A Plan for the Recovery of the Greater Prairie-Chicken in Illinois

FINAL DRAFT

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A Plan for the Recovery of the Greater Prairie-Chicken in Illinois

Executive Summary

The Greater Prairie-chicken, once an abundant species in Illinois, is now endangered due to loss of grassland habitat. Prairie-chickens have large home ranges and use a variety of grassland habitats throughout the year. Therefore, conservation regimes for prairie-chickens tend to encompass the needs of many prairie species that require less area or fewer habitat resources. The State of Illinois has been involved in prairie-chicken preservation for over 60 years, yet prairie-chickens have declined by >90% during that time. A comprehensive plan for ensuring the recovery and long-term preservation of this signature bird of the Illinois tallgrass prairie is necessary.

Greater Prairie-chickens were abundant in the 19th century in much of central North America and throughout Illinois. Primarily due to habitat loss, populations of this species have continued to decline range-wide in the 20th century. In Illinois, a remnant population of about 200 birds persists at Prairie Ridge State Natural Area in Jasper and Marion counties. Much effort has been devoted to prairie-chicken conservation, and effective methods have been developed for monitoring populations, restoring and managing habitat, translocation, and controlling predators and nest parasites.

As a resident species, prairie-chickens require a variety of habitats throughout the year, including dense, mid-height nesting cover, weedy brood-rearing areas with abundant arthropods, tall roosting and escape cover, and foraging areas such as agricultural fields. Prairie-chickens are generally intolerant of woody vegetation and human structures. Nesting success and brood survival are the most important determinants of population growth. Prairie-chickens are well-known for the males'

elaborate communal breeding displays. A few males perform the majority of copulations on a lek, and this contributes to a high risk of inbreeding depression within small populations. For this and other reasons, a minimum viable population of prairie-chickens is probably >800 birds. Although prairie-chickens are quite mobile, they are not migratory and dispersal among populations isolated by distances >30 km (20 miles) is unlikely. Small "satellite" populations that serve as "stepping stones" to link isolated populations reduce the risk of genetic drift, stabilize population demographics, and increase effective population size by establishing a metapopulation structure.

A number of other prairie species are also Threatened or Endangered in Illinois, and achieving joint recovery of these species with prairie-chickens is attainable. This goal is consistent with the Illinois Department of Natural Resources' "ecosystem-based management" mission. At PRSNA, prairie-chicken management has provided crucial habitat for at least 44 species of special management concern. This plan identifies 60 species, including 23 Endangered and 10 Threatened in Illinois species, which will benefit from the actions described in this plan. The species most expected to benefit from recovery of the Greater Prairie-chicken include the Northern Harrier, Upland Sandpiper, Barn Owl, Short-eared Owl, and Henslow's Sparrow, all of which are Endangered in Illinois.

The goal of this recovery plan is to preserve the remnant Greater Prairie-chicken populations, restore and protect habitat, re-establish prairie-chickens in suitable habitat, and monitor population levels to ensure the long-term viability of prairie-chickens and associated prairie wildlife in Illinois. Four objectives, with tasks for completion, have been developed:

Objective 1. Ensure the long-term preservation of the remnant Greater Prairie-chicken populations at Prairie Ridge State Natural Area. Population criteria for this objective include >1,000 birds for 5 years.

Task 1. Establish and protect an additional 1,150 ha (2,840 acres) of grassland habitat at PRSNA in Jasper County and an additional 1,520 ha (3,750 acres) of grassland habitat at PRSNA in Marion County.

Task 2. Develop adequate equipment and staff to establish and manage lands administered as PRSNA. This task is to be completed concurrently with Task 1.

Task 3. Increase synergy of protected grassland and adjacent lands by developing cooperative agreements and incentive programs for private landowners.

Task 4. Establish grassland habitat at satellite locations through cooperative agreements, conservation easements, private land incentives, and/or land acquisition.

Task 5. Develop a program for monitoring prairie-chickens and other species at PRSNA. This task is to be completed concurrently with previously identified tasks.

Task 6. Develop wildlife viewing opportunities, outreach and conservation education programs, adequate visitor facilities, and other public uses compatible with the objectives of this plan at PRSNA. This task is to be completed concurrently with previously identified tasks.

Task 7. Classify the remnant prairie-chicken populations as secure when the habitat and population criteria for Objective 1 have been met.

Objective 2. Downlist the Greater Prairie-chicken to *Threatened in Illinois*, when the population is no longer in danger of extinction in Illinois. For this objective, >3,000 birds in 3 or more populations for 5 years are required. Progress on Objective 2 can be made after Objective 1 is met by completing Tasks 1 through 7.

Task 8. When Objective 1 is met, three categories of prairie-chicken habitat must be evaluated for promoting the next stage of recovery:

1. Opportunities for expanding available habitat at PRSNA.
2. Protecting and enhancing habitat naturally colonized by prairie-chickens during successful completion of Objective 1.
3. Translocation of prairie-chickens into existing, unoccupied grassland habitat unlikely to be colonized by natural dispersal.

Task 9. Develop habitat to support, and then establish additional geographically separate, significant prairie-chicken populations.

Task 10. Establish or enhance additional habitat for existing prairie-chicken populations to allow total population size to meet or exceed criteria for completing Objective 2.

Task 11. Downlist the Greater Prairie-chicken from *Endangered in Illinois* to *Threatened in Illinois* when habitat and population criteria for Objective 2 have been met.

Objective 3. Recovery of the Greater Prairie-chicken in Illinois is complete when the species is delisted and not likely to become endangered in Illinois in the foreseeable future. Population criteria for recovery are >5,000 birds in 5 or more populations for 10 years. Progress on Objective 3 can be made after Objective 2 is met through completion of Tasks 8 through 11.

Task 12. When Objective 2 is met, two categories of prairie-chicken habitat must be evaluated for promoting the next stage of recovery:

1. Opportunities for expanding available habitat at existing population locations.
2. Translocation of prairie-chickens into existing, unoccupied grassland habitat unlikely to be colonized by natural dispersal.

Task 13. Develop habitat to support, and then establish additional geographically separate, significant prairie-chicken populations.

Task 14. Establish or enhance additional habitat for existing prairie-chicken populations to allow total population size to meet or exceed criteria for completing Objective 3.

Task 15. Delist the Greater Prairie-chicken from *Threatened in Illinois* when habitat and population criteria for Objective 3 have been met.

Task 16. Monitor the recovered population of Greater Prairie-chickens in Illinois in perpetuity.

Objective 4. Achieve joint recovery of associated prairie species, while preventing the need to list additional prairie species as *Threatened or Endangered in Illinois*. Criteria for recovery will vary by species and should be determined on a case-by-case basis. Progress on Objective 4 should be made concurrently with meeting Objectives 1, 2 and 3, but should not delay accomplishment of these objectives.

Task 17. Evaluate the potential for and conduct reintroductions for species of special concern onto grassland habitat established for Greater Prairie-chicken recovery when colonization through natural dispersal is unlikely.

Task 18. Monitor responses of prairie species of special management concern on grasslands established or enhanced through prairie-chicken recovery.

A Plan for the Recovery of the Greater Prairie-chicken in Illinois

I Introduction

The Greater Prairie-chicken (*Tympanuchus cupido pinnatus*) is the signature bird of the tallgrass prairie. The presettlement distributions of this bird and this ecosystem were essentially identical (Figure 1A). At present, the Greater Prairie-chicken is an endangered species in Illinois. Throughout their range, prairie-chickens receive high conservation priority, particularly due to continuing population declines. The charismatic breeding displays of prairie-chickens help to garner broad-based public support for conservation efforts. Further, Greater Prairie-chickens have large home ranges and require a variety of grassland habitats throughout the year. For these reasons, the Greater Prairie-chicken is an excellent "umbrella species" for prairie conservation: regimes that sustain prairie-chickens are likely to encompass the needs of numerous other species that require smaller areas or fewer habitat resources.

The State of Illinois has been involved with preserving Greater Prairie-chickens in Illinois since 1940 when the first prairie-chicken refuge (Green River State Wildlife Area) was purchased. Prairie-chickens disappeared from this area and the Iroquois County State Wildlife Area (purchased in 1944) by 1960. Beginning in 1963, "sanctuaries" of grassland habitat were established in Jasper and Marion counties, known today as Prairie Ridge State Natural Area, where virtually all of the remaining prairie-chickens in Illinois occur (Figure 2D). In spite of these efforts, the prairie-chicken in Illinois has declined by >90% over the past 50 years.

