-quality sites. More than half of the high-quality prairie remaining in the region is being managed. However, of the low-quality prairie of all types, perhaps as little as 10% is being managed.

Once prairies have reached the point of maintenance after restoration efforts, they are relatively easy to maintain. Regular burning is the only major management need, provided there has not been significant build-up of brush.

5.4.4 Biological significance

Some have referred to prairies as a tropical rainforest turned upside-down, as the underground portion of a prairie has a tremendous amount of biodiversity. Not only are prairies very rich in species, but they are also among the most endangered ecosystems in North America. The Nature Conservancy ranks almost all of the prairie types that occur here as globally imperiled (G2), because most examples have been eliminated through conversion to other land uses or have become woodier areas due to lack of fire.

Prairies contribute significant ecological benefits to humans. Prairies are able to retain considerable moisture on site, thus dampening extremes in hydrological cycles and minimizing flood damage. Grasslands also store more carbon per acre than most other ecosystems. Ninety percent of the biomass is underground, and therefore the carbon is locked underground.

All types of prairies rate very high in biological importance, due to their high levels of diversity, particularly of plants and insects. Of the prairie types, mesic prairies have higher diversity than wet or dry prairies. However, species richness is affected by scale; larger sites harbor more diversity.

Prairies have high plant-species richness and high plant-species conservatism. Species conservatism is particularly prominent in the dolomite prairies. Many local prairie plant species are important either because they are globally rare or because their critical range lies within or includes the Chicago Wilderness region. These species include the prairie bush-clover, eastern prairie fringed orchid, leafy prairie clover, globe mallow, pale false foxglove, shore St. John's wort, Kalm's St. John's wort, Hill's thistle, and Hall's bulrush. Of these species, the first three are threatened at the federal level.

The prairies within the Chicago Wilderness region have long been known to harbor rare insect species as well as insect species dependent on good-quality prairie remnants. Every prairie type has a distinctive insect fauna, a subset of which it does not share with other types. All of the prairie insect assemblages are of concern. Sensitive prairie insects include the regal fritillary, Belfrag's stinkbug, the red-veined prairie leafhopper, and the rattlesnake master borer moth. Important remnant-dependent species associated with prairie habitat include the

dusted skipper, silver-bordered fritillary, silvery checkerspot, two-spotted skipper, ottoe skipper, eyed brown, great grey copper, byssus skipper, Acadian hairstreak, aphrodite fritillary, and a variety of moths, leafhoppers, and grasshoppers. Many of these insects are tracked as species of concern throughout the Midwest. Some are at the eastern and southern extremes of their ranges, while others appear to be regional endemics. The insect assemblages of dry and mesic blacksoil prairie, dry and mesic sand prairie, and wet prairie are of global importance.

Various reptiles and amphibians depend on prairies as habitat. Three reptile and amphibian assemblages are associated with prairies, specifically with the fine-textured-soil, sand, and dolomite types. All three assemblages are in decline. The sedge meadow, fen and dolomite prairie assemblage is globally important. The species in these assemblages rely on other habitat types in addition to the prairie communities. Sensitive prairie species include the smooth green snake, plains leopard frog, queen snake, spotted turtle, bull-snake, eastern racer, eastern hognose snake, and Fowler's toad.

In their number of bird species, the prairie communities have fewer than other community types, but prairies do harbor many bird species of concern. Of all the bird assemblages, grassland birds have the highest percentage of threatened species and species of concern. Birds do not distinguish specifically between types of prairie, although habitat use does vary according to moisture gradient, and different bird species use different prairie structures. Moist-grassland bird populations in the Chicago Wilderness are critical to the global conservation of this assemblage. Sensitive species in this assemblage are willow flycatcher, yellow-breasted chat, Bell's vireo, American bittern, northern harrier, sandhill crane, king rail, short-eared owl, Henslow's sparrow, and bobolink. Important species in the drier areas are loggerhead shrike, lark sparrow, upland sandpiper, and western meadowlark.

5.4.5 Global significance and conservation importance

The Chicago Wilderness region is very important for the conservation of all its prairie types. The one possible exception is gravel prairie, for which less information is available.

This region is very important for dolomite prairie conservation, as it contains some of the best remaining examples. Similar plant communities called alvars grow on dolomite substrate around the Great Lakes, but these differ from the dolomite prairies of Chicago Wilderness.

The Chicago Wilderness region is also very important for sand prairies. The sand prairies of the Lake Plain Division, with its dune-and-swale topography, are globally rare. There are a few similar sand prairies around Toledo and Detroit, some of which are of high quality and large, but otherwise very few are situated in this topography. It is the flora of the dune-and-swale communities that are distinctive. This type of sand prairie occurs as part of a mosaic, typically with a narrow band of wet-mesic sand prairie, then a band of mesic sand prairie, then dry-mesic sand prairie.

Even though fine-textured-soil prairies stretch across the Midwest, plant communities gradually change between Illinois and Nebraska, with no obvious line splitting this prairie into distinct types. Nonetheless the prairies of the Great Plains are very different from the prairies of the Chicago region. For the conservation of fine-textured-soil prairies occurring east of the Mississippi, the Chicago Wilderness region is important. The Chicago Wilderness region has a high concentration of fine-textured-soil prairie remnants, particularly of high-quality remnants. Additionally, because much restoration work on these prairies is taking place in the Chicago Wilderness region, this region has added significance for their conservation.

Gravel prairies were created on glacial deposits, which were never abundant in the Chicago Wilderness region or elsewhere. Gravel prairies range into southern Wisconsin and other areas where gravel glacial deposits occurred, but they have always been rare. Through quarrying, most of gravel prairies have been destroyed in the Chicago Wilderness region. However, it is unclear how well they are surviving in other locations. Possibly this region has some important remaining examples.

5.4.6 Long-term vision and recovery goals

This plan's vision for the region's prairies is to manage and restore prairies on the landscape so that they sustain viable populations of all area-limited species and all formerly common species, and to protect multiple viable examples of all the region's prairie types. In addition, it is a goal to have landscape-scale natural processes, such as fire, hydrology, and gene flow between populations, play a significant role in maintaining the ecological integrity of prairies. Achieving these goals requires: (1) active protection of all high-quality prairie remnants that are large enough to sustain native species far into the future; (2) greatly increased and improved levels of management of all prairie remnants and other natural communities in a matrix of restored prairie and unrestored grasslands; and (3) far more acreage of restored prairie.

Prairies in the Chicago Wilderness region vary by substrate type and moisture level, and efforts should be made to protect and manage all prairie types. All are important components of the region's biodiversity, and all are considered rare or imperiled at the global level. A goal for prairie conservation in the region should be to protect viable populations of all currently endangered and threatened plant species that were historically widespread throughout the region. While some plants and insects rely on high-quality remnants, the region's grassland birds depend on large expanses of grassland. One of this plan's goals is to maintain stable or increasing populations of all grassland bird species that occur or historically occurred in the region. In addition to the birds that depend on pure grassland, a distinct set of birds relies on grassland with shrubs. Several species of reptiles, such as smooth green snake, are restricted to grassland habitats, and a goal is to conserve all of these species.

Of all the elements of the prairie community, the grassland birds are the most area-sensitive and are declining regionally and nationally. Focusing on the needs of these species will be necessary to fulfill this plan's goals for prairies. The region is fortunate to have a very large protected site for grasslands at Midewin. Efforts to manage and restore the most area-dependent species should focus on this site. However, no single site is sufficient to ensure stable populations of grassland birds. It is thought that ten to twelve large sites throughout the region, each approximately 3000–4000 acres in size, are needed to sustain viable populations of grassland birds and other prairie species.

These large sites should consist of native vegetation in mosaics of grasslands, savannas, and wetlands, in order to contribute to the conservation of all prairie-community elements. Both within and among sites, there should be variation in structure and moisture to provide a full range of habitats. Fire with different effects across the landscape would help to restore this diversity of habitats. Core areas of high-quality remnants need to be included in larger sites to provide a basis for recolonization by prairie plants and insects. Additionally, translocation and reintroduction may be essential to establish prairie invertebrates successfully. Watersheds containing key sites should be managed to allow hydrological restoration.

Viable populations of prairie reptiles and amphibians need a metapopulation structure. Reptile and amphibian assemblages appear to require a minimum of 200 acres to maintain most of the species. Therefore, to conserve all of the region's reptiles and amphibians, it is recommended that we create as many medium-sized (500- to 1000-acre) grassland sites as possible. These sites should consist of core natural areas within a landscape that allows them to function as breeding habitat. A priority should be to expand as many existing 80- to 200-acre prairie remnants as possible into 500- to 1000-acre sites. When given the opportunity, mobile species will recolonize functioning habitats. These sites should be managed with a diversity of processes to create the variety of habitats needed by different species.

As there are so few examples of gravel and dolomite prairies, all remaining examples should be protected, no matter how small. Beyond the rare prairie types, all remaining good-quality prairie sites (such as INAI grade C or above) should be protected and improved where possible. These sites will serve as important seed sources, and they will also play significant roles in conserving specific endangered and threatened plants and remnant-dependent insects.

Because the condition of prairie communities is currently declining due to lack of sufficient management, all prairie remnants under protection should be vigorously managed and, where possible, expanded to make management more efficient.

5.5 Wetland communities—status and recovery goals

5.5.1 Description of communities

The Chicago Wilderness region has one of the most diverse collections of wetlands in North America. The Chicago Wilderness community-classification system recognizes six major categories of wetlands: marsh; bog; fen; sedge meadow; panne; and seeps and springs. In addition, wet prairie is often considered a wetland type (although it is classified under prairie in this document). All wetlands are inundated or saturated by surface or groundwater for a sufficient part of the year to support vegetation that is adapted to life in saturated soil. Their vegetation, the amount of water they hold, and the chemistry of their soil and water define the different wetland types. For a more complete description of the different wetland types, see Appendix 1. Associated animal assemblages are shown in Table 4.3.

