Natural Fire and Controlled Burning in the Chicago Wilderness Region: A Model Policy

An Introduction to Chicago Wilderness

Chicago Wilderness is a regional nature reserve that includes more than 200,000 acres of protected natural lands within the greater Chicago metropolitan area. Chicago Wilderness stretches from southeastern Wisconsin, through northeastern Illinois and into northwestern Indiana. The protected lands in Chicago Wilderness are forest preserves, state parks, federal lands, county preserves, and privately owned lands. There are also many unprotected natural areas in the Chicago Wilderness region.

The Chicago Wilderness consortium is an alliance of more than 160 public and private organizations working together to protect, restore, study and manage the precious natural ecosystems of the Chicago region, enrich local residents' quality of life, and contribute to the preservation of global biodiversity.

Purpose of this Document

This paper is a product of the Chicago Wilderness consortium. It is one of a series of documents on regionally important questions. It is designed to aid decision-makers in developing and implementing policies which can strengthen the presence of nature in our region and in our communities, thereby improving quality of life, fostering harmony between people and nature, and creating a healthy environment. This paper seeks to inform, build consensus and foster implementation of the recommendations in the Chicago Wilderness *Biodiversity Recovery Plan*.

Effective controlled burning, fire safety, and fire education are high priorities for the restoration, management and sustainability of natural areas in the Chicago Wilderness region. For more than three decades, conservation agencies have been developing techniques for safe and effective controlled burning (also known as “prescribed” burning) programs and producing the necessary research and public education programs to support them. This paper is designed to:

- Provide a science-based overview of the importance of fire to the natural communities and biodiversity of Chicago Wilderness.
- Show how the healthy ecosystems that are a result of good management benefit the residents of the region.
- Explain the safety practices and careful planning that minimize any negative impacts of controlled burning.
- Outline general, regionally accepted controlled burning procedures in the major habitat types.

Summary

Most of the natural landscape of the Chicago region originally developed in the presence of regular, seasonal fires, which were ignited by lightning and Native Americans. Over thousands of years, most of our wetland, woodland and grassland ecosystems have become adapted to periodic fire.

As a result, most of the Chicago region's ecosystems fail to thrive in the absence of fire. Historic records indicate that many of our current woodlands, now infested with invasive plants, were once rich open woodlands and oak savannas. Many brushy fields were once tallgrass prairie. When restored to healthy conditions, these lands can provide superior ecosystem services for public benefit. Specific benefits include cleaner water, erosion control, soil conservation, and biodiversity conservation in addition to recreational, aesthetic and education benefits. Healthy natural ecosystems also provide better habitat for native wildlife. In general, restoring and maintaining healthy natural ecosystems means promoting and protecting the biological diversity of native species and communities; it means increasing and maintaining the ability of ecosystems to sustain the unique collections of living things that are best suited to those ecosystems.

The elimination of natural fire (coupled with the lack of controlled burning) is one of the most important threats to the protected conservation lands in the Chicago Wilderness region. Since the 1970s, controlled burning has been widely used in the region as an important tool in managing the natural landscape for the benefit of nature and people. Controlled burns can be conducted safely and with minimum inconvenience to nearby neighbors and the general public. In the Chicago region, the record in this regard has been exemplary.

Controlled burning is an important part of the sound management of prairies, oak woodlands, savannas, marshes, and other fire-dependant ecosystems. Many local land management agencies have provided leadership by conducting controlled burns on many sites for many years. Yet more resources are needed, since many worthy sites slowly degrade for lack of controlled burns. The following are critical steps that need to be taken to improve and sustain the ecological quality of the region's natural areas:

- Land management agencies need to procure sufficient equipment and workforce to conduct controlled burns on conservation land so that the quality of the region's natural communities is maintained and improved.
- Chicago Wilderness members need to substantially increase both the quality and quantity of information and education about the value of and need for controlled burns.
- Fire safety protocols should be shared with the general public, preserve neighbors and local authorities.
- Preserve visitors and neighbors should be notified of plans for controlled burns.
- The level of communication and coordination between land managers, fire departments and the scientific community should be increased.
- Research agencies should conduct ongoing, long-term research and monitoring on the effectiveness of different fire regimes.