The objective of this document is to establish a comprehensive framework for securing interests in the natural resources necessary to lead to the recovery of the

Greater Prairie-chicken in Illinois. Concomitant with this goal is improved conservation of the tallgrass prairie ecosystem.

II Taxonomy

The Greater Prairie-chicken, *Tympanuchus cupido*, is a species of grouse native to the tallgrass prairies of North America. Other common names for this bird are Pinnated Grouse, Prairie Grouse, and Prairie Hen. Two other extant species are in the genus *Tympanuchus*. The Sharp-tailed Grouse, *T. phasianellus,* is found in the northern Great Plains and Canada, and the Lesser Prairie-chicken, *T. pallidicinctus,* occurs in the southern Great Plains. There are three subspecies of Greater Prairie-chicken. The Heath Hen, *T. c. cupido,* occurred in coastal New England grasslands, but became extinct in 1932. Attwater's Prairie-chicken, *T. c. attwateri*, is Federally endangered and occurs on the coastal prairies of Texas. The Greater Prairie-chicken, *T. c. pinnatus,* exists in 11 states in the Midwest & Great Plains (Schroeder and Robb 1993, Westemeier and Gough 1999). *T. c. pinnatus* is the taxon occurring in Illinois, although Sharp-tailed Grouse were present in northern Illinois prior to 1870 (Bohlen 1989).

Greater Prairie-chicken X Sharp-tailed Grouse hybrids have been documented from several locations (Schroeder and Robb 1993). Typical hybridization rates where these two species come into contact are ~ 1%, although hybridization rates can exceed 50%. In areas of sympatry with Sharp-tailed Grouse, Greater Prairie-chickens tend to be adversely affected by hybridization and competition (Sparling 1980). One Greater Prairie-chicken X Ring-necked Pheasant (*Phasianus colchicus*) hybrid has been reported (Lincoln 1950).

III Description

Greater Prairie-chickens are medium-sized grouse (420-470 mm total length), slightly larger than Sharp-tailed Grouse and Lesser Prairie-chickens, and smaller than Ring-necked Pheasants. Males and females are nearly identical in plumage, which is extensively barred with brown, buff and black. The abdomen is buffy, and the undertail coverts are whitish. Tarsi are feathered to the toes. The tail is short, rounded, and black. Both genders have tufts of elongated feathers on the side of the neck ("*pinnae*"), but pinnae are considerably longer in males (70 mm) than females (38 mm). Males possess conspicuous yellow combs above the eyes and yellow-orange, scarlet-edged esophageal air sacs ("*tympani*") on the sides of the neck that are exposed and expanded during breeding displays. Males generally weigh 900 to 1,100 g, and females 750 to 950 g (from Johnsgard 1983 and Schroeder and Robb 1993).

IV Status

A. Historical Occurrence

North America. Prior to extensive European settlement, the Greater Prairie-chicken is presumed to have occurred in suitable open, tallgrass prairie habitats extending from eastern Indiana westward to roughly the 100th meridian, and from southern Minnesota, southward to northeast Texas (Schroeder and Robb 1993; Svedarsky et al. 2000; Figure 1A). There is little evidence of the abundance of Greater Prairie-chickens on the eastern tallgrass prairie in prehistoric times, but populations were likely dynamic in space and time, responding to particular habitat conditions created by fire, grazing, drought, and succession.

As European settlement cleared eastern and northern forests, introduced high-energy grains to landscapes, and decimated the herds of bison (*Bison bison*) on the Great Plains, the Greater Prairie-chicken increased tremendously in range and abundance. The prairie-chicken range extended from Ontario and Ohio westward to eastern Colorado, and from central Texas northward to southern Canada (Schroeder and Robb 1993; Svedarsky et al. 2000; Figure 1B). Peak abundance of Greater Prairie-chickens followed settlement to the west and north; peak abundance was circa 1860 in Illinois, 1880 in Iowa, and early 1900s in Colorado and southern Canada (Westemeier and Edwards 1987, Hjertaas et al. 1993, Svedarsky et al. 2000). After this period of expansion, the range and abundance of prairie-chickens contracted as grasslands were extensively converted to cropland and utilized more intensively.

Illinois. Greater Prairie-chickens are presumed to have occurred on most of the 21 million acres of tallgrass prairie in Illinois prior to 1800 (Westemeier 1985). As forested areas were cleared for agriculture, prairie-chickens expanded to all 102 of Illinois' counties. Peak abundance of 10 to 14 million birds from 1850-1860 coincided with extensive remnant prairies and interspersed high-energy grains. The abundance of prairie-chickens during this period is legendary. H. Clay Merritt, a market hunter in central Illinois, claimed in the 1860s, "I saw in October more birds rise out of a forty acre field than all the cities in the Union could consume in a month." Shipments of harvested prairie-chickens from Chicago to the eastern cities and Europe were measured in "cords" and "tons," and numbered in the hundreds of thousands of birds each year (Westemeier 1985).

Populations decreased after the advent of the steel plow and clay drainage tile, which allowed extensive conversion of prairie to cropland. Prairie-chickens were still found in at least 74 counties in 1912 (Forbes 1912; Figure 2A). An estimated 25,000 birds remained when the hunting season was closed in 1933. In 1940, the Greater Prairie-chicken in Illinois was restricted to about 50 square miles (130 km^2) of sand prairie along the Green River in Lee County, 2,600 square miles (6,740 km^2) in the redtop-farming district in southeastern Illinois, and a few flocks in northern Illinois and the Kankakee watershed (Yeatter 1943; Figure 2B). Approximately 2,000 birds remained in southeastern and south-central Illinois in 1962 (Ellis 1964; Figure 2C), but declined to <400 by 1966 (Sanderson and Edwards 1966).

B. Current Status & Abundance

North America. Greater Prairie-chicken population trends are well-monitored by surveys of leks in spring. By measuring males/lek, lek density, or male density, population trends are estimated. In many cases, the small, fragmented range of the species allows a more-or-less complete census of males in entire regions or states (see Svedarsky et al. 1999a). Further, range-wide status evaluations have been made at roughly 10-year intervals (Christisen 1969, Westemeier 1980, Gough 1990, Svedarsky et al. 2000).

Greater Prairie-chickens have been extirpated from Canada (Hjertaas et al. 1993), but still exist in 11 states (Figure 1C). Hunted populations exist in Colorado, Kansas, Nebraska, and South Dakota; modern annual harvests are around 60,000 birds (combined; from Westemeier and Gough 1999). The species is listed as *state threatened* in North Dakota and Wisconsin, and *state endangered* in Illinois and

Missouri (Svedarsky et al. 1999a). The estimated global population of Greater Prairie-chickens has declined from 1,079,000 in 1968 to 391,000 in 1997 (from Westemeier and Gough 1999).

Illinois. Greater Prairie-chickens are almost entirely limited to 1,330 ha (3,300 acres) of state-managed grasslands at Prairie Ridge State Natural Area in Jasper and Marion counties. A few individuals have been reported in recent years from Clay, Effingham, Marion, Washington and White counties, but are not persistent populations (Figure 2D). Spring 2002 censuses estimate 150 birds remain in Illinois (S. Simpson, personal communication). An all-time population low of <50 birds was recorded in 1994. The present recovery has followed translocations of birds from Kansas, Nebraska and Minnesota (Westemeier et al. 1998a) and establishment of nearly 550 ha (1,250 acres) of additional grassland habitat at PRSNA since 1995.

C. Reasons for Current Status

Habitat loss & degradation. The loss of suitable grassland habitat is the overwhelming factor responsible for population declines and range contraction of Greater Praire-chickens (Svedarsky et al. 2000). Within Illinois, only 1,330 ha (3,300 acres) of high-quality grassland habitat are available for the remnant prairie-chicken flocks. Intensifying agricultural practices are also implicated. Prairie-chickens persisted through the early 20th century in southeastern Illinois in areas farmed for redtop bentgrass (*Agrostis alba*) seed production, but declined as this crop was eliminated in favor of rowcrops and legume hays that are harvested during the prairie-chicken nesting season (Yeatter 1963). Near grasslands managed for nesting prairie-chickens, pasture, hayfields, small grains and idle grasslands have largely been converted to rowcrops (Sanderson et al. 1973, Simpson and Esker 1997). These habitats are potentially valuable for brood-rearing, roosting and nesting. Further, agrochemicals have greatly reduced populations of arthopods in agricultural areas, and this change has been implicated in reducing survival of Ring-necked Pheasant chicks, an ecologically-similar species (Basore et al. 1987, Warner et al. 1999). In other states, haying regimes and intensive grazing have contributed to Greater Prairie-chicken population declines (Svedarsky et al. 1999a).