Marshes are cyclical wetlands dominated by emergent reeds and grasses and other aquatic plants. Vegetation and wildlife composition varies spatially with water depth. The stages of the marsh cycle form a continuum from a ponded state in which open water covers all but the marsh's shallow edges to a closed, 100% cover by emergent vegetation. Maximum structural diversity of importance for wetland birds is reached where the sur-

face is approximately 50% open water and 50% emergent vegetation. This is called the hemi-marsh stage, and in it these two structural features are completely interspersed to maximize the internal interface between water and vegetation. There are two subtypes of marshes. Basin marshes occur in glacial kettles, potholes, and swales. They are most often found with savannas or prairies. Streamside marshes are restricted to the floodplains of creeks and rivers. They border the streams themselves or occupy connected backwaters and abandoned oxbows.

Bogs are glacial-relict wetlands restricted to hydrologically isolated kettles. Precipitation, naturally nutrient-poor, is the sole source of water. This factor, the cool basin microclimate, and the nutrient- and water-absorption properties of its dominant ground cover, sphagnum moss, combine to create a highly anaerobic, cold, nutrient-deficient acidic substrate of sphagnum peat with little biochemical decay. Three developmental stages in bog succession are recognized as distinct subtypes (graminoid, low shrub, and forested), but all are characterized by relict boreal wetland vegetation, which is now rare in the Chicago Wilderness region.

Fens are created and maintained by the continuous internal flow of mineral-rich groundwater from bordering upland rock formations and other recharge areas. An impervious layer of till or other water barrier forces cold, oxygen-deficient, mineralized groundwater to seep out at the bases of upland slopes. Fens support many plants adapted to high concentrations of dissolved alkaline minerals. There are three subtypes of fen: calcareous floating mat, graminoid fen, and forested fen.

Sedge meadows are sedge-dominated grasslands that include wet-prairie grasses. Groundwater seepage and / or shallow flooding are the principal hydrological factors, and frequent fire is needed to retain their open structure. Sedge meadows often grade into fens, marshes, or wet prairies.

Pannes are unique interdunal wetlands on calcareous, moist sands of the lake plain, generally within one mile of Lake Michigan. Sedges and sedge relatives dominate this open-structured wetland, which has considerable floristic overlap with fens and calcareous seeps.

Seeps and springs occur where groundwater flows to the surface. A *seep* is an area with saturated soil caused by water flowing to the surface in a diffuse flow. Seeps may have local areas of concentrated flow, and the water usually collects in spring runs. Seeps are usually smaller than 0.1 acre and are most common along the lower slopes of glacial moraines, ravines, and terraces. The three subtypes of this community (calcareous, neutral, and sand) are separated on the basis of water chemistry. A *spring* has a concentrated flow of groundwater from an opening in the ground.

5.5.2 Findings and priorities

All types of wetlands in the Chicago Wilderness region have declined in quantity and quality. Conservation of the remaining examples, restoration of degraded sites, and creation of new wetland areas are priority activities within Chicago Wilderness due to the high value of these communities both for species diversity and for ecological processes of functional value to people.

Graminoid fens are in the first tier of priority for additional conservation action, due to their rarity, degraded condition, and the global significance of the remaining examples in the Chicago Wilderness region.

Pannes are also a first-tier conservation priority due to their rarity and the loss of natural nourishment processes. Pannes have high biological importance, and the region has some of the best remaining examples.

Basin marshes are a relatively high priority for additional conservation attention. Basin marshes have high biological importance, particularly as habitat for wildlife. They merit particular consideration for additional conservation effort, because restoration efforts have proven successful in recreating their functional values, particularly when compared to the other wetland types.

There is a high level of concern about streamside marshes, because so few remain and they are in poor condition. Unfortunately, it will be difficult to design effective conservation actions for these areas without addressing substantial problems arising from changes in the hydrology of the region's streams and rivers. Bioengineering techniques are showing limited success, but more effective watershed practices and ways to restore streamside marshes must be found.

Calcareous floating mats are more numerous and in better condition than graminoid fens. Calcareous floating-mat fens rate as a relatively high priority for additional conservation attention due to their biological importance and the significance of the Chicago Wilderness region to their global conservation.

Sedge meadows are of slightly lower priority for additional conservation attention. Their status is somewhere in the middle of the continuum of concern, as a fair amount of this community type remains. Managed sedge meadows are improving in condition, and there is opportunity to improve further by bringing more sedge meadows under management.

Bogs are of lower priority than other wetland types for additional conservation attention, because, for the most part, the remaining bogs are well protected and receive high levels of management. Additionally, the Chicago Wilderness region is at the edge of their range, and they are of less overall biological importance due to their small size, although they do harbor a high number of locally rare plant species.

Calcareous seeps are of higher priority than neutral and sand seeps, because they have higher biological importance. There is concern about the rarity and the poor condition of all seep types. Due to their small size, however, they are difficult to target for additional conservation attention without focusing on the surrounding communities.

WETLAND COMMUNITIES
Conservation targets in top tiers

First (highest) tier
Graminoid fen
Panne

Second tier
Basin marsh
Calcareous floating mat
Calcareous seep
Streamside marsh

Third tier
Forested fen
Sedge meadow

5.5.3 Status

Marshes

Since the time of European settlement, the Illinois has lost nearly 90% of its wetlands, and Indiana has lost more than 85% of its wetlands (Critical Trends Assessment Project 1994, Bennett et al. 1995). Today, the Chicago Wilderness region continues to lose acres of marsh due to development. Protection measures are in place largely through the Federal Clean Water Act, and, thanks in great part to these measures, fairly large amounts of basin marsh remain. The wettest marshes in particular have survived, because they are the most difficult to drain for conversion to other uses. Although most of the largest examples of basin marsh have been lost in the region, it is still the most common of the wetland community types found within Chicago Wilderness.

The remaining marshes have undergone general degradation across the entire region, and most are considered to be of low quality. The main threats are invasive species, salinization, siltation, nutrient loading, and hydrological change. While all of the largest remaining complexes are in public ownership, many basin marshes are neither protected nor managed. Many of the marshes that exist on public land are not receiving proper management. The stressors are very large and widespread and are difficult to control.

A larger percentage of streamside marshes than basin marshes has been lost since European settlement, and very few good-quality examples remain today. Cook County has no known streamside marshes larger than one acre. Over the years, streamside marshes have been lost to channelization, siltation, or hydrology modification, or they have been cut off from their rivers by levees. Because the flow of a stream can be altered by changes anywhere in its watershed, streamside marshes are threatened even when they are in public ownership.

Sedimentation is a significant problem for streamside marshes, and they are vulnerable to invasive species whose propagules are carried by floodwaters. Non-point-source pollutants that degrade marsh systems are increasing.

Bogs

Bogs are a very rare community type in the Chicago Wilderness region, with fewer than 20 documented occurrences. Most of the remaining bogs are protected. Because bogs have small watersheds, they are the least threatened of the wetland community types by outside impacts, although development of surrounding land leading to changes in hydrology is a threat. Even though the bogs appear to be in better condition than other wetland community types, there is still cause for concern about their long-term maintenance. The remaining bogs are surrounded by development and are therefore difficult to manage.

Fens

Of the fen community types, forested fens and graminoid fens are at a higher level of concern (both for quantity remaining and for condition) than the calcareous floating mat. Forested fens are the rarest of all the fen types, with only nine known occurrences in the Chicago Wilderness region. There may have been more forested fens before European settlement. While forested fens are very rare, some exist that are not officially protected. Remaining forested fens are in urban areas and are suffering from road run-off and other pressures of development. Their quality is believed to be declining, as they are losing species, but not enough is known about how to best measure the long-term health of forested fens.

Although there are more graminoid fens than other type of fen, they are being lost at an alarming rate. Unpro-

tected graminoid fens have been identified recently, and experts think more are still to be discovered in the region, although their condition is likely declining. Hydrological changes, invasive species, and cattle grazing threaten graminoid fens. Although the full effects of these threats have not been seen yet, there is a high potential for further degradation of the graminoid fens. In general, graminoid fens are in poorer condition than calcareous floating mats and, of the fens, are the most sensitive to groundwater changes.

Current investigations, such as the McHenry County Wetland Advanced Identification study, are still finding a few previously unknown calcareous floating mats. It is probable that the region has suffered historical loss of this community type, but there are no data on pre-settlement amounts. Because calcareous floating mats are difficult to reach, they tend to be better protected than the other fen types. Like other fens, calcareous floating mats are associated with their groundwater, and therefore are subject to issues of water quantity and quality. In addition, calcareous floating mats are subject to inundation by surface water. Invasive species, particularly purple loosestrife, are also a threat.

Sedge meadows

A fairly large number of sedge meadows remain in the Chicago Wilderness region, and many are officially protected. Nevertheless, very large amounts have been lost since the start of European settlement, when this community occurred throughout the region. Sedge meadows are susceptible to draining and to flooding as well as to the suppression of fire. Sedge meadows have been severely degraded by past grazing. Currently, most sedge meadows are of fair quality. Approximately half are being managed, and management appears to be improving their quality. The rest are degrading and in danger of being lost as they are overgrown by brush and invasive exotic species.

Pannes

Very few pannes remain in the region, with only twelve known occurrences covering less than 40 acres. Due to physical impediments on beaches, the natural processes by which pannes were created are almost totally blocked. Thus, while they appear stable and in good quality in the short term, pannes are threatened in the long term. The lack of littoral drift of sand due to hardening of shorelines in Wisconsin, Chicago, and other areas of the region has led to the lack of sand replenishment in the pannes. Without management in the form of adding sand to the beach system, the pannes will be eventually lost. Even though the remaining pannes are mainly protected, there is a high possibility of complete loss. Even in a protected state, pannes are threatened by succession, lake erosion, and elevation changes of Lake Michigan.