Conservation Benefits of Controlled Burning

Adaptations to fire arise from this region's history. Following the last ice age (10,000 to 12,000 years ago), species from the east, south, and west coalesced here into the natural communities of plants and animals that have made up the natural landscape of the Chicago region for more than 8,000 years. Prior to that time, many of these species evolved for hundreds of thousands of years in oak woodlands, grasslands and wetlands where fire was a normal and essential part of life. Historically, periodic fires seem to have occurred frequently (from every year to every few years) over large areas. They were patchy in distribution and varied in season, severity, and other factors.

As a result, many of our native species are adapted to fire or depend on it for seed germination, nutrient recycling, reduction of competition, or maintenance of open tree canopies. Fire also stimulates flower and seed production in many native plant species. Many tree, shrub, herb, and animal species can not survive over the decades without the complex effects of occasional fires. Returning the natural process of periodic fire to our conservation lands helps to restore and maintain hundreds of native species that would otherwise be eliminated from these sites.

Control of invasive woody species
A variety of invasive species of shrubs and trees pose major threats to grasslands, woodlands and wetlands. Both non-native and native species can become invasive and disturb the ecological balance in habitats that are not adapted to their presence. For example, some species native to woodlands cause serious problems in prairies and marshes. Some of the shade-tolerant species that are native to the closed forests of floodplains and to ravines can cause problems in open oak woodlands. Often these invasive species are not adapted to fire. With the loss of a natural fire regime, populations of invasive species have become so high that they shade out light-dependent woodland plants such as oaks, hickories, hazelnuts, and associated grasses and wildflowers. This leads to a loss of the diversity of these plants and the animals adapted to living with them. Controlled burning helps to eliminate non-native invasive plants (e.g., European buckthorn, Asian honeysuckle) and reduce aggressive natives (e.g., sugar maple, box elder, wild cherry) to their normal density and distribution.

Control of invasive herbaceous species
Invasive herbaceous vegetation can also out-compete and eliminate many native plants, thereby eliminating the food and shelter for many native animals. Controlled burning helps to manage invasive plants and encourage the growth the species that are characteristic of healthy ecosystems. Often, invasive grasses and forbs are among the earliest species to begin growth after winter. For this reason, spring burns can reduce many invasive species while other plants are still dormant. Fire is most effective over time, gradually increasing the numbers of species that naturally occur in ecosystems, while reducing non-native and native invasive native species until a natural balance is achieved. In some cases, fire merely reduces the numbers of problem plants to levels where they can be managed by other means such as cutting or applying herbicide.

Support of fire-adapted native animals
Insects and other invertebrates comprise the bulk of the animal species in our prairie and woodland ecosystems. Research has shown that fire-sensitive native species re-colonize burned

habitats rapidly from nearby unburned areas, typically occurring in large numbers within a year or two. Over time, many of our rarest, fire-sensitive prairie invertebrates (butterflies, native bees, and others) have been found to be most abundant on sites maintained with regular burning.

In some cases, native animals have become uncommon because their fire-maintained habitats have been degraded or destroyed. The Franklin's ground squirrel, smooth green snake, bobolink, and Aphrodite butterfly are four examples of this phenomenon. Without the use of controlled burns, populations of these and other species will continue to decline until they disappear from the region.

Survival of woodland trees and communities

Most of our wooded communities benefit from fire. These include our oak savannas and forested lands that are often found on the edge of savannas and prairies: red oak forests (with basswood, walnut, maple, and others), bur and white oak woodlands, and the swamp white and pin oak flatwoods.

When these forest types are excessively shaded, whether by non-natives such as buckthorn or invasive natives such as sugar maple, sufficient light does not reach the forest floor. The result is the loss of the wildflowers and grasses which hold the soil and which support many animal species. The shade also prevents regeneration of the open woodland trees and shrubs such as oaks, hickories, hazelnuts, and plums. The thinning of invasive trees by controlled burning restores and maintains the quality and structure of most of this region's original natural forest types.