Hunting & poaching. In the 19th century, prairie-chicken populations were exploited by market hunters. In many states, earliest game laws were enacted to control the slaughter of prairie-chickens. Only four states currently allow hunting of prairie-chickens, all of which restrict harvest through season length and relatively small bag limits. Illinois permanently closed the prairie-chicken hunting season in 1933.

Currently, poaching is not perceived as a threat to Illinois' remnant prairie-chicken flocks. This is attributed to (1) very low chance of encountering the species, (2) few upland game hunters afield in areas where prairie-chickens might be encountered, due to lack of habitat on private land, and (3) a sense of protectionism for the remnant birds among local residents (S. Simpson, personal communication).

Nest & brood predators. Agricultural landscapes often host large populations of generalist, mid-sized, mammalian predators, which benefit from humans through additional den sites and alternate food sources. At PRSNA, predators destroyed roughly 27% of prairie-chicken nests from 1963-1972, but this increased to 53% nest predation from 1973-1981 (R. Westemeier, unpublished data).

Ring-necked Pheasants. Extirpation of Greater Prairie-chickens from many areas in the early 20th century actually pre-dated the elimination of suitable grassland habitat. These local extinction events were often correlated with the local establishment of ring-necked pheasants (Calahane et al. 1942, Sharp 1957). At PRSNA in Jasper County, pheasants became established around 1970 and quickly increased in abundance (Vance and Westemeier 1979). Male pheasants were observed disrupting male prairie-chickens on leks, and female pheasants laid eggs in prairie-chicken nests. Pheasant eggs require about 23 days of incubation to hatch, versus 25 days for prairie-chicken eggs. In several instances, prairie-chicken hens incubated mixed-species clutches until the pheasant eggs hatched, and abandoned many or all of their own eggs prior to hatching. By 1983, 43% of prairie-chicken nests contained pheasant eggs. Greater Prairie-chicken nests containing pheasant eggs suffer lower egg success and higher abandonment than unparasitized nests (Westemeier et al. 1998c).

Genetic inbreeding & Demographic constraints. Due to chronic small population size and isolation, the remnant flocks of Greater Prairie-chickens in Illinois showed signs of inbreeding depression after 1980. Fitness, as indexed by egg success, dropped from 91-100% in the 1960s to 38% in 1990 (Westemeier et al. 1998a). Bouzat et al. (1998) showed that Greater Prairie-chicken specimens collected in Illinois after 1974 were genetically impoverished compared to specimens from Kansas, Minnesota and Nebraska, and compared to specimens collected in Jasper County, Illinois, in the 1930s and 1960s. In 1994, <50 prairie-chickens remained in Illinois, suggesting demographic constraints (such as imbalanced gender ratios and the amplified importance of individual dispersal, mortality and nest failure events, due to small population size) were as threatening to the remnant populations as genetic inbreeding.

Disease. Disease is another factor that has been implicated in causing declines of Greater Prairie-chickens in Illinois. A 500,000-hen egg production facility came on-line near Farina in Marion County in 1987, and domestic chicken manure was applied to cropland surrounding PRSNA grasslands (Westemeier et al. 1999). Males at leks associated with three grasslands near this site totaled 28 birds in 1987, decreasing to 9 birds in 1988, and 1 bird in 1989. At leks >6 km from this facility, prairie-chickens numbered 31 in 1987, 28 in 1988 and 16 in 1989 (S. Simpson, personal communication). Wintering waterfowl have been implicated as possibly transmitting cestode, nematode and trematode endoparasites to Attwater's Prairie-chickens in Texas (Silvy et al. 1999). Avian cholera occasionally affects waterfowl concentrations and presumably would adversely affect local prairie grouse populations. In Jasper County, Illinois, Newton Lake filled in the mid-1970s, and often hosts >10,000 migrant

and wintering waterfowl. Thus far, waterfowl-born disease has not been implicated as a problem for prairie-chickens at PRSNA.

Other. Many factors have been identified as mortality factors for Greater Prairie-chickens. Oil extraction at PRSNA in Jasper County has prompted concern since oil can be transferred from feathers of incubating females to eggs, causing embryo mortality. Prairie-chickens have been killed flying into utility lines, particularly during foggy conditions (Rubin 1994, R. Jansen and S. Simpson, personal communications). Collisions with utility lines have been recorded in several states, and may cause 10% annual mortality in some areas (J. Toepfer, fide S. Simpson). Human disturbance is another factor that can cause Greater Prairie-chicken declines. Researchers and managers are advised not to disturb prairie-chickens during nest-site selection, egg-laying, and early brood-rearing stages (Westemeier and Gough 1999), although females are apparently quite tolerant of disturbance during incubation (Westemeier et al. 1998b). Greater Prairie-chicken leks have significantly less residential-farmstead area nearby compared to random locations, and leks are not within 1.6 km (1 mile) of towns (Merrill et al. 1999). Although uncontrollable, weather can have a great influence on Greater Prairie-chicken population dynamics. At PRSNA, egg success is negatively correlated with May precipitation (Westemeier et al. 1998a). Likewise, cold and wet weather causes high mortality of recently hatched prairie-chickens. Winter weather is not generally considered a decimating factor for prairie-chickens (Kirsch 1974), except perhaps when food and cover are covered by ice-crusted snow (S. Simpson, personal communication).

D. Conservation Measures

Illinois. A variety of measures have been employed to conserve Greater Prairie-chickens in Illinois, including regulated harvest/closed seasons, population monitoring, acquisition and management of refuges, long-term ecological research, a reintroduction attempt, predator control, pheasant control, genetic and demographic enhancement through translocations, and habitat incentives for private lands.

Seasons were established for hunting prairie-chickens in Illinois in 1887. A 5- to 15-day hunting season with a daily bag limit of 3 birds was closed in 1933, and has remained closed since. Yeatter (1943) thought a closed season would prolong the existence of scattered flocks in northern Illinois, and had allowed the expansion of the range of prairie-chickens in southeastern Illinois.

Prairie-chicken populations in Illinois have been monitored fairly well since 1900. Population estimates and/or range descriptions of Greater Prairie-chickens in Illinois were made in 1912 (Forbes 1912), 1933 (Lockhart, undated), 1940 (Yeatter 1943), and 1962 (Ellis 1964). Since 1963, annual censuses have been made of males attending all known leks (booming grounds) within Illinois (e.g., Westemeier et al. 1998a; S. Simpson, personal communication); thus continuous population estimates are available for the past 40 years (Figure 3).

The first public-owned prairie-chicken refuge in Illinois was the Green River State Wildlife Area in Lee County. This 653-ha (1,612 acres) sand prairie site was purchased in 1940, and expanded to 943 ha (2,330 acres) by 1947. The Illinois Department of Conservation also purchased the 840-ha (2,077 acres) Iroquois County State Wildlife

Area in 1944. Apparently due to multiple use programs, Greater Prairie-chickens were extirpated from both areas by about 1960 (Westemeier 1985).

An attempt by Southern Illinois University to reestablish a population of Greater Prairie-chickens on strip mine lands in Perry and Randolph counties, Illinois, took place in 1979 (Sparling 1979; Fig 4). Prairie-chickens were captured in early February in feeding fields in Kansas, and held in pens until release in late March. Only 35 birds survived or were in suitable condition for release of 57 captured. The release failed to establish a lek or produce any evidence of a nest attempt. No birds were observed 5 weeks after the release.