Seeps and springs

In general, seeps and springs are very small, and many are not being managed. They are invaded by a number of plants including buckthorn, reed canary grass, cattail and Impatiens. Often there is limited burning of the woodland community surrounding seeps and springs, and this lack of burning contributes to their poor condition. Many of the seeps and springs are not on protected lands, and these are in poor condition. There is only one known sand seep in the region, making this community type extremely rare.

5.5.4 Biological significance

Marshes

Marshes are of high importance to this region because they are so widespread and provide habitat to a number of species. Some plants are restricted to this community type, and marshes play an important role for a number of animal species. For example, many birds rely on the marshes in this region during migration. State-listed endangered or threatened plant species of concern that occur in marshes include American bur-reed and green-fruit bur-reed.

The region's marsh reptile and amphibian assemblage, which includes the western chorus frog, green frog, northern leopard frog, painted turtle, Blanding's turtle, Graham's crayfish snake, and western ribbon snake, is considered globally important. The assemblage seems relatively stable, although it includes some species that are declining. For marsh reptiles, Blanding's turtle, Graham's crayfish snake, and the western ribbon snake are the species of special concern either because they are in decline or because they are restricted to a declining habitat. In general, marsh reptiles and amphibians suffer from management regimens that prevent the natural cycling of water. Development of surrounding lands, purple loosestrife invasion, and loss of plant diversity also threaten marsh reptiles and amphibians.

The region's marsh insect assemblage is considered to be in decline. In particular, purplish copper, great copper, broad-winged skipper, and Dion skipper have been identified as sensitive marsh insects. Water-table alteration, siltation, and the invasion of cattails threaten the marsh insects.

The community of birds found in hemi-marshes without shrubs, which includes black tern, marsh wren, and yellow-headed blackbird, is considered to be in sub-optimal condition. The Lake Calumet complex was a very important site for hemi-marsh birds, but it is now greatly degraded through pollution, habitat loss, invasion by aggressive plants, and disruption of hydrology. Else-

where, small- to medium-sized marshes that maintained significant populations have also been badly degraded.

Bogs

Bogs have a large number of distinctive plant species, as well as a distinctive insect fauna. State-listed endangered or threatened plant species that occur in bogs include water arum, few-seed sedge, and round-leaved sundew. There is a possibility that bogs have a distinctive reptile and amphibian assemblage, but this has not been confirmed. Because they were never a significant component of the landscape, bogs are of relatively less biological importance than the other wetland types in this region.

Fens

Fens in general have high overall diversity as well as distinctive plant communities, and they are of high biological importance to the region. Priority plant species dependent on fens include marsh valerian, a candidate for federal listing, American burnet, and queen of the prairie.

Forested fens tend to be rich in amphibians. It is possible that, in this region, the four-toed salamander is only found in forested fens. The reptile and amphibian assemblage of sedge meadow, fen, and dolomite prairie includes western chorus frog, green frog, northern leopard frog, pickerel frog, Blanding's turtle, smooth green snake, northern water snake, and queen snake. This assemblage in the region is considered to be globally important. Across the region, this assemblage is declining, although there is a north/south division. In the northern part of the region (Lake and McHenry Counties in Illinois), the assemblage is doing better, perhaps even increasing, due to management and protection. In the southern part of the region, the species that are specialists are declining, with only a few species hanging on. This is primarily due to fragmentation and isolation. Purple loosestrife poses a threat to these species over time.

The fen insects are of conservation concern with many rare species. Sensitive species, which are rare and habitat-restricted, include Baltimore checkerspot, swamp metalmark, and bluebell dragonfly. Hydrological alteration and invasion by common reed and cattail threaten fen insects.

Sedge meadows

Sedge meadows are extensive and important at the landscape level. While they do not harbor many rare plants, they harbor great diversity. Additionally, they are important for several animal species and as water-cleansing agents. Sedge meadows partially support the globally important reptile and amphibian assemblage of sedge meadow, fen, and dolomite prairie; this assemblage is discussed above under "Fens."

Pannes

Pannes are of high biological importance because they harbor some narrowly endemic species. While the panne reptile and amphibian assemblage is presently stable, its species are of conservation concern due to their rarity. Sensitive species include Fowler's toad, northern cricket frog, and Blanding's turtle. These species are affected by human disturbance, including collection, air pollution, and invasion by alien plants, mainly purple loosestrife.

Seeps and springs

Calcareous seeps are biologically important because they maintain many restricted plants, including the federal candidate species forked aster. In general, because seeps and springs are so small, they do not harbor many species, and they have no distinctive associated faunal communities.

5.5.5 Global significance and conservation importance

Both basin marshes and streamside marshes are widespread throughout the country. Good examples of both these community types occur within the Chicago Wilderness region, as well as elsewhere. The region does have a significant opportunity to create complexes of marsh, prairie, and other community types that does not occur anywhere else. Marshes are very important locally.

Pannes are globally imperiled and many of the best examples exist in the Chicago Wilderness region. The Chicago Wilderness region is important to the global conservation of this community type.

Both calcareous floating mats and graminoid fens range up into southern Wisconsin and further north but do not occur south of the Chicago Wilderness region. The Chicago Wilderness region contains many good examples of both graminoid fens and calcareous floating mats and is in a good position to contribute to their global conservation.

The forested fens of the Chicago Wilderness region are not significant to the global conservation of this community type. Similarly, most bogs are located to the north of the Chicago Wilderness region, and thus we are on the edge of the range.

The Chicago Wilderness region occupies a central part of the midwestern range of sedge meadows and contains a number of good examples of this community type, although other good examples can be found elsewhere.

Neutral seeps are widely distributed and are common in eastern forests. Chicago Wilderness is on the edge of the

range of sand seeps, which occur where there are sandstone outcroppings, beach ridges, or dunes. Good examples of calcareous seeps occur in the region, but they are distributed elsewhere as well.

5.5.6 Long-term vision and recovery goals

This plan's goal for the region's wetland communities is to preserve all wetland types in viable examples and to expand the amount of some wetland types for wildlife habitat and for the sake of other ecologically important functions. The floristic diversity of wetlands should be maintained by managing most wetlands to good quality for natural species, eliminating or aggressively controlling invasive species. Hydrological regimes for most wetlands should be improved by managing surrounding lands in a manner that protects wetland integrity, and by planning management at the watershed level. A goal should be to look at planning for wetlands at a landscape level, recognizing that having complexes of wetlands in close proximity and embedding wetlands in a matrix of other natural areas is essential to their functioning.

Chicago Wilderness's wetlands represent an array of diverse community types (marshes, bogs, fens, sedge meadows, pannes, and seeps), all of which should be protected as unique contributors to the region's biodiversity. Due to their complex life cycles, amphibians rely on several different habitats. Therefore, conserving habitat mosaics, particularly including wetlands with varying hydrologic regimes, is important if we are to have demonstrably secure populations of amphibians. Serving as a good indicator species for marsh reptiles and amphibians, Blanding's turtle is a sensitive reptile for which habitat conditions should be improved. Many birds species, both breeding and migratory, depend on the region's wetlands. We need to increase the breeding populations of wetland birds and improve wetland management to be able to sustain populations through droughts. Within wetland complexes and across the region, different wetlands should be at different stages at the same time. Wetland plants depend on hydrological cycling of wetlands, yet the birds need open water during droughts. Some particularly sensitive species include American bittern, sandhill crane, king rail, and black tern. Requiring a diversity of habitats, including mudflats, high water, and low and high vegetation, amphibians also depend on a number of wetlands in a variety of hydrologic phases.

The above elements along with the overall goal help to define some specific requirements for protection and management. To maintain viable populations of marsh breeding birds, reptiles and amphibians, the region needs more large marsh complexes. Based on scientific knowledge of habitat requirements of wetland birds, reptiles, and amphibians, a natural-area complex of approximately 1000 acres, with several marshes of 100 acres or more and with smaller wetlands and ephemeral pools, appears to be appropriate. There is the potential to create and restore around fifteen of these large wetland complexes in the region, and this number should allow sufficient acreage and diversity of condition to meet the habitat needs of breeding and migratory waterfowl. Management of large wetland complexes across the region should be coordinated to ensure a diversity of conditions at all times.

In addition, many more relatively small wetland complexes are needed throughout the region, but particularly in the southern and western parts, to connect existing wetlands. These connections help species disperse. These complexes would protect the full range of wetland types, particularly as smaller wetland types do better when managed as part of a larger complex. In particular, fens, sedge meadows, bogs, pannes, and seeps require continued protection of currently designated natural areas and protection of newly identified sites. Wetlands, particularly those fed by groundwater, require protection of their recharge areas as well as protection of their plants. Natural hydrology needs to be restored in many areas as well as protected in others. Invasive species and other threats, such as salt and nitrates, need to be controlled in order to maintain healthy communities.

5.6 Minor community types

5.6.1 Shrubland communities

At the time of settlement, the woody vegetation matrix of northeastern Illinois is thought to have included three vegetation types: oak savanna, woodland, and forest. This vegetation occurred across a landscape fire gradient, with forest having the greatest level of fire protection and savanna the least (Moran 1976, Hanson 1981, Anderson 1991, Bowles and McBride 1998, Bowles et al. 1994). However, a fourth community type, shrublands or barrens, was also a component of this landscape, but it has been overlooked or misunderstood. Most historic accounts describe shrublands as maintained by fire (Bowles and McBride 1994, White 1994). Illinois shrublands represented a late stage of fire-caused forest degeneration characterized by four- to five-foot sprouts of scrub oak, hazel, and wild plum (Gleason 1922). They were most common in uneven or rolling topography and in stream valleys, which reduced fire effects, or they developed on the west sides of forests attacked by eastward-moving prairie fires driven by prevailing winds (Gleason

1913). Shrublands appear to have been strongly allied floristically with savanna (Packard 1991, Anderson and Bowles 1999). However, savannas were formerly widespread, while shrublands may have been much less frequent, occurring in a linear pattern bordering the western flanks of prairie groves. For example, less than 1% of the DuPage County landscape comprised barrens or shrublands at the time of European settlement, while savanna may have covered about 18% (Bowles et al. 1999).