There is at this time no consensus on the use of fire to manage forests of sugar maple and basswood that developed along the east sides of some rivers, or in floodplain forests of silver maple, green ash, and cottonwood. Some experts recommend complete fire protection for these systems, pointing out that similar forests in eastern states are not adapted to fire. Other experts recommend the use of controlled burns experimentally, especially in preserves where the declining black maple is present. They note that, in the absence of fire, excessive numbers of young trees deplete the native plant populations in some natural areas. The role of fire in non-oak forests of Chicago Wilderness deserves additional research.

Benefits to the soil

Lack of burning disrupts the normal nutrient cycling that is crucial to the health of natural communities. When dead plant material is consumed by fire, many nutrients stored in aboveground portions of the plant are returned to the soil. The following spring, plants have ready access to the nutrients they need to flourish. The release of phosphorus from the burned material increases the activity of nitrogen-fixing bacteria, which will naturally fertilize the soil by adding to the supply of nitrogen available to plants. Nitrogen-fixing bacteria in the roots of legumes are also stimulated by fire, further adding to the pool of available nutrients.

Despite the high heat above the ground during a fire, soil is an excellent insulator and native soil organisms remain unharmed during a burn. Fire does control exotic soil species, some of which negatively change the chemistry of the soil and may facilitate invasion by other invasive plants and animals.

After burns in prairies, sunlight is able to reach the soil without interference from dead plant material. The blackened soil heats more rapidly than soil insulated by a blanket of dead leaves and grass. Warmer soils encourage the growth of many native species, which do not start their growing season while the soil is cool. Thus, a burned prairie has a substantially longer growing season. One result of the prairie's many adaptations to fire is that a burned prairie produces twice as much biomass (the total weight of plant growth) as an unburned prairie. The greater biomass indicates increased productivity and ecosystem health: plants in burned prairies demonstrate increased flowering and greater seed production.

The Public Benefits of Controlled Burning

Healthy habitats provide a number of benefits to nearby residents and to the region as a whole.

Clean water and soil conservation
A healthy wetland, woodland or prairie holds the soil in place, thereby decreasing siltation in water courses. It also lessens flooding by absorbing and filtering rain. When increasingly shaded by invasive shrubs in the absence of fire, the grasses and wildflowers of prairie and forest are less and less able to grow. Without the natural absorption capacity created by healthy native plants and their root systems, the soil breaks down and can no longer absorb large amounts of rain. Runoff increases, eroding the soil and carrying silt to waterways and wetlands and increasing the magnitude of floods.

Reduced global climate change
Healthy prairies and woodlands remove carbon dioxide from the atmosphere and store organic carbon in plant material and in the soil. The vast majority of carbon sequestered in prairie ecosystems is in the soil. Burning a prairie releases carbon dioxide from the aboveground crop but increases carbon sequestration in the soil and roots by stimulating vigorous summer growth. There is little research available that allows us to compare overall air quality impacts of burned and unburned woodlands, but at least some of the principles that apply to grasslands are likely to apply to oak woodlands as well. Maintaining healthy prairies and forests can therefore help reduce the region's production of atmospheric carbon dioxide, and contribute to the reduction of global climate change.

Clean air
Where practical, the U.S. Environmental Protection Agency recommends replacing mowed turf with natural landscaping featuring native plants. Controlled burns are often the most ecologically sound management of such sites. While smoke from controlled burning produces particulates and carbon dioxide and therefore contributes to air pollution for a brief period in the spring and fall, the increased growth of burned grasslands helps to clean the air during the hottest periods of summer—times when poor air quality is of greatest concern. More importantly, the lack of mowing represents a substantial reduction of pollution from combustion engines.

Aesthetics and conservation benefits
A well-managed controlled burn program enhances the value of natural areas for visitors and neighbors today, and keeps our natural areas healthy for future generations. Once an area is part of a regular burn regime, the richness of plant and animal species increases, areas that had been dominated by invasive shrubs will become more open and attractive, and the changing varieties of plants and flowers will be evident from season to season. These qualities can make natural areas more accessible to the general public and foster appreciation of nature among preserve neighbors and visitors.

Public education
Controlled burns can attract public attention and create opportunities to inform people about the ecology of the Chicago region and the role that fire plays in local ecosystems. Public education and communication efforts on the subject are useful both to build understanding of and support for the use of controlled fire as a management tool and to increase public understanding of the region's natural resources.