The Illinois Prairie-Chicken Sanctuaries, now known as Prairie Ridge State Natural Area (PRSNA), were established beginning in 1962 in Jasper and Marion counties. Prairie-chickens had persisted in southeastern Illinois, particularly due to farming of redtop bentgrass for seed (as a cash crop) and hay. These "sanctuaries" of nesting habitat were purchased by the Prairie Chicken Foundation of Illinois (disbanded), The Nature Conservancy, Illinois Audubon Society, Central Illinois Public Service Company (now AmerenCIPS), and the Illinois Department of Natural Resources (formerly the Illinois Department of Conservation). PRSNA grasslands are seeded and managed in large part to mimic the vegetation structure resulting from redtop farming (Sanderson et al. 1973). To date, about 1,330 ha (3,300 acres) of grassland habitat have been established as PRSNA. The last remaining populations of Greater Prairie-chickens in Illinois are associated with PRSNA grasslands.

Researchers affiliated with the Illinois Natural History Survey have investigated the ecology of Greater Prairie-chickens. Remnant flocks in Jasper County have been

the focus of nearly continuous research since 1935 (e.g., Yeatter 1943, 1963; Buhnerkempe et al. 1984; Westemeier et al. 1998a). This work has resulted in highly effective management regimes for prairie-chicken nesting habitat.

In response to a critically low population size of prairie-chickens and indications of high rates of nest predation, mammalian predators have been controlled at PRSNA since 1988. Traps are placed in grasslands where prairie-chicken nests are presumed to be especially concentrated, and predators are removed from mid-March to early June. Roughly 85 predators are removed from each county (Jasper and Marion) annually, primarily opossums (*Didelphis virginianus*; 70%), raccoons (*Procyon lotor*; 15% and striped skunks (*Mephitis mephitis*; 10%). Nest predators are also controlled at PRSNA through removal of den sites and wooded travel corridors (S. Simpson, personal communication). This predator control program aims to improve nesting success of several species of ground-nesting birds, including threatened and endangered species. Success of 20 prairie-chicken nests from 1997-2000 was 55% (E.L. Kershner and J. W. Walk, unpublished data).

An aggressive pheasant control program began in 1987, and pheasants have been shot opportunistically since. Strips of tall, rank grass (especially switchgrass, *Panicum virgatum*) are maintained to concentrate pheasants during periods of snow cover and facilitate control (Westemeier 1988). The management goal is to maintain pheasant populations below 10 crowing males on and near PRSNA grasslands in each county (Simpson and Esker 1997). Only one instance of pheasant parasitism of a prairie-chicken nest has been reported since 1988 (Westemeier et al. 1998c, Walk et al. 1999).

Due to isolation and chronically-low population levels, the remnant flocks of Greater prairie-chickens began to show signs of inbreeding depression and reduced fitness by 1980 (Westemeier et al. 1998a). A small-scale attempt was made to exchange genetic material between the Jasper and Marion county units of PRSNA in 1990, when two clutches of eggs were successfully swapped between prairie-chicken nests being incubated in each county (Westemeier et al. 1991). The populations, separated by about 70 km (45 miles) were presumed to be sufficiently isolated to prevent exchange of individuals. By 1994, fewer than 50 prairie-chickens remained in Illinois, and the population faced eminent extinction due to genetic and demographic problems. From 1992-1998, 518 Greater Prairie-chickens were translocated to Illinois from Minnesota, Kansas and Nebraska. Egg fertility returned to normal levels (>90%) following translocations, and this action appears to have rescued the populations in the short-term (Westemeier et al. 1998a, Westemeier et al. 1999).

Recently, private land near PRSNA in Jasper and Marion counties has been a Conservation Priority Area for the Conservation Reserve Program (CRP). The CRP pays landowners to remove environmentally sensitive lands from crop production and establish grassland cover for 10- or 15-year periods. Private land near PRSNA is given 25 bonus points during contract sign-up periods, which increases the likelihood that bids are accepted (S. Simpson, personal communication). How landowners will respond to this initiative, and how prairie wildlife will benefit from these privately-managed tracts, have yet to be determined.

Other States. Adjacent states have utilized many of the same conservation measures as Illinois. Wisconsin, Iowa and Missouri all have Greater Prairie-chicken

populations that (1) are protected from hunting, (2) are monitored annually by censuses of displaying males, (3) are supported at least in part by publicly-owned and –managed grasslands, (4) are subject to considerable research attention, and (5) have been augmented or established with translocated birds. Indiana does not have an extant population of prairie-chickens, but is evaluating the potential for reintroduction.

In Wisconsin, about 10,000 ha of public lands are managed in whole or in part for Greater Prairie-chickens (Anderson and Toepfer 1999, Keir 1999). The spring 1998 population was estimated at 1,200 birds (Westemeier and Gough 1999). A reintroduction of wild and pen-reared birds (1974-1978) was initially successful in the Crex Meadows Wildlife Area (Toepfer 1988), but the population was gone by 1992 due to habitat deterioration (Anderson and Toepfer 1999). Prairie-chicken research has been particularly active in Wisconsin, with the long-term efforts of Fred and Frances Hamerstrom (e.g., Hamerstrom and Hamerstrom 1973; see Anderson and Gawlik 1999).

Iowa's native prairie-chickens were extirpated around 1952. A reintroduction attempt in the early 1980s failed to establish a population in south-central Iowa. A second reintroduction program began in 1987, supported by a 300 ha (750 acres) of public grassland, "thousands of acres" of CRP grasslands, and 500+ ha of high-quality habitat in adjacent north-central Missouri (Moe 1999). In the spring of 1998, an estimated 200 birds were present in south-central Iowa (Westemeier and Gough 1999). The Kellerton Bird Conservation Area is a public-private project for ensuring long-term habitat availability for Greater Prairie-chickens and other prairie wildlife near the reintroduction site. Currently, this 4,170 ha (10,300 acre) landscape is 70% grassland,

25% cropland and 5% woodland. The Iowa Department of Natural Resources is to acquire 830 ha (2,050 acres). CRP and Wildlife Habitat Incentives Program (WHIP) will be used to improve habitat on at least 1,000 ha (2,470 acres) of private land (Moe 1999).

Missouri has about 6,700 ha (16,550 acres) of publicly owned prairie (Mechlin 1991). The spring 1998 statewide population was about 1,000 prairie-chickens (Westemeier and Gough 1999). Plans call for additional public acquisition of 3,077 ha (7,600 acres) of Greater Prairie-chicken habitat (Mechlin 1991). The Missouri Department of Conservation has created the "Partners for Prairie Wildlife" program to improve habitat for prairie-chickens and other prairie species on private lands. The program includes provisions for tree removal to reduce fragmentation of grasslands, establishment of permanent and temporary grasslands, and conversion of fescue (*Festuca elatior*) to other, more beneficial grasses (Mechlin et al. 1999).

Prairie-chickens were extirpated from Indiana by 1972 (Mumford and Keller 1984). At present, Indiana is evaluating potential reintroduction sites, including the Kankakee Sands Project Area in northwestern Indiana (2,900 ha or 7,163 acres) and reclaimed strip mine lands in southwestern Indiana, which are roughly 100 km (60 miles) from the remnant Illinois population at PRSNA in Jasper County (Castrale 2001). Nearly 17,000 ha (42,000 acres) of reclaimed strip mine grassland occur in southwestern Indiana, including 7 sites with >1,000 ha (2,470 ha) of grassland (Bajema et al. 2001).

E. Recovery Potential

Throughout the species' range, suitable habitat limits the abundance and distribution of Greater Prairie-chickens (see Svedarsky et al. 1999a). Prairie-chickens have also responded favorably to a number of conservation actions in Illinois and other states, including habitat establishment and management. Effective methods for controlling pheasants (as brood parasites and competitors) and predators have been established in Illinois (Westemeier 1988, Simpson and Esker 1997). Recently, much more effective protocols for capturing and releasing Greater Prairie-chickens to augment or establish populations have been developed (Toepfer et al. 1988). Prairie-chickens are adaptable to a range of grassland types and readily utilize agricultural lands for many life history needs. The recovery potential of this species is very good, and appears to be limited only by human motivation to provide adequate habitat.

Habitat establishment. There are numerous well-documented cases of Greater Prairie-chickens increasing in abundance following creation of habitat. In Illinois, prairie-chicken numbers increased following the establishment of secure nesting cover (Sanderson et al. 1973). Prairie-chickens are found nesting as early as the second or third growing season following planting, and use grasslands in their first growing season as brooding habitat (Kershner 2001). Extensive grasslands established by the Conservation Reserve Program have been colonized by Greater Prairie-chickens in Colorado, Iowa, Minnesota, Nebraska, and South Dakota (Svedarsky et al. 2000). Incidentally, these five states have had stable or increasing prairie-chicken populations over the past 20 years. In contrast, prairie-chickens have declined in 5 of 6 states where significant CRP grasslands have not been available (Svedarsky et al. 2000).