Shrubs and fire-stunted oak grubs appear to have been structurally dominant components of shrublands. Historic descriptions (reviewed in Bowles and McBride 1994) identify more than 30 shrub species that may have characterized barrens, including hazel, New Jersey tea, dogwood, wild crab, wild plum, sumac, rose, prairie willow, and prickly ash. Shrublands that formed along the western flanks of forests were dominated by hazel, forming a margin for the interior forest (Gleason 1913). Hazel is an important source of wildlife habitat and browse, and its nuts are among the richest wildlife food sources (Stearns 1974). Thus, hazel may have been a keystone species in the historic continuum of vegetation from forest to prairie. In addition, historic descriptions list more than 30 forb species occurring in barrens (Bowles and McBride 1994).

Due to their instability without fire, few, if any, high-quality shrublands exist (Packard 1991, Anderson and Bowles 1999). No high-quality shrublands remain in the Chicago region (Bowles and McBride 1996). With advancing settlement and fire protection, many authors described the instability and disappearance of shrublands (White 1994). Thus, large areas of shrublands were converted into forest “as by magic” when the fires that had maintained them were stopped and the oak sprouts became trees (Gleason 1922).

Because of the apparently total loss of intact shrublands or barrens, restoration of degraded land will be required to recreate this community. Perhaps the best potential site for shrubland restoration is the Hickory Creek Barrens Nature Preserve, which is part of the Hickory Creek Forest Preserve in Will County. Because of fire-management and introduction of prairie grasses at Hickory Creek and other sites, the process of restoring shrublands will differ from natural shrublands development. Hazel is a fire-sensitive, yet fire-dependent species. Burning kills back hazel canes, which require three to five years to reach reproductive size from root sprouts, and severe or growing-season fires can reduce stem density or cause mortality. However, without fire, trees replace hazel. Thus, the establishment and maintenance of hazel barrens must incorporate burning frequencies and intensities that are concordant with the life history of hazel. Competition from grass appears to hamper the establishment of hazel clones within a restored graminoid matrix (Bowles et al. 1993). To accelerate development of large hazel clones, fire protection may be needed for several years. How fire or fire protection affects establishment of barrens species is not clear, and may vary with species.

5.6.2 Cliff communities

Dolomite cliffs

Exposures of dolomite containing plant and animal assemblages in pre-settlement condition are very rare, due primarily to the lack of exposed dolomite and to the historic commercial extraction of the substrate. Most natural occurrences of dolomite have been quarried, resulting in serious loss of ecological value. Most of the remaining high-quality examples of this community type have been protected. Protected areas, however, are prone to a variety of conditions that may result in their degradation. Additional areas with degraded examples of dolomite cliffs are unprotected and under private ownership.

Dolomite cliff communities provide areas for primary colonization on highly alkaline, sterile substrates, which are unlike the vast majority of more common communities in the region. Undisturbed exposures of dolomite provide ecological conditions suitable for a variety of plants and animals with very narrow ranges of ecological tolerance, and these species are limited to dolomite cliffs and the large blocks of dolomite talus that result from natural erosion of these cliffs. Four groups of organisms in this category are ferns, lichens, other herbaceous plants, and land snails. Springs and seeps at the base of dolomite cliffs add a great deal of diversity to these communities, as do the perennial or intermittent streams that flow through dolomite canyons.

The primary ferns found on dolomite cliffs are purple cliff brake, walking fern, bulblet bladder fern, and slender rock brake. All four species are found only on dolomite cliffs or boulders in our region and are limited to communities with high ecological quality.

The lichen population of dolomite cliffs is not completely known, but it contains crustose, foliose and fruticose lichens. Many species in this habitat are restricted to bare rock that remains free of external disturbance for long periods of time. Several species previously unknown in this region were found in the Sagawau Canyon Nature Preserve in 1990. Numerous other species most likely remain to be discovered at this and other sites, and little is known of their ecological requirements.

Several herbaceous species also require the highly alkaline substrate. The hairy rock cress only grows on small

ledges of cliff faces where a small amount of soil has formed. Other primitive plants such as mosses and liverworts are well represented on undisturbed dolomite cliffs and on the talus at the bottom of the cliffs but have restricted distribution elsewhere.

Narrow ledges covered with soil, small herbaceous plants, and plant detritus harbor a few species of land snails that are restricted to these habitats. Additional faunal species restricted to this habitat may also exist.

Other organisms with wider tolerances, but with an affinity for dolomite or limestone, may be quite abundant on dolomite cliffs but be fairly rare elsewhere in this region.

Eroding bluffs/ravines

The ravine bluff ecosystem occurs along the Highland Park moraine from approximately Wilmette to North Chicago, Illinois. Although much of this system is in private ownership, the finest examples and highest-quality remnants occur on publicly owned property in Lake Forest, Highland Park, and other North Shore communities. These remnants include McCormick Ravine in Lake Forest, and Rosewood Park and Ravine Drive Park in Highland Park. These sites contain examples of the rich diversity of the eastern deciduous hardwood forest intermixed with northern boreal forest relics that botanists theorize are left behind from the post-glacial ecosystem. Two such plants, buffalo berry and dwarf scouring rush, are only in these ravine bluff ecosystems. Thirty-eight percent of the ravine bluff flora grows in no other Lake County plant community (Wilhelm 1991). Many typically northern species occur in relative abundance in the ravines. A staggering 367 species of plants have been found in these ravine bluff ecosystems. Unfortunately, many of the more rare species have been extirpated from the ravine landscapes.

In addition to the rare plant community harbored within the ravine bluff complex, the geologic features are quite dynamic and unique. The relative geologic youth of this system results in dramatic change due to erosion and mass wasting events. The glacial till includes ancient rock and rocks otherwise not found in Illinois that were carried down with the glacier from Canada, Wisconsin, and Michigan.

5.6.3 Lakeshore communities

Beach communities

Many beaches still exist, at least in terms of substrate presence, although a large majority is unable to function naturally. Most remaining beaches are very damaged or altered by continual disturbance caused either directly or indirectly by people, and they only harbor a tiny fraction of their natural biota. However, some moderate- to large-sized stretches of beach in Indiana and Lake County, Illinois, are in relatively good condition.

For their nourishment, beaches rely on a continuing supply of sand transported by currents along the shore to replace sand lost to areas further along the shore. Unfortunately, the supply is being cut off or deflected into deep areas by construction or dredging. In some cases, this has made it necessary to import sand to maintain beaches. The beach community is one of the few natural communities where natural, periodic, catastrophic disturbance is a healthy part of the community. These disturbances occur as the result of storms and natural changes in lake levels.

Beaches and immediately adjacent foredune communities serve as virtually the only habitat for several specialized plant species, some of which are regionally rare, including beach pea (endangered in Illinois), marram grass (endangered in Illinois), sea rocket (threatened in Illinois), and dune thistle (threatened federally and in Illinois). It appears that beaches can serve as colonization zones for plants that specialize in beaches and foredunes and that can migrate over fairly large distances around the edge of the lake during storms or ice movement.

Beaches are important stops for migrating shorebirds. Migrating species include ruddy turnstones, buff-breasted sandpipers, and semipalmated plovers. Beaches are the only possible local nesting habitat for the piping plover (endangered federally and in Illinois), which now probably no longer nests in the area.

Foredunes

The foredunes in the Chicago Wilderness region are the first vegetated dunes formed adjacent to the Lake Michigan shoreline. They still exist in portions of northwest Indiana and north of Chicago, but they have largely been destroyed around the city as fill has extended development into the lake. Few high-quality, dynamic foredune systems remain because the construction of harbors and jetties and the hardening of the coastline to prevent erosion have cut off littoral drift of sand. The nearshore foredunes are dominated by marram grass with scattered cottonwoods. Secondary dunes and blowouts are dominated by little bluestem, bunchgrass, sand reed grass, sand cherry and numerous scattered forbs: hairy puccoon, sand cress, bugseed, and horizontal juniper.

Foredunes are important as buffers between the shore and the lake. Linear foredunes form with the interaction between lake level, sand supply, and vegetation establishment by marram grass in many years and cottonwood in cool, moist years. They formerly harbored the federally threatened Pitcher's thistle and other rare

plants. Foredunes at Illinois Beach State Park harbor a larger element of western prairie than do those in northwest Indiana.

High dunes

High dunes occur in the southeast shoreline of Lake Michigan where post-Nipissing winds piled up large sand dunes. High dunes in Miller, Ogden Dunes, Dune Park, Dune Acres, and Beverly Shores in Indiana have been altered or destroyed by residential and industrial development, leaving about half of what existed in presettlement times. The best unfragmented examples occur in the Indiana Dunes State Park, but Indiana Dunes National Lakeshore has high-quality examples as well. High dunes harbor a mesophytic community on the north / northeast slopes and in the deep valleys, called mesophytic pockets. Here, climatic extremes are moderated by Lake Michigan, in contrast to the barrens and savannas that occur on the south and west slopes. High dunes are often interrupted by large blowouts whose origins are controversial. Some believe the blowouts are the result of post-settlement disturbance, and others believe they represent past movement of sand when lake levels were high or decreasing from a high level. Dominants in the high dunes can include jack and white pine, basswood, white and red oak, ash, tulip tree, and dogwood. Further from the lake, high dunes have black oak forests or white oak flatwoods.

These are important transitional communities between the unforested foredunes and the savanna and forested portions of the dunes. They harbor mesophytic and boreal elements including winged polygala, hepatica, trailing arbutus, ivory sedge, rice grass, bellwort, and black oat grass. Red-headed woodpeckers and white-footed mice are common.