Assuring Good Results and Public Safety

The Chicago region's conservation agencies have conducted controlled burns safely for more than 30 years. To ensure that this record continues, the Chicago Wilderness consortium has developed a training program for burn crews. Burn training is an ongoing process, and personnel are instructed in updated techniques on a regular basis.

Land managers plan and implement controlled burns according to certain guidelines. The Chicago Wilderness consortium recommends that any agency developing policies and procedures for controlled burning incorporate these important guidelines:

- A controlled burn plan is developed specifically for each site. Such plans should take into account factors such as temperature, wind speed and direction, and area to be burned.
- All required permits are obtained and related guidelines conscientiously followed.
- Controlled burns follow the Illinois EPA air quality and safety regulations to protect the public near areas scheduled for burning.
- Controlled burns are conducted only when conditions fall within the range set in the site's fire plan, or when senior level personnel approve exceptions.
- Local police and fire departments are notified in advance of a controlled burn and again on the day of the burn.
- People living near natural areas scheduled for controlled burning are notified of the scheduled burns.
- Appropriate equipment and trained personnel commensurate with the size and condition of the site are used to ensure safety of the crew and the public.
- Detailed and accurate records are kept of all controlled burns conducted on public lands.
- Burns are conducted so as to minimize the production of smoke and to minimize the drifting of smoke into residential or commercial areas.
- Burns are prohibited on ozone action days in the summer.

Standards

The following section outlines the recommendations of the Chicago Wilderness consortium on general procedures for conducting controlled burns in the Chicago region.

Planning and setting goals
Controlled burns should be conducted as part of overall management plans. A key component of such plans is a definition of what the site will look like when it has been restored to health–a target goal for the management efforts. This goal should initially be based on historical records and soil and plant characteristics as they exist on the site. These clues will indicate the likely habitat type or types that best fit the characteristics of an area. An experienced manager can produce an interim management plan and a basic controlled burn plan in a short period of time. The lack of a controlled burn plan and baseline monitoring should not be used as a long-term reason not to burn a fire-dependent community.

Flexible or adaptive management
Once the use of controlled burning has begun as part of an overall management plan, the response of the plants and animals at the site will help to refine the goal. In large sites, controlled burning and other management techniques may modify the locations and ratios of different habitat types over time. Therefore, the initial management plan should not be seen as inflexible, but should be a living document that changes as restoration progresses. Over time, monitoring may reveal new information about the site, and land managers may adapt their management plans accordingly in response to the changing state of the flora and fauna. Each site is unique; the terrain, plant and animal community and location may require that the fire prescription be adapted and updated to changing site conditions.

Monitoring
Whether or not management and the use of controlled burning is under way, regular monitoring should be conducted to document the effects of management, or lack thereof. Monitoring will provide information on how various fire regimes affect rare species. Increases in the numbers of invasive plant species or the decline of sustainable community structure may indicate the need for more frequent burns.

Fire intervals
The use of fire as a management tool is recommended for most habitat types in Chicago Wilderness. If fire is to be employed in parts of beech-maple or maple-basswood forests, fire should be considered experimental and the results documented. Areas that include bogs should be burned only when the peat is saturated or frozen in order to avoid peat fires.

The frequency of controlled burns depends on both the habitat type and the health of the site. More frequent burns are recommended for sites in poor condition (not good or high-quality examples of the habitat type) in order to control invasive plant species. Once a site no longer has a major problem with invasive species or excessive brush, the frequency of controlled burns may be decreased. Some species of invertebrate animals and birds present in high quality sites have

been shown to require fire-free intervals of two or more years to maintain their populations. Therefore, longer fire intervals are recommended for such sites.

The following fire interval recommendations are general, and individual sites may require different fire return intervals based on management objectives and observed results. The figures below refer to burn intervals for individual units within a preserve. If land managers burn at a preserve every year, but only burn half of the preserve's units each year, this would be a two-year fire interval for the individual units.