Habitat management. As with habitat establishment, prairie-chickens respond well to habitat management. In Illinois, prairie-chickens have persisted on a very small habitat base for 30 years due to intensive management of these grasslands (Simpson and Esker 1997). Similarly, managers in Wisconsin have maintained stable populations of prairie-chickens for 50 years through active management of grasslands (Anderson and Toepfer 1999). Effective management regimes are discussed in detail below.

Translocation. Toepfer et al. (1990) evaluated 40 attempts to establish populations of prairie grouse (*Tympanuchus spp.*) since 1950. Almost all failed to establish persistent populations. Lack of suitable habitat at release sites, failure to account for dispersal patterns of this genus, and poor documentation of results were notable deficiencies.

Since 1985, successful translocations have been conducted in Colorado, Illinois, Iowa, Missouri, and North Dakota (Svedarsky et al. 1999a). These translocations involved large numbers of birds translocated over a several year period and/or release of birds during molting to reduce dispersal. Techniques for translocating prairie-chickens are discussed in detail below.

Species adaptability. The Greater Prairie-chicken is a bird of the tallgrass prairie, and persists on large remnant fragments of this ecosystem in Kansas, Missouri, Nebraska, North Dakota, Oklahoma, and South Dakota (Svedarsky et al. 1999a). However, prairie-chickens will utilize a variety of grassland types. In Illinois, prairie-chickens thrived for decades on the "substitute prairie" created by redtop bentgrass meadows in southeastern Illinois (Westemeier 1985). In Wisconsin, forest clearing followed by fire resulted in extensive sedge (*Carex spp.*) and bluegrass (*Poa spp.*)

regions where prairie-chickens have persisted for a century (Anderson and Toepfer 1999).

Greater Prairie-chickens also readily utilize agricultural lands. Indeed, the introduction of grain to the tallgrass prairie was likely a major reason for the dramatic abundance of prairie-chickens following European settlement (Westemeier 1985, Svedarsky et al. 1999a). In Illinois, cropland near PRSNA is used extensively by prairie-chickens for foraging (Rubin 1994). The design of prairie-chicken reserves in Wisconsin (Hamerstom et al. 1957) and Illinois (Sanderson et al. 1973) depends upon prairie-chickens utilizing agricultural lands surrounding protected nesting habitat for brood-rearing, foraging and displaying.

Just as excessive conversion of prairie to cropland caused prairie-chicken declines from 1860-1900, agricultural intensification results in these lands providing fewer life history needs of prairie-chickens. In particular, brood-rearing habitat must now be created on reserves, effectively reducing the amount of nesting habitat they can provide (Simpson and Esker 1997). It has long been recognized that intensified agricultural land use would increase the size of reserves necessary to maintain an equal number of prairie-chickens (Yeatter 1943, Sanderson et al. 1973).

Habitat Suitability Index model. A habitat suitability index model has been developed for the Greater Prairie-chicken (Prose 1985). The model considers 520 ha (1,280 acres), located within 20.7 km (8 square miles), in blocks >0.8 km (>0.5 mile) wide, as a minimum amount of prairie-chicken habitat. Only two life history requisites are included: winter food and nesting cover. Optimum winter food is provided by unharvested or untilled stubble of corn or sorghum within 1.6 km (1.0 mile) of nesting

cover. Optimum nesting cover is defined as grassland, pasture and hayland, and herbaceous wetland habitat, with a visual obstruction reading (a measure of vegetation height and density; Robel et al. 1970b) of 2.0 to 3.0 dm at the beginning of the nesting season, within 1.6 km (1.0 mile) of winter food.

There are no published accounts of this HSI model being implemented, thus its validity cannot be evaluated. However, a number of problems are apparent. The model does not include any minimum viable population guidelines. The grassland area requirements were based on information from Illinois, Indiana, Michigan and North Dakota. Yet, Greater Prairie-chickens have been extirpated from two of these states (Indian, Michigan) and rescued from extirpation by translocations in the other two states (Illinois, North Dakota). This strongly suggests the HSI model grossly underestimates the spatial requirements of a viable population of Greater Prairie-chickens.

V Ecology & Management of Greater Prairie-chickens

A. Life History

General. The Greater Prairie-chicken is a characteristic bird of tallgrass and mixed-grass prairie ecosystems. In historic times, prairie-chickens may have been somewhat migratory and mast in savannah and open woodlands may have been important winter foods. At present, prairie-chickens are generally considered residents throughout their range, and waste grain is a key winter food source. Populations often fluctuate greatly in response to habitat and environmental conditions. Nesting success and brood survival are generally the factors limiting population growth rates (Wisdom and Mills 1997).

Mating System. Greater Prairie-chickens are an arena or "lek" breeding species. This is a rare mating system, found in <3% of bird species. Males defend relatively small territories (mean 518 m^2) aggregated on a lek (or "booming ground"). Booming grounds may range from 2-70 males, although 8 to 9 males is average. Few dominant males hold central territories, and perform 70-90% of copulations. To attract females, males perform an elaborate display involving erecting their pinnae, inflating their typani, drooping their wings, and giving a deep, resonating sound ("*whhooo-doo-doooohh*"), or "booming" while stamping their feet. This booming sound can be heard >1.6 km (1 mile) in calm weather. A variety of other vocalizations (*cluck, whine, whoop, cackle*) and displays (flutter jumps, bowing, and aggressive displays among males) are made (Johnsgard 1983, Schroeder and Robb 1993).

Males attend leks sporadically during the fall and winter. In late winter, male attendance increases and displaying becomes more intense. Booming in Illinois is most intense in March and April, beginning at dawn until a few hours after sunrise. A less intense display period typically occurs late in the afternoon. Females primarily attend leks from late-March to mid-April.

Nesting & brood-rearing. Following copulation, females nest and raise the young without assistance from the male. Female prairie-chickens nest on the ground at well-drained sites. Nest sites are typically within 1.6 km (1 mile) of a lek (Hamerstrom and Hamerstrom 1973, Drobney and Sparrowe 1977). Females lay 1 egg per day in the nest; average clutch size in Illinois is 12.3 eggs (Yeatter 1943). Incubation lasts approximately 25 days, and hatching may take 1-2 days. Hatching success of eggs is normally ~90% (Yeatter 1943), but decreases to <40% in inbred populations

(Westemeier et al. 1998a). Hens will renest if first nests are destroyed, but are only known to raise a single brood per season (Schroeder and Robb 1993).

Recently hatched prairie-chickens are precocial and leave the nest with the hen shortly after hatching. Females lead broods to secure habitat with foraging resources; young broods typically move 0.3 km (0.2 mile) and older broods may move 2 km (1.2 miles) daily. Chicks move and locate food on their own, and are brooded by females frequently during the first 2 weeks. Chicks grow rapidly, and can perform weak flights by 2 weeks and strong flights of 35 m at 3 weeks. Broods break up when young birds are 80-84 days old (Schroeder and Robb 1993).

Foods & water. Prairie-chickens are known to eat leaves, buds, fruits, and seeds of a variety of plants, as well as invertebrates. For young prairie-chickens, access to an abundance of high-protein invertebrates is crucial for development. Yeatter (1943) found grasshoppers were a particularly important food item for juvenile prairie-chickens during summer, as were dewberries (*Rubus villosus*), wheat and other seeds. For adults during summer, plant matter makes up 90% of the diet, particularly seeds and fruits (Yeatter 1943). Through the winter, grain comprises up to 90% of the diet. Corn and sorghum are preferred grains. Water from foods and dew is usually adequate for prairie-chickens, although drinking from ponds and livestock tanks has been observed (Schroeder and Robb 1993).

Survival. Nest success averages 44% for Greater Prairie-chickens (Schroeder and Robb 1993). In Illinois, success was 73% 1963-1972 (n = 292 nests), and 47% from 1973-1981 (n = 401 nests; R. Westemeier, unpublished data). Success of 20 nests located 1997-2000 was 55% (E. Kershner and J. Walk, unpublished data). Brood

survival ranges from 15% to 65% (Baker 1953, Horak 1985, Svdarsky 1988). Together, nest success and brood survival are the most important determinants of prairie-chicken population growth rates (Wisdom and Mills 1997). Annually, 48% to 65% of females successfully produce a brood (Schroeder and Robb 1993). Annual survival rates range from 40% to 50% for yearlings and adults (Hamerstrom and Hamerstrom 1973).