5.7 Threats and stressors to terrestrial communities

5.7.1 Hydrological change

Altered hydrology is a severe threat to a number of communities, including wetlands, prairies, flatwoods, and dolomite cliffs. There are a number of sources of hydrological change. Urban and suburban development with associated draining, paving, and topography changes often alters the hydrology of nearby natural communities, either increasing or decreasing the quantity of water flowing into the community. Low-lying communities, particularly marshes, flatwoods, and seeps, are threatened by the development of associated uplands.

The other significant cause of altered hydrology is tiling. Tiles were often used to drain lands for agriculture. In many cases the land has returned to natural vegetative cover, but tiles remain and stress the natural community. This is particularly a problem in prairies, sedge meadows, and fens.

Streamside marshes are dependent on the streams with which they are associated, and thus a number of the threats to streamside marshes are linked to stream issues. Extreme water-level fluctuation is a significant problem, due to the increasing amount of paved surfaces in the region. Alterations to the quantity and quality of stream flow also disturbs the talus and gravel areas of dolomite cliffs, resulting in widespread changes to plant communities.

Other threats associated with altered hydrology include increased sedimentation in floodplain forests due to flashier floods. Additionally, gravel mining and paving of recharge areas threaten communities dependent on groundwater flow, including fens, sedge meadows, and seeps. Changes to the subsurface water flow affect the distribution of liverworts and some mosses in dolomite-cliff communities. Some marshes suffer from a different type of hydrological change, in that they are often managed for one hydrological state and not permitted to go through the normal hydrological cycling.

In addition to altered hydrology, deteriorating water quality might be damaging a number of communities. The effects of toxins on wetland and other plants are not fully known.

5.7.2 Fragmentation

Fragmentation particularly threatens the communities that were once more widespread: prairies, savannas, woodlands, and upland forests. Fragmentation is a lesser threat in the naturally small communities, although populations of some species may suffer loss of genetic variability if migration patterns are disrupted. Fragmentation is caused by many forms of human development. Roads and areas of human occupation divide up the community, affecting it in a number of ways, including altering gene flow (possibly leading to loss of genetic diversity and increased inbreeding), increasing predation, and increasing opportunities for invasive species. In some cases, fragmentation occurs in less obvious ways. For instance, a power line through an upland forest or a trail through a prairie may fragment that habitat for insects and other small organisms.

The effects of fragmentation include not only the partitioning of sites but also what happens in the remaining small, isolated patches. Development surrounding a nat-

ural area limits the amount and types of management that can be done. For instance, in some cases new development has limited the opportunities to burn prairies due to prevailing wind direction. Fragmentation is a particular problem for animal species, most notably grassland and forest birds, that can only breed successfully in large, contiguous habitat blocks.

5.7.3 Altered fire regimes

Fire was once a natural disturbance across the entire Chicago Wilderness region. While pockets of the region were protected from fire by landscape features, all of the community types evolved in the presence of fire. Therefore, the lack of fire and altered fire regimes lead to the degradation of most community types. Altered landscape patterns and the suppression of natural fires in the region have eliminated natural disturbances, and prescribed burns are therefore necessary to maintain the condition of the region's natural communities. Lack of fire is most threatening to the forested, prairie, and savanna communities. Fire is being used as a management tool at a rate far below that which is necessary to sustain healthy natural communities. This is due to a number of factors, including lack of human and financial resources and lack of public understanding of the importance of fire. Management with fire is often constrained by necessary precautions to protect nearby houses. This is particularly true with prairies, which for the most part remain only in small patches. In forested communities, invasive species, particularly once they are well established, can also alter fire regimes and make it more difficult to manage with fire alone.

The lack of fire in forested communities, particularly those with shorter fire-return periods such as woodlands, can lead to canopy closure. This causes overshading, which limits growth in the understory and the herbaceous layer. The health of the herbaceous layer depends on light penetrating the canopy and periodic control of shrubs and saplings by fire. Some species, such as oaks, are more fire-tolerant and have seedlings and saplings whose survival is aided by periodic fire. For some communities, the lack of fire has meant a shift in major type of disturbance from external forces to internal disturbance, such as canopy-gap processes from disease and windthrow. However, these internal disturbances are not sufficient to maintain the long-term health or viability of the communities. The exception is upland forests, which have always operated under canopy-gap processes.

A particular problem with the absence of fire is the invasion of exotic species and fire sensitive native species into savannas, which were once dominated by oaks.

5.7.4 Loss of structural diversity

For many animals, the structure of the community is very important. "Structure" refers to the spatial arrangement of the community elements. Loss of structural diversity results from the loss of natural disturbances and then lack of management to mimic these processes. Fire was the main disturbance process creating structural diversity in the prairies, but grazers also contributed. In some cases, monotypic management fails to achieve the desired structural diversity. For example, limitations on prescribed burns often mean that the management does not create the structural diversity that natural fire once did, because the location and intensity of burns are controlled. Natural prairie fires varied in intensity and skipped areas as they moved across the landscape, leaving structurally varied grassland behind.

In the forested communities, a loss of structural diversity occurs with the loss or degradation of the herbaceous layer. Lack of fire, invasive species, and overabundant deer all threaten the herbaceous layer in today's forested communities.

5.7.5 Nutrient loading

Excess nutrients in a system are often a stress to the plants adapted to that system. Many native plants do not compete well against invasive plants at higher nutrient levels. Excess nutrients enter communities through agricultural run-off, urban and suburban run-off, and air pollution. In this region, excess nutrient loading particularly threatens the prairies, marshes, bogs, and floodplain forests. Airborne pollutants, such as nitrogen and even carbon dioxide, can also contribute to excess nutrient loading, and are potential problems in the future.

5.7.6 Increased salinity

Increased salinity is a possible threat in all communities, but is recognized primarily in the wetter ones, including certain prairies, marshes, and floodplain forests. The specific effects of increased salinity on the plant communities still require further study. The primary source of increased salinity is road salt, both airborne and dissolved.

5.7.7 Erosion and increased sedimentation

Excessive erosion and sedimentation are caused by a variety of problems. The greatest source of sediment is from urban and suburban development and from agriculture. Quantities from development can be very large, but typically occur for only one or two years from any one par-

cel of land. Agricultural cultivation tends to produce substantial quantities annually unless conservation measures are adopted. In natural areas, invasive species can cause the loss of herbaceous plants, leaving exposed soil that may lead to increased erosion, particularly where other human disturbances help create gullies. The extent to which loss of the herbaceous ground layer in the region's forested communities contributes to large-scale sheet-erosion is a topic for continued study. Excessive sedimentation is of greatest threat to streams, lakes, and low-lying areas including wetlands, floodplain forests, and vernal ponds in flatwoods and other forested communities.

Along the lakeshore, erosion and sedimentation are natural processes, which provide sand to nourish beach and dune communities. However, when these natural processes are disrupted, erosion becomes a threat, as in the case of pannes. Erosion in pannes is caused by recreational pressures and storms, and because the natural processes have been disrupted, there is a lack of natural sand replenishment.

5.7.8 Invasive species

Altering the species composition of the community, invasive species are a threat to almost every community type in the Chicago Wilderness region. Invasive species are usually non-native species that have been brought to the region intentionally or unintentionally by human actions. They become established in natural habitats, threatening native biodiversity. Most non-native species are not invasive, but the few that are, are often aided by having few if any predators or diseases that held them in balance in their native habitat. Species native to the region can also be invasive when they move into habitats that did not originally contain them, as a result of human disruption of natural processes and lack of management. Species are often able to invade a community of which they are not naturally a part when the community is suffering under other stresses. In many communities, this stress is a lack of fire, but other stresses enabling invasion include nutrient loading, hydrological change, and soil compaction. Sometimes non-native species can out-compete native species even when the system is not under stress.

Forested communities in the region are particularly threatened by invasion by buckthorn, Asiatic honeysuckle, and garlic mustard. Regular fires often prevent the establishment of invasive species, but some invasive species are adapted to fire and cannot be controlled after they are established, even with the reintroduction of fire. In these cases, mechanical or chemical control is needed to balance the system so that less severe management practices will become sufficient. Floodplain forests are also threatened by the invasion of reed canary grass. As demonstrated by the recent urban occurrence, there is potential for invasion by a substantial forest pest, the Asian longhorned beetle, as well.

Because savannas are more open and have more light, they are more susceptible to invasive species than forests or woodlands. Buckthorn is extensively invading fine-textured-soil savanna. Other significant invasive species include garlic mustard, bush honeysuckle, and reed canary grass in the wetter savannas. Mesic sand savannas have problems with purple loosestrife and common reed invasion. Species such as Norway maple, Amur maple, and Japanese hedge parsley are also invading. In the absence of fire in savannas, many native tree species behave as invasive species, especially those with wind-disseminated seed such as ash, maple, and elm.

Prairie invaders, which may or may not be controlled by fire, include crown vetch, sweet clover, reed canary grass, teasel, and leafy spurge. These non-native grassland species can alter species composition and eventually structure and soil chemistry. A whole host of additional plant species is beginning to invade prairies. As discussed earlier, lack of fire in prairies leads to invasion and major degradation by brush, both native and non-native. Knapweed is invading dolomite prairies, and wet prairies of all types suffer from invasion by purple loosestrife.

Wetlands are also threatened by invasive species. Basin marshes suffer from the invasion of giant reed, purple loosestrife, glossy buckthorn, narrow-leaved cattail, reed canary grass, and carp, among others. Carp is the primary invasive species threatening streamside marshes. Buckthorn and purple loosestrife are the invasive species of particular concern for bogs. Lack of fire in graminoid fens and calcareous floating mats leads to invasion by brush and non-native species. A very significant threat to sedge meadows is the invasion of reed canary grass, which might be correlated with increased siltation. Purple loosestrife is another threat to sedge meadows.

Dolomite cliffs are being invaded by garlic mustard, which is resulting in a serious decline of native species. Red and Austrian pine and Lombardy poplar are frequent invasive species in foredune communities. Garlic mustard, Asiatic bush honeysuckle, winged euonymus, and oriental bittersweet are occasionally a problem in high dunes. Although it is a secondary threat, beach communities are also subject to problems from invasive species.