Fire intervals for poor to fair quality sites:

Prairie	1-2 years
Savanna	1-2 years
Woodland	2-4 years
Flatwoods	2-3 years
Oak Forest	2-5 years
Sedge Meadow	1-2 years
Marsh	1-2 years

Fire intervals for good to high quality sites:

Prairie	3-5 years
Savanna	3-5 years
Woodland	3-8 years
Flatwoods	3-8 years
Oak Forest	5-10 years (or longer)
Sedge Meadow	3-5 years
Marsh	3-5 years

These are not hard and fast rules, but typical examples of appropriate burn regimes that can be adapted based on site specifics. For example, in a high quality prairie with a substantial brush problem and no species that are known to require a longer fire interval, it may be appropriate to burn half of the site every year (a two year fire interval for each burn unit).

Burn cycle variation

The intervals described above are typical cases, but there are many exceptions. Regardless of the length of the fire return cycle, burn variation is important to achieve good species balance. Burning a site only in mid to late spring may result in dominance by warm season grasses. Burning a site only in the fall will favor spring grasses, wildflowers and annuals. To balance the effects that seasonal differences and intensity have on a community, the time of year and intensity of controlled fire used on a unit should be varied over the course of the burn cycle. It is also desirable to burn some areas less often and some more often than the recommended averages and to monitor the components of such communities carefully for comparison with more conventionally managed areas.

Burn personnel training

Although controlled burning is an extremely cost-effective management tool, most public landholders to date have had insufficient trained staff and volunteer personnel to burn more than

a small portion of their holdings. Due to the limited range of weather conditions that allow fire to be used safely in some areas and the realities of this region's weather, certain sites may meet the criteria for controlled burning on only a few days each year. Thus the most limiting factor for achieving ecosystem health is the availability of trained personnel during good burn conditions.

It is therefore essential that, throughout the region, more personnel and resources be devoted to controlled burning. These personnel can include trained staff, trained volunteers, and contractors. There is a need for more fire-management training workshops, more equipment, more funding of contract burning and more funding for controlled fire research. These expenses and the reallocation of staff time should be a high priority for all land management and conservation research agencies.

Fire sensitive species

There are a number of fire-dependent animal and plant species that are vulnerable to fire during portions of their life cycle. Natural areas should be monitored for these species, and fire prescriptions should address their presence. For most sensitive species, burning only a third of their habitat in a given year will provide them both a refuge from the fire, and healthy habitat to re-colonize after the burn. For others, the timing of the burn is critical. However, if a restricted burn window is resulting in habitat loss, managers need to make the best compromise between habitat loss and individual animal mortality.

Following are considerations for some species that can be vulnerable to fire. It is not a complete list of such species, but rather a starting point for such a list, which should be included in site management plans.

Native shrubs: While native shrubs may be problem species in some habitats, they may be desirable in others. Where native shrubs are desired, burn frequencies for the site should be lengthened, fire breaks should be cut around the shrub communities, or most burning should be restricted to environmental conditions that keep the fire intensity low.

Reptiles: When possible, burns should be conducted before reptiles become active after winter hibernation or after they become dormant in the fall. Burns in areas likely to contain vulnerable populations of reptiles should not be conducted after the first of April if the temperature is above 50ºF.

Karner blue butterfly: Heterogeneity is key for sites with Karner blues. Sites should be burned so as to leave unburned patches of lupine (the Karner blue's host plant).

Hines emerald dragonfly: If possible, specific areas where the dragonflies emerge from the water should not be burned. If it is impossible to cut a fire break to prevent those areas from burning, the burn should be conducted early in the spring before the larvae become active.

Within these limitations, every effort should be made to burn the fire-dependent habitats of rare species, even if the species themselves appear to be fire sensitive. Without the healthy habitats that result from fire management, the populations of these rare species will diminish.

Working with fire departments
While regulations differ between jurisdictions, fire fighters are sometimes required to respond to fire complaints even if they have previously been informed that a controlled burn is scheduled. Land managers should work with the fire fighting community to assure safe regulations that are compatible with good controlled burning and find ways to ease the burden on the fire departments' staff time.

As a first step, Chicago Wilderness has developed a regional controlled burn training program and is working to offer this training to representatives of the region's fire departments. In addition, consortium members are working to improve communication with local fire departments, and land managers are working to provide precise controlled burn plans that will help burn crews and fire departments coordinate their efforts.