Home range & movements. Relative to other gallinaceous birds, prairie grouse (*Tympanuchus spp.*) are highly mobile, and sustained flights of >11 km (7 miles) have been recorded. Home ranges and daily movements are considerably smaller during the summer than winter. Adult males had home ranges of 32 ha (79 acres) in August, but 513 ha (1,267 acres) in March (Robel et al. 1970a). In Minnesota, prelaying female prairie-chickens had the largest home ranges (82 ha, 200 acres) whereas home ranges of hens with broods were 11 to 18 ha (27 to 44 acres; Svedarsky 1988).

Juveniles tend to disperse from their natal area in the fall and spring. Hamerstrom and Hamerstrom (1949) reported a female recovered 47 km (29 miles) from her natal area during her first autumn. Nearly half of all juvenile females move >8 km (5 miles) from their wintering to first breeding areas, whereas just 7% of males move to this extent (Hamerstrom and Hamerstrom 1973). Adults tend to show high fidelity to leks and nesting areas among years (Schroeder and Robb 1993).

B. Habitat & Habitat Management

Leks (booming grounds). Leks are typically situated in open areas with short or no vegetation. Frequently, booming grounds are on ridges or other elevations. These sites allow males to see and be seen by female prairie-chickens and predators. Habitats used for booming grounds include recently burned, heavily grazed and closely mowed grassland, tilled fields, soybean stubble, and wheat plantings. Lek sites should be at least 4 ha (10 acres), and essentially treeless within 1 km (0.6 mile).

Lek sites are positively correlated with grassland and negatively correlated with forest and rowcrop land cover within 1.6 to 2.4 km (1 to 1.5 miles; Merrill et al. 1999, Niemuth 2000). Prairie-chickens also avoid lek sites near farmsteads, residential areas, and towns (Merrill et al. 1999). Leks in Illinois 1994-2001 have been >0.4 km (0.25 mile) from public roads, although ~70% of the PRSNA landscape is within 0.4 km of a public road (J. Walk, personal observation).

Nesting. Nest sites of Greater Prairie-chickens are usually in well-drained locations, relatively near booming grounds, in vegetation with a dense upright structure and residual litter. Nesting vegetation is a dynamic habitat created by periodic disturbance. Recently burned and heavily grazed areas provide too little litter and/or too little cover for nesting. Undisturbed sites with vegetation >1 m (39 inches) and excessive litter build-up are unsuitable for nesting (Yeatter 1943, Westemeier 1973, Kirsch 1974, Drobney and Sparrowe 1977, Westemeier and Buhnerkempe 1983, Buhnerkempe et al. 1984, Horak 1985). Prose (1985) described optimal nesting habitat as grassland, hay/pasture or herbaceous wetland vegetation with a visual obstruction reading (VOR; Robel et al. 1970b) of 2.0 to 3.0 dm (8 to 12 inches). Vegetation with

VOR less than 0.5 dm (2 inches) or greater than 5.0 dm (20 inches) is unsuitable as nesting habitat.

McKee et al. (1998) found success at nest sites with >25% litter cover was one-half success at sites with <25% litter cover. Nest success also declined when woody cover exceeded 5%, when forb cover was <5% and grass cover was <25%. Success was not related to distance to trees. Nests located in agricultural grasslands (e.g., hayfields) had significantly lower success than nests located in native prairies and mixed native-nonnative grass pastures (Ryan et al. 1998). Further, nesting success tended to be lower in a prairie-agriculture mosaic landscape than a contiguous prairie landscape. Svedarsky (1988) observed somewhat higher nest success in nonnative grasses (particularly smooth brome, *Bromus inermis*) than native grass habitats. This was due to more brush clumps in native habitats, which negatively affected nest success, as did excessive litter. In Illinois, nest success is lower in management units with higher nest densities (Buhnerkempe et al. 1984).

Suitable nesting habitat is apparently determined by vegetation structure, location and landscape context; plant species appears to be unimportant (Hamerstrom et al. 1957). Greater prairie-chickens readily nest in hayed, high-mowed, and lightly to moderately grazed native prairie grasses, and high-mowed, lightly grazed, and undisturbed non-native grasses (e.g., redtop bentgrass; timothy, *Phluem pratense*; smooth brome; bluegrass). Mowing, haying, grazing and prescribed burning have all been effective management tools for controlling vegetation height/density and litter build-up to provide prairie-chicken nesting habitat (Westemeier 1973, Kirsch 1974, Drobney and Sparrowe 1977, Westemeier and Buhnerkempe 1983, Buhnerkempe et al.

1984, Horak 1985, Svedarsky 1988, Svedarsky et al. 1999b). At PRSNA, all the above vegetation types and management regimes are employed to benefit nesting prairie-chickens (Simpson and Esker 1997).

Brood-rearing. Good prairie-chicken brood-rearing habitat offers considerable bare ground to allow easy movement for small chicks, overhead screening cover for protection from predators and direct sunlight, an abundance of invertebrate prey (particularly grasshoppers) for rapidly-growing young, within relatively close proximity to nesting habitat. In Illinois, broods of radio-tagged females were often located in newly seeded grass-legume fields, recently burned sites, and in annual weeds (Westemeier et al. 1995). Patches of brood habitat >4 ha (10 acres) were preferred over smaller plots. No-till soybean fields were frequently used by broods as well, but repeated spraying of agrochemicals in this habitat resulted in high brood mortality. Yeatter (1943) found broods in redtop meadows, small grains, fallow fields and field border habitats. In Missouri, Drobney and Sparrowe (1977) observed broods in small grains, prairie pastures, prairie hay, and legume fields. Horak (1985: 48) noted, "grassland is generally preferred by prairie chickens, but there is a tendency for major brood activities to be associated with lands formerly or presently cultivated." He noted open, disturbed areas (overgrazed, field edges, cattle rubs) near tall escape vegetation were important brood sites. Edges of rowcrops, alfalfa and "go-back" areas (land reverting to grassland following cultivation) were considered excellent brood habitat in Kansas. Burning and moderate grazing were recommended to increase plant diversity (particularly of forbs) and increase insect abundance. At PRSNA, managers create brood habitat in the forms of new grass-legume plantings, recently burned areas, annual weed fields

maintained by a 2-year tillage rotation, and overseeding legumes on tilled fire breaks (Simpson and Esker 1997).

Roosting. To a large extent, habitat suitable for nesting is suitable for roosting, although taller vegetation is utilized, particularly during harsh winter weather (Yeatter 1943, Hamerstrom et al. 1957, Kirsch 1974). In Missouri, the vast majority of roosting occurs in prairie pastures (Drobney and Sparrowe 1977). Radio-tagged female prairie-chickens mostly roosted within grasslands in Illinois in the fall, winter and early spring, although cropland was primarily used during the day (Rubin 1994).

Foraging. Through the fall, winter and early spring, cropland is the overwhelmingly favored foraging habitat (Yeatter 1943, Hamerstrom et al. 1957, Drobney and Sparrowe 1977, Johnsgard 1983, Horak 1985, Rubin 1994). However, cultivated grains are perhaps not required for prairie-chicken winter survival, and native seeds and tree buds may be adequate winter foods (Prose 1985, Schroeder and Robb 1993). Kirsch (1974) advised against spending management resources to provide winter food. Corn, soybeans and sorghum are preferred in winter over small grains (Drobney and Sparrowe 1977, Schroeder and Robb 1993). Yeatter (1943) found corn, soybeans and weed seeds to be important winter foods in Illinois. Post-harvest tillage dramatically reduces waste grain available to wildlife in corn and soybean fields (Warner et al. 1985). During the breeding season, foraging habitat resembles brood habitat (Yeatter 1943, Drobney and Sparrowe 1977).

Loafing. Habitat used for loafing, a mid-day period of general inactivity, has been reported infrequently. Drobney and Sparrowe (1977) recorded most birds in prairie pastures in late winter, with prairie hay and legume fields becoming more important by

late spring. Robel et al. (1970a) showed that short to mid-height grassland areas were frequently used at mid-day in all seasons, with higher use of grain fields during winter.