5.7.9 Overabundance of deer and other animal species

A major concern for forested and savanna communities is deer overabundance. Deer overabundance results from the absence of natural predators, the shrinking of avail-

able habitat due to development, and lack of management. The primary effects of overabundant deer are reduction or elimination of some herbaceous plants and selection against certain woody species, including oaks, with consequent increases in less-palatable species such as maple, white ash, and ironwood. Deer often harm species of conservation concern, typically monocots (lilies, orchids), which are usually the most difficult to restore because of their rarity, and legumes, which may be important for soil fertility (Etter 1998). Deer also create a corridor for invasive species to move into quality areas by disturbing the soil along their trails. These trails can also serve as an avenue for animal predators. The interactive relationship between deer overabundance and fire, or lack of fire, is an important topic for further study to improve management techniques. Although deer favor forests and woodlands over savannas, the effects from deer are the same in savannas as they are in forests. Deer numbers generally decrease with successful savanna restoration. Overabundant deer are also a severe threat to high-dune communities and a concern in prairie restoration and management.

The density at which deer cause permanent damage to ecosystems varies by community type and specific site conditions. Studies in eastern forests (deCalesta 1994, Alverson et al. 1988, Tilghman 1989) indicate that damage to ecosystems occurs at densities exceeding 10–15 per square mile. However, excessive damage from lower densities has been observed, and lower densities may be required for communities to recover from their current degraded state. Current research in Chicago Wilderness is assessing the local situation, and the results will be important for future management efforts.

Not enough is known about the natural population sizes of various other animal species, or about the effects of changes in relative population sizes, to fully understand the negative impacts they may be causing. For instance, nest-predation rates are currently high for grassland and forest birds due to small predators such as raccoons and house cats. Raccoons are abundant due to development and the absence of large predators. Forest fragmentation also leads to high nest parasitism by brown-headed cowbirds. In grasslands, the specific causes of nest predation are less clear, and more research is needed.

5.7.10 Other threats

Many communities are threatened by other, less pervasive human activities. Forested, savanna, and lakeshore communities are threatened by human over-use and abuse. Activities of concern include bike and horseback riding off trails, foot trampling, off-road vehicles, and the dumping of grass clippings. Beaches are frequently raked and bulldozed by municipalities in order to sculpt them for recreational purposes. This abruptly terminates beach substrate succession and plant succession so that nothing beyond the earliest successional stage can be reached. Recreational activities including hiking, rock climbing, and rappelling, along with fossil and plant collecting, seriously degrade dolomite cliff communities.

Beach health includes successional periods of stabilization when there is a rough balance between sand deposition and erosion. But major public works projects such as harbors and piers interfere with the original patterns of lake-water movement, often leaving sand deposition too low at some beaches and too high at others. Some structures divert sand into deep water, where it is lost as beach nourishment. Shoreline erosion is a threat to high dunes and foredunes.

Basin marshes are often used as a dumping ground for grass cuttings and other wastes, and humans and dogs often disturb marsh wildlife. Mosquito abatement is also a potential threat to wildlife. Cats are a threat to many birds and mammals. In some places, commercial collection of snakes and turtles is an increasing problem. With the growing popularity of mushrooms, mushroom collecting in savannas, woodlands, and forests is a potential problem. If collection harms a mushroom population, this may affect the habitat negatively for other species as well. For example, some mushrooms are the fruiting bodies of symbiotic fungi, whose presence is necessary for the survival of oak trees.

5.8 Recommended actions

✔ Increase number of acres under management on public lands

Many of the natural communities, even when they are protected, are degrading, because natural ecological processes have been disrupted and the communities are not being adequately managed to compensate for the loss. Depending on the community type, required management includes controlling invasive species, controlling water levels, conducting prescribed burns, and carrying out other activities to improve the habitat for plants and animals. When communities are not managed, they degrade and lose biodiversity. All of the community types need more management attention. For the forested community types, marshes, and fens, the most important action is to increase the amount being managed. Because of the apparently total loss of intact shrublands, restoration of degraded land will be required to restore this community. Lack of human and financial resources, and public resistance to certain management practices, often hinder current management.

Across the region, probably less than 10% of forested land is being actively managed. The DuPage County Forest Preserve District is actively managing approximately 30% of its forested communities, but this is likely the highest of all counties. The Cook County Forest Preserve District is actively managing about 15% of its forested communities.

While some high-quality sites still require further management and they are a priority where they are not managed, a much greater general effort needs to be placed on managing fair- and low-quality sites. Priority should be placed on sites with important species and on sites with the highest species diversity. In managing more fair-quality sites, one goal is to reconnect remnant high-quality pockets. Priority should also be placed on managing and restoring areas that have multiple community types.

The top priority for wetlands is to manage those where the associated uplands are protected in order to maintain the proper hydrology of wetlands and to mitigate the threat of invasive species. In general, it is best to restore a community within a complex of existing natural communities, because source populations will be there, increasing the likelihood of reconstructing a high-quality community.

An important area for continued and expanded management efforts is that of deer. The overabundance of deer is causing significant harm to forested communities and is also a threat to savanna and other natural community types. Chapter 9 includes further discussion of deer and other wildlife-management issues.

Some specific actions include:

- Allocate more funds to management activities
- Apply generally accepted management techniques, as discussed in Chapter 9, including prescribed burning, hydrological restoration, reintroduction of native species, control of invasive species, and management of deer and other problem wildlife.
- Train more people in management techniques
- Make more effective use of volunteers in management activities
- Educate the public to build support for needed management practices

✔ Increase management and biodiversity planning outside preserves

While the recommendations described above generally apply to sites owned by public land-managing agencies, local parks, private land, and land held by agencies not charged with protecting natural resources also require ecological management in order to conserve biodiversity. For some community types, such as the forested, substantial amounts are on private lands. And for all community types, although particularly wetlands, biodiversity concerns need to be incorporated into other, broader planning efforts. Since the degradation of marshes and other wetlands is so widespread and the stressors so large, the best way to improve the quality of wetlands is for watershed planning to integrate biodiversity concerns.

Strategies need to be developed to work with various landowners to protect and manage communities on their property. One goal is to work more cooperatively with IDOT, utility companies, and railroads in managing prairies and other communities that exist in their rights of way. Corporate and college campuses provide another opportunity for cooperative management. These sites can be managed for hydrology and some biodiversity values, and, possibly more importantly, they can serve as demonstration sites. Corporate land could be used for broad-scale linkages or corridors to public land.

Some specific actions include:

- Develop and implement strategies to work with landowners
- Work with IDOT, utility companies, and railroads to manage communities in rights of way
- Implement Best Management Practices (BMPs) for water quality and water management in ongoing development
- Integrate a biodiversity component into existing BMPs
- Integrate a biodiversity component into watershed planning

✔ Increase public understanding of land-management needs

Management of natural communities is often limited by poor public understanding of their significance and of what actions are needed to keep them healthy and save biodiversity. Public resistance may inhibit certain management activities that are essential to the protection of biodiversity. Greater emphasis needs to be placed on informing and educating the general public. In particular, the importance of disturbance in natural communities needs to be better explained to create support for a wider range of management activities. The best example of a social barrier to management is objection to burning.

A first step is to identify all of the barriers to the effective use of fire and other management practices in the

region. Then, appropriate education and training of both the public and land managers should be incorporated into overall regional planning.

Some specific actions include:

- Identify all barriers to the effective use of fire
- Inform / educate the public about disturbance and appropriate management
- Train / educate land managers about social barriers and appropriate approaches to sharing information with the public

✔ Communicate information about the effects of management

Considerable knowledge about the effects of management on communities and specific animal populations exists, but not all of it is easily accessible. Chicago Wilderness members should facilitate compilation and communication of such information to the land managers, scientists, and the public throughout the region. This information will not only help land managers in their work, but should also be used to inform the public about the benefits of restoration.

Some specific actions include:

- Compile information on techniques and effectiveness of management
- Disseminate to land managers and researchers
- Summarize and communicate to the public

✔ Increase the number of people qualified to manage land

Limited human resources are one barrier to managing more. One goal is to develop a region-wide standardized training program for burning that would give the public confidence in the oversight of burns and increase the number of people trained to conduct burns. In particular, a burn-training course specific to our urban context should be developed and implemented in the Chicago Wilderness region. Illinois is establishing statewide burn-leader standards, which should be supported in the Chicago Wilderness region.

Some specific actions include:

- Develop a region-wide standardized burn-training program
- Implement the training program
- Support Illinois statewide standards for burn leaders
- Publicize the training process

✔ Implement adaptive management, linking goal setting, implementation, monitoring, and research

To recover biodiversity and achieve greater diversity, management techniques should be improved and diversified through knowledge currently available and through additional research. This can be achieved by implementing adaptive management across the region. Adaptive management is the practice of conducting management within an experimental framework and using the results in future management decisions. Adaptive management allows testing and diversification of management strategies. Diversified management is needed for everything from learning how to better manage communities to learning more about various elements and processes in the system. Experimental approaches to improving existing techniques should be developed for prescription burns, control of invasive species, and other management practices.

A specific action is to:

- Develop and implement a region-wide monitoring program based on conservation design, as discussed in Chapter 9.

✔ Increase the variety of management approaches to better simulate the effects of natural processes

In order to restore biodiversity, the types and effects of management need to be diversified. Management is used in large part to mimic natural disturbances that once maintained the region's communities. However, today's management tends to be somewhat narrow in its effects and thus does not fully mimic the variety of natural processes. For example, the limited diversity in fire regimes reduces the diversity of habitat conditions and structures necessary to maintain a full complement of biodiversity. Many animal species rely on structural diversity within a given community type, and this diversity is often achievable under current management constraints. Also, some natural processes, such as elk grazing, have been lost but are not yet being mimicked adequately.