These efforts to improve communication with fire departments, share detailed plans, and offer training to fire department staff should continue and expand, and should become standard practice for all landowners that use controlled burns on their holdings.

Public education
A controlled burn typically attracts the public's attention. Such occasions are opportunities to educate people about fire safety, the historic role of fire in nature, and how controlled burns are used today to restore and sustain natural areas. Agencies that conduct controlled burns should take full advantage of these educational opportunities. Additionally, interpretative signs should be used to point out the differences between burned vs. unburned areas. Finally, land managing agencies should engage the public in programs that bring people to burned and unburned areas during the growing season, to demonstrate the benefits of fire to the landscape.

Sources for More Information

Scientific publications

Abrams, M. "Fire and the Ecological History of Oak Forests in the Eastern United States." Proc. of Workshop on Fire, People, and the Central Hardwoods Landscape, General Technical Report. 2000. Ed. Yaussy, D. A. Newton Square, PA: USDA Forest Service, Northeastern Research Station.

Anderson and Menges. "Effects of Fire on Sandhill Herbs: Nutrients." *American Journal of Botany*, 84:7 (1997): 938-948.

Anderson, R.C. Prairies in the Prairie State. Trans. IL Academy of Sciences, 1970: 214-221

Anderson, R.C. The Historic Role of Fire in North American Tallgrass Prairies. Norman, OK: University of Oklahoma Press, 1990.

Barnes, Zak et al. Forest Ecology, 4th edition. John Wiley & Sons. Ch. 12, Fire.

Cole, Klick and Pavlovic. "Fire Temperature Monitoring During Experimental Burns at Indiana Dunes National Lakeshore." Natural Areas Journal, 12:4 (1992): 177-183.

Collins. S.L. and L.L. Wallace, eds. Fire in North American Tallgrass Prairies. Norman OK: University of Oklahoma Press, 1990.

Delcort and Delcort. "Pre-Colombian Native American Use of Fire." Conservation Biology 11:4 (1997): 1010-14.

Dickmann, D.I. "Fire for Restoration Of Communities And Ecosystems." Bulletin of the Ecological Society of America, 79 (1998): 157-160.

Grigore & Tramer. 1996. "The Short Term Effect of Fire on Lupinus Perennis." Natural Areas Journal, 16:1 (1996): 41-48.

Harty, F.M., J.M. Ver Steeg, R.R. Heidorn, and L. Harty. "Direct Mortality and Reappearance of Small Mammal in an Illinois Grassland after a Prescribed Burn." Natural Areas Journal 11 (1991): 114-118

Harper, M. G., Dietrich, C. H., Larimore, R. L., and Tessene, P. A. "Effects Of Prescribed Fire On Prairie Arthropods: An Enclosure Study." Natural Areas Journal 20:4 (2000): 325-335.

Herkert, J.R. & Glass, W.D. "Henslow's Sparrow Response to Prescribed Fire in an Illinois Prairie Remnant." Studies in Avian Biology, 19 (1999): 160-164.

Hessl, A. and Spackman, S. "Effects of Fire on Threatened and Endangered Plants: An Annotated Bibliography." Information and Technology Report. Washington, D.C.: U.S. Department of Interior, National Biological Service, 1995

Higgins, Kenneth F., Arnold D. Kruse, and James L. Piehl. 1989. "Effects of fire in the Northern Great Plains." Extension Circular 761. Jamestown, ND: Northern Prairie Wildlife Research Center Home Page. U.S. Fish and Wildlife Service and Cooperative Extension Service, South Dakota State University, Brookings, South Dakota. 16 May 2000 <http://www.npwrc.usgs.gov/resource/2000/fire/fire.htm>

Huddle, J.A. & Pallardy, S.G. "Effects of Long-Term Annual and Periodic Burning on Tree Survival and Growth in a Missouri Ozark Oak-Hickory Forest." Forest Ecology and Management, 82 (1996): 1-9.

Hulbert, L. C. "Fire Effects On Tallgrass Prairie." Clamby, G. K. and Pemble, R. H. The Prairie - Past, Present, and Future: Proceedings of the 9th North American Prairie Conference. Fargo, North Dakota: Tricollege University Center for Environmental Studies.