Escape cover. Drobney and Sparrowe (1977) determined escape cover after 383 observations of adult prairie-chickens flushing from various disturbances, and recording the cover type they next used. Cover 20 to 90 cm (8 to 36 inches) was used more than shorter vegetation, and cover <10 cm (4 inches) was not used. Prairie pastures were used as escape cover 46% of the time. Horak (1985) also noted the importance of tall escape cover near brood areas.

Landscape composition. Areas being considered for prairie-chicken management should be >30% grassland (Hamerstrom et al. 1957, Prose 1985). Horak (1985) considered 75% grassland and 25% cropland to be optimal prairie-chicken range. Prairie-chicken populations have been known to linger for a number of years in areas with as little as 15% grassland (Hamerstrom et al. 1957). Woodland is incompatible with prairie-chicken management, and linear woody vegetation, in particular, should be minimized to maintain open vistas and reduce predator abundance (Mechlin 1991, Sample and Mossman 1997, Simpson and Esker 1997, Fitzgerald et al. 2000).

Spatial considerations. Due to the mobility of Greater Prairie-chickens, their large home ranges, and relatively low population densities, large areas are required to maintain prairie-chicken populations. At PRSNA, the average spring density from 1963-1994 was 3.5 males/km^2 (9 males/square mile) in an area with about 20% permanent grassland (Simpson and Esker 1997). This is relatively high compared to other states; in Wisconsin and Missouri for example, spring density estimates were nearer 2

males/km^2 (5 males/square mile). Densities occasionally approach 10 males/km^2 (25 males/square mile; Johnsgard 1983).

Greater Prairie-chickens have also been reported to be "area sensitive," avoiding grassland patches smaller than some threshold level. Samson (1980) found prairie-chickens regularly only in prairie fragments >100 ha (250 acres) and within 40 km (25 miles) of another occupied prairie. Winter and Faaborg (1999) reported prairie-chickens were absent from prairie fragments <77 ha (190 acres) in Missouri. At PRSNA, prairie-chickens are most often associated with grassland tracts >40 ha (100 acres; Walk and Warner 1999).

Many prairie-chicken conservation plans were modeled after the "ecological patterning" plan of Hamerstrom et al. (1957). In this plan, a minimum of 1,040 ha (2,600 acres) of grassland habitat are maintained in a landscape with >20% permanent grassland, in blocks 16 to 65 ha (40 to 160 ha). This arrangement was hypothesized to support a greater number of prairie-chickens than a single block of habitat. The assumptions underlying this reserve design include (a) birds preferentially nesting within the protected grasslands and (b) utilizing the intervening agricultural matrix for foraging, brood-rearing, and other life history needs. Kirsch (1974) thought the minimum area necessary to support prairie-chickens was 520 ha (1,280 acres) within an area not to exceed 20.7 km^2 (8 square miles). Grasslands should be at least 65 ha (160 acres) and wider than 0.8 km (0.5 mile).

In designing PRSNA, Sanderson et al. (1973) thought 610 ha (1,500 acres) of nesting habitat in tracts 16 to 65 ha (40 to 160 acres) would sustain a population of 500 prairie-chickens. This pattern was to be duplicated in Jasper and Marion counties.

These authors recognized that prairie-chickens in this "sanctuary" system would be heavily dependent upon surrounding agriculture, and that agricultural intensification would increase the amount of land necessary to provide brood habitat in addition to nesting habitat. Westemeier (1997) thought this objective was realistic if grasslands were "well-situated, properly managed, and well-used by the birds," but acknowledged as much as 1,600 ha (4,000 acres) may be necessary in each county to support 400-500 prairie-chickens.

In a similar scatter-pattern, or "mosaic," landscape in Missouri, prairie-chicken populations declined over a 27-year period, but were stable in a contiguous prairie landscape (Ryan et al. 1998). Further, nest success was lower in the mosaic landscape, primarily due to destruction of nests in agricultural lands (mainly hay fields). Prairie-chickens in the mosaic landscape had larger movements, larger brood movements, and lower survival compared to birds in a contiguous prairie landscape (Burger 1988, Ryan et al. 1998).

At present, scatter patterning is not considered the ideal prairie-chicken management plan in Missouri; rather, core grasslands of >520 ha (1, 280 acres) surrounded by additional scattered grassland tracts are desirable (Mechlin et al. 1999). In Wisconsin, large grassland landscapes suitable for prairie-chickens are to be 4,050 to 20,250 ha (10,000 to 50,000 acres), with a 800-ha (2,000 acre) core grassland. At least 35% of the remaining landscape should be in permanent grassland cover such as pasture, prairie remnants and idle grassland; the remaining 52% can remain in crop production, ideally small grains and hay, with a minimum of forest cover (Sample and Mossman 1997). Similarly, Fitzgerald et al. (2000) advocate a 800 ha (2,000 acre) core

grassland surrounded by a 4,000 ha (10,000 acre) matrix of at least 25% compatible grassland, 51% of which is in tracts >40 ha (100 acres). For the federally-endangered Attwater's Prairie-chicken in Texas, the goal is to de-list the subspecies when 5,000 birds are supported by 12,150 ha (30,000 acres) of managed grassland (U. S. Fish & Wildlife Service 1993). Simpson and Esker (1997), responding to the agricultural intensification predicted by Sanderson et al (1973) and the long-term decline and near-extirpation of prairie-chickens in Illinois by the early 1990s, revised land management goals for PRSNA. Current goals are 1,600 ha (4,000 acres) of grassland, in tracts >64 ha (160 acres), in both Jasper and Marion counties, supporting a spring population of 500 prairie-chickens.

C. Minimum Viable Population, Metapopulation, & Source-Sink Population Considerations

Minimum viable population. A minimum viable population (MVP) is an estimated ideal population size that conservation biologists use to determine how many individuals are necessary in a population to have a certain probability of persisting for a certain length of time, given foreseeable demographic, genetic, and environmental stochasticity, or variation (Meffe and Carrol 1994). Models of MVP tend to show threshold levels: below certain levels, extinction risk increases dramatically and persistence time plummets. An MVP is thought to be 50 to 500 individuals (Brussard 1985).

Real populations often have the same genetic risks (inbreeding and drift) as smaller ideal populations upon which MVP estimates are based. This is particularly true in Greater Prairie-chickens, with male-biased populations (1.1:1 to 1.6:1), lek-breeding system with few males successfully mating (10% to 40%), variance in reproductive success of females, and considerable annual variation in populations (Schroeder and Robb 1993). For prairie-chickens, the genetically effective population size is much smaller than the census population. A genetically effective MVP of 500 prairie-chickens may require a census population of 860 to >2,500 birds (Appendix I).

Metapopulations. In Illinois, extirpation of small populations of prairie-chickens surrounding the Jasper County PRSNA grasslands has been implicated as a key demographic event that accelerated the loss of genetic diversity and fitness (Westemeier et al. 1998a). This "metapopulation," a population of sub-populations, facilitates gene flow and counter-balances the effects of skewed sex ratios and local environmental variation (Brussard 1985). One of the key aspects of metapopulations is the periodic extinction and recolonization of areas. The experience at PRSNA offers an example. Particularly following the infusion of translocated birds, subpopulations have become temporarily established at sites with little or no habitat in Jasper, Marion, Effingham, Clay, Wayne and White counties (S. Simpson, personal communication). Facilitating metapopulation structure, with incentives for establishing grassland habitat on private lands at present or historic "satellite" population locations (Figure 4, Appendix VII), will reduce genetic drift and environmental and demographic stochastic threats to the remnant Illinois population of Greater Prairie-chickens.

Source-Sink populations. This concept is similar to metapopulation theory, but considers the key demographic rates (births, deaths, and movements of individuals) within subpopulations. In source populations, overall numbers may remain the same, but births exceed deaths, and individuals leave in search of other habitats. In sinks, deaths exceed births, and populations decline without an influx of "extra" individuals from source populations (Pulliam 1988). Counter-intuitively, overall population size (metapopulation size) may be larger in systems where most individuals are in sink habitats surrounding a source habitat, compared to a situation where only the source habitat exists with no available sink habitat (Pulliam 1988). As with metapopulation theory, source-sink dynamics suggest management of satellite population habitat for Greater Prairie-chickens would increase overall and genetically-effective population size, and promote population stability.