Some specific actions include:

- Increase the variety of burns through space, time, and intensity
- Manage for short-structured grasslands
- Explore how haying and other mechanical techniques can mimic loss of biomass consumption by grazers

✔ Create and manage large preserves

To conserve biodiversity at all scales, the ideal condition is to have large sites that contain a variety of community types. Large preserves are important for a number of reasons. Small remnants have been shown to lose species. To maintain viable populations, larger areas are needed. The exact size needed depends on the species. Large preserves also allow landscape-scale processes to occur. These processes are important for maintaining healthy and diverse communities. Buffer zones around natural areas are also recommended because they help to mitigate threats and to make management easier and more effective. Creating large sites also makes economic sense, as it is much more expensive to maintain small preserves than large, functioning ecosystems.

Knowledge of habitat needs of various taxonomic groups provides some clues to the preserve sizes needed to support viable populations. The various workshops convened to compile information for the recovery plan produced some rough estimates of minimum size requirements for various target species and groups. Based on scientific knowledge of habitat requirements of wetland birds, reptiles, and amphibians, a natural-area complex of approximately 1000 acres, with several marshes of 100 acres or more and with smaller wetlands and ephemeral pools, appears to be appropriate.

At least 500 acres are needed to support a full community of birds in a wet-mesic grassland. A few very large grassland sites (1000 to 3000 acres) are needed in the area to support species such as harriers that require relatively large expanses to breed. These larger grasslands are also needed to act as anchors for the grassland-bird community in the region. Although smaller areas (100 to 500 acres) will lack a few of the species normally found in a full community, as long as there are enough of these blocks spread throughout the region, most species should be present.

Forest and woodland amphibians need good-quality sites of at least 500 acres to maintain a complete suite of sensitive species. Forested sites as large as 10,000 acres may be needed to maintain viable populations of sensitive larger mammals such as gray fox. These figures are all rough planning guides, and additional research in this area will be needed to understand the conditions that ensure long-term population viability. The vision statements for community classes found earlier in this chapter provide additional information on the goals for creating large preserves, based on our current best knowledge.

Some specific actions include:

- Acquire buffer zones around existing preserves
- Protect and restore natural communities adjacent to existing preserves to connect and enlarge preserves
- Continue research to determine how large a site must be to maintain target species
- Direct Section 404 mitigation funds and land-acquisition funds to sites near existing preserves
- Protect recharge areas for groundwater-fed wetlands and other wet communities

✔ Create and manage community mosaics

Historically, natural communities occurred in mosaics with a heterogeneous mix of different habitats depending on soil type, moisture, aspect, fire patterns, and other factors. As a result, many species and processes depend on the close interconnections between community types. In particular, many animals rely on multiple habitats for their various life stages, and these habitats need to be managed together. For example, wetland insects, reptiles, and amphibians require integrated management of uplands and wetlands, as well as integrated management of multiple wetland types. Wetlands themselves do much better when managed together with their associated uplands. The large preserves discussed above do not need to be of a single community type. In fact, large mosaics of different community types are preferable in most cases, because the interconnection of communities allows more ecological processes. The one caution, however, is that mosaics should not be created on sites too small to support them. In addition, some species, notably grassland birds, need large areas of one structural community type.

Some specific actions include:

- Manage associated uplands with wetlands
- Mange communities as part of a large system
- Manage whole watersheds to conserve ecosystem processes
- Restore communities as part of mosaics

✔ Protect priority areas

A region-wide viability assessment is recommended to determine which sites would give the biggest return for the investment, thus helping to prioritize regional protection efforts. The three protection priorities are: 1) remaining high-quality sites, 2) land that will connect or expand existing natural areas, and 3) any large sites with some remnant communities (see

next action). High-quality sites are important because they are genetic reserves. It is very difficult to translocate plants and insects, and thus protecting remaining high-quality areas is the best conservation action. Remnant communities in larger areas are important because they serve as the basis for reconstructing larger natural communities.

Some community types found in the Chicago Wilderness region have always been rare, but nevertheless are an important part of the region's biodiversity. Some of these communities are rare because they are on the edge of their range here. However, these examples are important to the global conservation of the community type, because areas at the edge of the range often harbor high genetic diversity. Many of Chicago Wilderness's rare community types, such as bogs and pannes, are currently well protected, but their need for protection is worth highlighting because we cannot afford to lose any examples of these community types. The rare lakeshore communities (beaches, foredunes, and high dunes) and dolomite cliffs need protection from recreational pressures.

Some specific actions include:

- Assess acquisition opportunities
- Prioritize opportunities
- Develop protection strategies for priority areas
- Look to protect remaining remnants of particularly rare community types, including dolomite and gravel prairies, forested bogs, dolomite cliffs, and pannes.

✔ Identify potential large complexes

Opportunities still exist in the Chicago Wilderness region to create large protected areas with a variety of community types, through either expanding existing preserves or connecting several together. This current opportunity to acquire large blocks of undeveloped land to reconstruct into natural communities or to provide buffers, however, will not last long. In the near future, this opportunity will be lost as open space is developed. Land-owning agencies should take advantage of this opportunity now (as recommended earlier), even if they do not have the capacity to restore the land immediately. It is particularly important to acquire more buffer zones around existing woodlands, as there is little opportunity to protect any additional woodland areas, and the buffer zones will improve the condition of existing woodlands.

There is also the likelihood of increased funding for land acquisition in the near future from state and federal sources. As a priority action, the Chicago Wilderness Science and Land Management teams should help to identify possible areas for large mosaics. A list of criteria, including size, current condition, diversity, presence of conservative species, and estimated cost, would need to be developed to prioritize sites for restoration and acquisition. This assessment would maximize the contribution of each land-owning agency. The Chicago Wilderness teams should help to identify areas where preserves could be expanded if connected together to form larger preserves.

The region-wide assessment would help to identify opportunities to create more large complexes. Some counties, such as DuPage and Lake Counties, are already working to map out potential complexes, but this would be more beneficial if done on a regional scale. Specifying exactly which blocks of land and how big the blocks need to be requires further investigation. These questions require immediate attention because acquisition should start as soon as possible. The Illinois Department of Natural Resources has started this work with its "large grasslands ecosystem project," which aims to identify large grassland sites remaining in Illinois. A study of hydric soils could help to identify areas where large wetland complexes could be created. The Lake Calumet area and Midewin may provide opportunities to restore and create some large complexes. The regional vegetation map prepared through the recent NASA Chicago Wilderness project can serve as a very important tool for planning and identifying opportunities.

Some specific actions include:

- Use tools—hydric soil maps, GIS, large grassland areas project—to identify potential sites
- Develop criteria to prioritize sites for restoration and acquisition
- Chicago Wilderness members should facilitate acquisition and management of sites that cross political borders.

✔ Understand and mitigate urban threats to metapopulations and gene flow

Genetic diversity may not be maintained in fragmented landscapes, because many things act as barriers to dispersal. Therefore, in the urbanized context of Chicago Wilderness, it is important to learn more about genetic neighborhoods, gene flow, and barriers to dispersal. Given the number of small sites, strategies to maintain genetic diversity need to be researched, developed, and implemented. Gene flow studies on plants are particularly needed.

One possibility for plants is to introduce seed from small, high-quality sites to larger, degraded sites. Good

techniques to do this type of translocation with reptiles and amphibians have not been developed, and past attempts have often degraded the source population. More is known about genetic management in mammals, although the specific effects of fragmentation in this region have not been studied, and strategies for genetic management for mammal species of concern should be developed.

To aid gene flow, it might be better to think in terms of connections rather than artificial colonization. The effectiveness of narrow corridors is still not clear, and they may have some negative aspects by facilitating movement of invasive species and predators. A better strategy might be understanding and removing barriers to dispersal. For instance, the intervening space between blocks of forest or woodland can be a significant barrier to woodland wildlife dispersal. Planting oak trees in this space can diminish the barrier, even if the full community type is not restored. Other barriers need to be removed as well. For instance, a road can be a significant problem because it increases the mortality of wildlife and acts as a complete barrier to some species. Also, gradients rather than abrupt shifts should be maintained between habitat types. These gradients are of particular importance for birds.

Some specific actions include:

- Research , develop, and implement strategies to maintain genetic diversity
- Study gene flow in plants
- Translocate plants or seeds from high-quality areas to larger fair-quality sites
- Improve translocation techniques for amphibians and reptiles
- Develop strategies for genetic management in mammals
- Study barriers to dispersal
- Plant oaks in space intervening between forest or woodland blocks
- Remove or mitigate barriers such as roads in key areas
- Maintain gradients between community types

✔ Manage a portfolio of sites

In our urban landscape, a portfolio approach to management and protection is necessary. Protecting a wide variety within each community type ensures proper habitat for the broadest array of species. Likewise, diversity in management spread across sites allows a greater diversity of habitats.

As prairies are quite varied and only small remnants remain today, a variety of sites is needed to provide appropriate habitat for the region's fauna. Very few sites, if any, provide all things for all birds, and therefore a collection of sites is needed to capture a wide range of habitats.

The natural fluctuations in the hydrology of wetlands are important in maintaining species diversity, and wetland management should therefore be considered at a regional scale. Marshes and other wetlands will not provide good habitat for birds in all of their stages. However, birds will move from site to site. So long as there is a diversity of hydrological states within wetlands of the region, the birds can find suitable habitat. Land managers should communicate with each other about planned fluctuations in their wetlands to promote hydrologic variability at the regional level.

Currently, management is being conducted mainly on a site-by-site basis. However, it would be better for management planning to occur on a broader scale, at least at the county level, as is already occurring in some counties. A range of effects from management strategies should be distributed across sites, rather than using a narrow range of management prescriptions on every managed site. It is difficult to implement a broad-scale management strategy because many high-quality remnants contain rare species, for which these sites are and need to be managed specifically.