Hunter, W. C., D. A. Buehler, R. A. Canterbury, J. L. Confer, and P. B. Hamel. "Conservation of

Disturbance-Dependent Birds in Eastern North America." Wildlife Society Bulletin 29:2 (2001): 440-455

Johnson, K. C. and J. E. Ebinger. "Effects of Prescribed Burns on the Woody Vegetation of a Dry Sand Savanna, Hooper Branch Nature Preserve, Iroquois County, Illinois." Transactions of the Illinois Academy of Science. 85: 3-4 (1992): 105-111.

Ladd, D. "Reexamination Of The Role Of Fire In Missouri Oak Woodlands." Proceedings of the Oak Woods Management Workshop, Eastern Illinois University, Charleston, IL. 1991: 67-80

Leach, M.K. & Givnish, T.J. "Ecological Determinants of Species Loss in Remnant Prairies." Science 273 (1996): 1555-1558.

Lorimer, C. G. "Historical and Ecological Roles of Disturbance in Eastern North American Forests: 9,000 Years of Change." Wildlife Society Bulletin 29:2 (2001): 425-439.

McClain, W.E. & Elzinga, S.L. "The Occurrence of Prairie and Forest Fires in Illinois and other Midwestern States, 1679 to 1854." Erigenia, 13 (1994): 79-90.

Olson. "The Historical Occurrence of Fire in the Central Hardwoods" Natural Areas Journal, Conservation Issues. 16:3 (1996): 248-256.

Panzer, R. and M. Schwartz. "Effects of Management Burning on Prairie Insect Species Richness within a System of Small, Highly Fragmented Reserves." Biological Conservation 96:3 (2000): 363-369.

Panzer, R. 1988. "Managing Prairie Remnants for Insect Conservation." Natural Areas Journal 8:2 (1998): 83-90.

Panzer, R. "The Importance of In Situ Survival, Recolonization, and Habitat Gaps in the Postfire Recovery of Fire-Sensitive Prairie Insect Species." Natural Areas Journal. 23 (2003): 14-21.

Panzer, R. "Compatibility of Prescribed Burning with the Conservation of Insects in Small, Isolated Prairie Reserves." Conservation Biology. 16 (2002): 1296-1307.

Siemann, E., Haarstad, J., & Tilman, D. "Short-Term and Long-Term Effects of Burning on Oak Savanna Arthropods." American Midland Naturalist, 137 (1997): 349-61.

Taft, J.B. "The Role of Fire in Maintaining Plant Diversity in Oak Woodland Communities." Illinois Natural History Survey Reports, 357 (1999): 4-5.

Land management guidelines and policies

Japsen, E.N., K. Leigh, R. Sliwinski, and J. Anderson. Midwest Ecological Prescription Burn Manual. Christopher Burke Engineering, Ltd. 2001.

Smoke Management Techniques. RX-450. Boise, ID: National Interagency Fire Center, 1994

Wayne R Pauly. How to Manage Small Prairie Fires. Dane County, 1985. 117-139.

For an exhaustive list of pre-1995 references, see:

Henderson, Richard A. and Sandra H. Statz. "Bibliography of Fire Effects and Related Literature Applicable to the Ecosystems and Species of Wisconsin." Technical Bulletin No. 187 (1995). Madison: Wisconsin Department of Natural Resources

Northern Prairie Wildlife Research Center. Jamestown, ND. 3 February, 1998 <http://www.npwrc.usgs.gov/resource/literatr/firebibl/firebibl.htm>

Contributors to this Manuscript

The Woods Fund of Chicago and the Chicago Wilderness consortium provided funding for the development of these controlled burn policy recommendations. The work was undertaken by the Chicago Wilderness Conservation Policy Committee, with Steven Frankel of Audubon – Chicago Region serving as the principal editor. The principal contributors were the participants in the Chicago Wilderness teams for Science and Land Management. The following individuals were key contributors:

Jim Anderson, Natural Resource Manager, Lake County Forest Preserves
Roger Anderson, Professor of Biological Sciences, Illinois State University
Debbie Antlitz, Resource Ecologist 2, Forest Preserve District of Cook County
Leslie Berns, Natural Resources Supervisor, Forest Preserve District of DuPage County
Marlin Bowles, Plant Conservation Biologist, The Morton Arboretum
Nancy Braker, Agency Relations Director-Fire/Invasives, The Nature Conservancy - Wisconsin
Ed Collins, Restoration Ecologist, McHenry County Conservation District
Christopher Dunn, Director of Research, The Morton Arboretum
Jennifer Filipiak, Wildlife Biologist, Lake County Forest Preserves
Steven Frankel, Policy Coordinator, Audubon - Chicago Region
Bill Glass, Ecologist, USDA Forest Service
Donna Green, Team Leader for Environmental and Emergency Management, Argonne Area Office, U.S. Department of Energy
Ralph Grundel, Ecologist, U.S. Geologic Survey, Indiana Dunes National Lakeshore
Richard Henderson, Research Scientist, Wisconsin Department of Natural Resources
Dave Hodge, Restoration Ecologist, Turning Leaf Conservation
Ellen Jacquart, Director of Stewardship, The Nature Conservancy - Indiana

Ken Klick, Restoration Ecologist, Lake County Forest Preserves
Steve Marquardt, Environmental Engineer, U.S. Environmental Protection Agency
Dave Mauger, Land Management Program Coordinator, Forest Preserve District of Will County
Jeff Mengler, Botanist/Wetland Ecologist, U.S. Fish and Wildlife Service
Stephen Packard, Director, Audubon – Chicago Region
Ron Panzer, Conservation Biologist, Biology Department, Northeastern Illinois University
Noel Pavlovic, Ecologist, U.S. Geologic Survey, Great Lakes Science Center
Tom Post, Regional Ecologist, Indiana Department of Natural Resources
John Raudenbush, Resource Manager 4, Forest Preserve District of Cook County
Wayne Schennum, Research Field Station Manager, McHenry County Conservation District
Doug Short, Land Manager, Lake County Forest Preserves
James Steffen, Ecologist, Chicago Botanic Garden
Donna Twickler, Environmental Engineer, U.S. Environmental Protection Agency
Drew Ullberg, Director of Planning, Kane County Forest Preserve District
Rod Walton, Ecologist, Fermi National Accelerator Lab

Chicago Wilderness Executive Council Approval

This model policy paper was approved by the Executive Council of the Chicago Region Biodiversity Council (Chicago Wilderness) on November 19, 2003.

Members of the Executive Council as of October 7, 2003
Audubon- Chicago Region
Brookfield Zoo
Center for Neighborhood Technology
Chicago Academy of Sciences/Peggy Notebaert Nature Museum
Chicago Botanic Garden
Chicago Park District
Chicago Wilderness Corporate Council
City of Chicago, Department of Environment
Conservation Research Institute
DePaul University
Field Museum
Forest Preserve District of Cook County
Forest Preserve District of DuPage County
Forest Preserve District of Kane County
Forest Preserve District of Will County
Friends of the Chicago River
Geneva Lake Conservancy
Illinois Nature Preserves Commission
Illinois Dept. of Natural Resources
Illinois Endangered Species Protection Board
Illinois Natural History Survey
Indiana University Northwest

Kendall County Forest Preserve District
Lake County Forest Preserves (IL)
Lake County Parks & Recreation Dept. (IN)
Lincoln Park Zoo
Max McGraw Wildlife Foundation
McHenry County Conservation District
McHenry County Conservation Foundation
Morton Arboretum
Nature Conservancy - Illinois Chapter
NiSource Environmental Challenge Fund
Northeastern Illinois Planning Commission
Northwestern University Environmental Council
Openlands Project
Purdue University - Calumet
Shedd Aquarium
Sierra Club, Illinois Chapter
University of Illinois at Chicago
US Army Corps of Engineers
US Dept. of Energy, Argonne National Laboratory
US EPA, Region 5
US EPA Great Lakes National Program Office
USDA Forest Service
USDA Natural Resources Cons. Serv.
USDI Fish and Wildlife Service
USDI National Park Service
Village of Lake Barrington
Village of Lincolnshire
Waukegan Citizen's Advisory Group
Wheaton Park District