Some specific actions include:

- Communicate across the region about planned fluctuations in wetlands
- Vary management from site to site

✔ Increase seed supply of local genotypes

One current limitation to management is the limited availability of seeds of local genotypes. The growing demand for native species depletes the supply of seeds for restoration projects, and nurseries and garden centers often stock non-local genotypes. Native species of non-local genotypes can cause genetic deterioration of the local genotypes if they spread into local natural areas. Native plantings in gardens and on corporate campuses should be encouraged, but an adequate supply of seeds from local genotypes is needed. Potentially, corporations could increase the pressure on garden centers to carry local genotypes by increasing the demand.

- Land-managing agencies should create nurseries to increase supply for seed
- Increase demand on nurseries and garden centers to supply local genotypes

✔ Mitigate the threat of salinization

Salinization of wetlands and other wet community types due to road salt is a growing problem. Alternatives to road salt in sensitive areas need to be investigated, as well as ways to keep excessive salt and water out of wetlands. The full impact of salt on plant communities is not understood and should be researched.

Some specific actions include:

- Search for alternatives to road salt
- Investigate the full impact of salt on plant communities
- Look for ways (especially in the design of road drainage) to keep excessive salt and water out of wetlands

✔ Mitigate the threat from hardening of shorelines and prevent further hardening

With the hardening of shorelines in some portions of the Chicago Wilderness region, a continuous supply of additional sand is needed to resupply natural beach ecosystems including pannes, beaches, foredunes, and sand prairies. Sand needs to be deposited at strategic locations at Illinois Beach and the Indiana Dunes National Lakeshore and littoral drift allowed to carry the sand along the lakeshore. Coastal protection funds (from the Conservation and Reinvestment Act) should be allocated to ensure a continued, adequate source of sand to maintain coastal ecosystems. These funds should be used to obtain and transport clean dredge sand from harbors and local quarries, and they could be used to clean minor amounts of contaminants from closer sources of sand. In addition, agencies should discourage additional hardening of the shoreline, which ultimately starves the down-drift beaches and other communities of sand.

5.9

Research needs for maintenance and recovery of biodiversity in the Chicago Wilderness region

5.9.1 Introduction

Continuing to increase our knowledge about biodiversity and how to maintain it is an important recommendation of this plan. Suggestions for increasing the amount and effectiveness of research are included in Chapter 9. Ten areas of research concern have been identified through several workshops that brought together scientists and land managers in the region. These concerns can be grouped into two broad categories of Natural History / Ecological Process and Management / Stresses. Providing answers to some or all of these questions will greatly improve the effectiveness of preserving biodiversity in the Chicago Wilderness region. Below are listed examples of some of research issues for terrestrial communities.

5.9.2 Research needs on natural history and ecological processes in terrestrial communities

Ecological process

In considering biodiversity conservation, the number of species of plants and animals is usually foremost in people's minds. Equally important, however, is the preservation of the diversity of ecological processes (decomposition, pollination, herbivory, predation, etc.). Preserving the pieces without considering the processes that formed them and tie them together would fall short of long-term, sustainable conservation. To guide management, it is important to understand both former and current processes at work in a community and how the community responds to these processes. To obtain a better understanding of these processes, the following examples are representative of the research needed in this area:

- Examining the role of grazers in prairie systems and how best to mimic their effects today
- Examining how fire functions in natural systems, and how it can best be used in restoration and management
- Studying below-ground processes to improve long-term success of restoration
- Understanding the return of soil structure to more natural conditions when previously cultivated land is restored to natural communities

Hydrology

Historically, most of the plant communities of the Chicago region were dependent on ground water. Today, surface water is the predominant source. This water is often irregularly abundant and of poor quality. Understanding the hydrology of healthy systems and how to restore this critically important function is of tremendous importance to maintaining the biodiversity of the region. Examples of research issues in hydrology include:

- Studying the relationship of vegetation cover to amount and quality of runoff water

- Looking at the long-term impact of water quality on reptile and amphibian populations
- Monitoring effects of restored hydrology in natural communities
- Identifying methods of managing ground-water-fed systems under changing hydrological conditions

Soils

Soil is a valuable resource for ecological restoration in several ways. It is an archive of ecological information and may help managers better understand the vegetation and ecological history of their sites. This knowledge may assist the manager in choosing historically appropriate management objectives, where such considerations are important. Soil provides the rooting medium of plants, and soil characteristics may provide an important criterion when selecting species for reintroduction. While the micro-biota of soil is poorly understood, soil microbes represent the greatest concentration of biological diversity within terrestrial ecosystems. Soil provides direct benefits to the public and is a resource to be protected and developed. Public benefits include carbon storage; rainwater absorption and storage; and adsorption of toxins on soil particles, preventing their movement into surface and ground water.

The soils of natural areas in the Chicago Wilderness region are poorly known. Our understanding of soil in the Chicago area and elsewhere has focused primarily on the manipulation of soil for agriculture, horticulture, and development. Scientific understanding of soil and its role in Chicago Wilderness ecosystems needs to advance in at least five major areas:

- Describing soils for the entire region, including local variations in properties, and extensively ground-checking existing soil maps
- Examining relationships between soil and ecosystem, starting with less disturbed ecosystems. Knowledge gained here then can be applied to situations in which the biota has been greatly or completely disrupted.
- Investigating soil function, particularly as it relates to hydrology and nutrient regimes.
- Studying soil biodiversity, particularly comparing the diversity and composition of organisms in remnant natural soils to those in the highly disturbed and manipulated soils of agricultural and developed landscapes
- Monitoring the short-term and long-term effects of ecological restoration on the soils of natural areas

Distribution, abundance, and status

Knowing where species and communities are, how many individuals are in populations, and whether these populations are increasing or decreasing are essential pieces of information to effectively preserve biodiversity. As more work is done, once-rare species are found to be more common, new species for the region are discovered, and species previously thought to be extirpated are rediscovered. All of this information helps in planning and directing resources and effort. Inventories are also important as a baseline against which to compare the impacts of management techniques. Examples of research needed on this topic include:

- Mapping the distribution of specialized and rare communities such as gravel prairies
- Determining the distribution of understudied faunal species, such as bats
- Identifying taxonomic groups that have key remnant-dependent species
- Developing baseline inventories for understudied groups such as soil fauna

Life history and habitat needs

Basic information on life history is lacking for many species. This is particularly true of difficult-to-study organisms such as nocturnal species and invertebrates. The habitat needs of many species are also poorly understood. Different community types may be necessary for different parts of an organism's life cycle. For threatened and endangered species, it is necessary before developing recovery plans to know basic information on their life histories, phenology, and reproductive biology, as well as their ecological and habitat requirements. Research needs here include:

- Ascertaining habitat requirements relevant to the entire life history of priority reptiles and amphibians
- Determining the habitat needs of bats for foraging and roosting
- Documenting the effects of coyotes on other native species
- Investigating relationships between species of concern and the effects of overabundant species
- Determining the habitat and other ecological needs of endangered and threatened species

Genetic studies

Many once-common species have been isolated in small, fragmented pockets. This isolation may have led to loss of genetic variability in species that were once genetically

diverse and widespread. Genetic considerations also are important in determining sources for propagules to reestablish lost populations or to bolster severely fragmented ones. Knowing the best method to increase and to restore these populations depends on a good understanding of their genetic make-up, especially for species that have always been rare or that survive in drastically reduced populations. Examples of research topics relating to genetics are:

- Determining the genetic relationships between populations of priority reptiles and amphibians to identify management needs
- Evaluating the significance of genetic drift in plants in fragmented habitats
- Determining habitat and population dynamics needed for viable populations and communities

5.9.3 Research needs on management and stresses

Restoration and effects of management techniques

Restoration is being carried out currently on many sites using a variety of management methods. Although specific goals and objectives direct this work, many unanswered questions present themselves about how these methods affect various pieces or processes within the communities being restored. Many of these questions may require long-term investigation. Therefore, due to imminent threats to the communities, restoration often proceeds without having all the information in hand and without setting up controls to measure the impacts of management. No one realizes the importance of obtaining pertinent management information more than the restorationists themselves do. Land managers are continually looking for ways to improve their management, and so they require an experimental framework to examine options. Research issues in this category include the following:

- Determining how restored habitats accommodate all major life forms of those communities
- Looking at the impacts of restoration on soil properties
- Investigating the effects of timing, frequency, and intensity of fire on biodiversity and habitat quality
- Determining which species will move from remnants into restored areas and under what conditions
- Evaluating whether management to a presettlement condition maximizes biodiversity

Human effects and effects of urban environments

Growing human populations and changing land-use practices have shifted the relationship between human and non-human communities into one of instability and unsustainability. Understanding our relationship to the land will be critical to maintaining biodiversity in the region. Examples of research in this area include:

- Examining the effects of adjacent land-use practices on natural communities
- Studying the impact of materials such as road salt on plant populations
- Determining the effects of mosquito-abatement programs and pesticides on native species
- Determining the effects of fragmentation on metapopulations, and determining effective mitigation strategies

Preserve design

Knowing how species interact with their habitat is critical to designing effective preserves for conservation. The preserve's size and shape, the diversity of communities within it, and its connectivity to other similar habitats are all important factors in preserve design. Examples of research concerns in this area include:

- Examining the dispersal of reptiles and amphibians
- Studying how species use corridors, and under what conditions corridors promote biodiversity conservation
- Understanding barriers to dispersal for different species
- Determining the conditions under which nearby isolates function as a complex for species viability

Further research is not necessary to understand that most of the natural communities in the Chicago region are in a degraded condition, are losing ground, and are in need of human action. The need for research should not be seen as a reason to fail to take positive action based on best current knowledge. However, research is necessary to refine and improve land-management methods to achieve the desired goals of these practices. As restoration of natural communities progresses, more questions will be generated. Research into those questions, in addition to the examples provided above, will serve to inform the restoration process. More details on the interaction between conservation planning, monitoring, and research are presented in Chapter 9.