D. Managing Interspecific Interactions

Humans. Managing people is an important consideration of Greater Prairie-chicken populations. Hunting regulations or prohibitions are in place throughout the species' range, and in Illinois poaching is not perceived as a threat. Researchers are cautioned to avoid disturbing egg-laying and brood-rearing prairie-chickens (Westemeier and Gough 1999), although they are apparently tolerant of flushing during incubation (Westemeier et al. 1998b). Observers of the breeding displays at leks can also disrupt mating, requiring limitations on the number of visitors and frequency of visits to leks, as well as enforcement of "etiquette" among viewers (Sanderson et al. 1973, Simpson and Esker 1997). Even when restricted to roadsides and distances over 400 m (0.25 mile), concentrations of visitors sometimes cause prairie-chickens to cease displaying, and occasionally leave leks (J. Walk, personal observation).

Competitors & Parasites. In the northern portion of the prairie-chicken's range, Sharp-tailed Grouse hybridize with and dominate interactions with Greater Prairie-chickens (Schroeder and Robb 1993, Svedarsky et al. 1999a). In Illinois, the Ring-necked Pheasant is the most ecologically-similar species to Greater Prairie-chickens, and therefore most likely to seriously compete with the species (Buhnerkempe 1979). Male pheasants have been observed disrupting male prairie-chickens on leks, and female pheasants lay their eggs in prairie-chicken nests (Vance and Westemeier 1979). Pheasant parasitism is problematic since their eggs require fewer incubation days than prairie-chicken eggs, resulting in prairie-chicken females abandoning many of their own eggs prior to hatching. Pheasant densities increased at PRSNA during the 1980s, and parasitism rates of prairie-chicken nests exceeded 40% (Westemeier et al. 1998c).

Highly effective pheasant control methods have been established in Illinois (Westemeier 1988), resulting in the virtual elimination of parasitism by pheasants (Westemeier et al. 1998c). However, the prairie-chicken populations did not increase following pheasant control, suggesting other factors such as genetic inbreeding were limiting the population (Westemeier et al. 1998c).

Disease. To reduce the threat of disease being transferred from domestic birds to prairie-chickens, Simpson and Esker (1997) recommended put-and-take pheasant hunting areas not be developed within 50 km (30 miles) of grasslands managed for prairie-chickens. Following the dramatic decline of the Marion County prairie-chicken population as a nearby egg-laying facility began operation, Simpson and Esker (1997) advised that spreading domestic chicken manure on cropland near prairie-chicken habitat be eliminated.

Predators. Methods of controlling mid-sized mammals, perceived as important prairie-chicken nest predators, have been established at PRSNA (Simpson and Esker 1997). Combined with elimination of den sites and wooded travel corridors, nesting success of ground-nesting birds is good at PRSNA (roughly 55%; E. Kershner and J. Walk, unpublished data). However, the prairie-chicken population did not increase after predator control was implemented, suggesting other factors have been limiting the population, such as brood survival, dispersal patterns, or genetic inbreeding.

Besides mammals, other groups of predators are of unknown importance. Red-tailed hawks (*Buteo jamaicensis*) and Great Horned Owls (*Bubo virginianus*) are abundant, potential predators of prairie-chickens (Yeatter 1943), although prairie-chickens avoid wooded areas that offer hunting perches for these species. Elimination

of wooded fencerows at PRSNA has further reduced the threat of these predators. Northern Harriers (*Circus cyaneus*) uncommonly prey on juvenile prairie-chickens and very rarely kill adults. However, harriers and Short-eared Owls (*Asio flammeus*) can be disruptive of booming male prairie-chickens (Westemeier 1986). These two Illinois endangered species are abundant winter residents at PRSNA (Walk 1998), but have largely left the area by the peak of prairie-chicken breeding (J. Walk, personal observation). Cooper's Hawks (*Accipiter cooperi*) and Northern Goshawks (*A. gentilis*) may also be predators of adult prairie-chickens (Yeatter 1943, Schroeder and Robb 1993). Snakes are likely predators of eggs and young prairie-chickens (Yeatter 1943), although their importance has not been established. Snakes, particularly eastern garter snakes (*Thamnophis sirtalis*), prairie kingsnakes (*Lampropeltis calligaster*) and racers (*Coluber constrictor*), are abundant within PRSNA grasslands (20-40 individuals/ha; D. Olson, unpublished data).

E. Translocation & Reintroduction

Historically, translocations of *Tympanuchus* grouse have been notoriously unsuccessful (Toepfer et al. 1990, Schroeder and Robb 1993, Snyder et al. 1999). Most failed attempts have been due to too little habitat at the release site and failure to consider the dispersal capabilities of these birds. However, recently developed techniques have increased the probability of successful prairie-chicken translocations. As a result, several states have initiated translocation programs, creating a demand for prairie-chicken donors that may exceed supply. In general, requests to augment existing populations are favored over plans to establish new populations. Likewise, federally threatened or endangered populations are prioritized above unlisted populations (Prairie Grouse Technical Council 1999; Appendix II). For all translocations, specific, quantifiable management goals must be identified. Translocations must be monitored through radio telemetry, nest-brood-survival-dispersal studies and population surveys, particularly to identify causes of translocation failure. Thus future efforts will be more likely to succeed. Guidelines for translocations in Illinois are presented below, based on current knowledge. These guidelines will ensure that translocation efforts are a good investment of conservation resources that facilitate recovery of the Greater Prairie-chicken in Illinois.

Existing populations. Translocations of prairie-chickens may be periodically necessary for small, isolated populations to counter genetic drift and inbreeding depression by mimicking natural dispersal. Exchange of eggs among populations may be effective (Westemeier et al. 1991). Problems associated with this include difficulty in locating candidate nests in each population, and the relatively small number of birds

that are likely to be recruited into the breeding populations. Therefore, egg exchange is suitable for simulating dispersal to avoid genetic drift, but is not appropriate for critically small populations (<50 birds) that are in need of genetic and demographic "rescue."

Existing, geographically separate populations should be considered candidates for augmentation through translocation when population size falls below 50 birds or genetic and/or demographic constraints are demonstrated to be preventing population recovery. "Existing" populations are remnant populations (extant only at PRSNA), populations that have naturally colonized sites and persisted for >10 years, or populations which have been established by reintroduction and have persisted for >20 years. Because of their natural heritage value, efforts should be made to rescue the remnant populations so long as available permanent grassland habitat is at least equal to present day PRSNA grasslands. Naturally established populations should be rescued if supported by >1,000 ha (2,500 acres) of permanent grassland. Reintroduced populations should be rescued if >2,000 ha (5,000 acres) of permanent grassland habitat is available.

Birds can be translocated into existing populations by using spring release or summer release methods. (Methods of capturing prairie-chickens from donor populations are available in Toepfer et al. 1988. All translocated birds should be released within 72 hours of capture.) In spring releases, birds are released at or near active booming grounds from mid-March through April. Fifty to 100 birds (even sex ratio) should be translocated per year for at least 3 years. The major advantages of this method are that large numbers of birds can be captured, translocated and released over short periods of time, at comparatively low expense. The major disadvantage is the

relatively low rate at which translocated birds are incorporated into populations. By using this method of translocation in Illinois, roughly 40% of released birds from Kansas and Nebraska remained near the release site, and fewer successfully bred or nested. Other birds dispersed and/or died. Dispersing birds were recorded >100 km (60 miles) from release sites.

Alternatively, birds (including broods) may be translocated during the summer (July-August) when their tendency to disperse is much less. Using this method, at least 20 birds should be released per year for at least 3 years within grasslands occupied by prairie-chickens. These birds are captured in spring on leks, fitted with radio transmitters, and recaptured in summer for translocation. This method requires considerably more expense and time, and generally fewer birds can be translocated. Survival is high and dispersal low for birds released in this manner (Toepfer 1988), although dispersal in spring (prior to nesting) was high among females released by this method in Illinois (Rubin 1994).

Establishing new populations. A key element of prairie-chicken recovery in Illinois is establishment of additional populations. This will very likely require translocation of birds into areas of suitable habitat that are too isolated (probably >50 km or 30 miles) to be colonized naturally. Candidate areas for reintroduction of prairie-chickens should meet the conditions described for an "Illinois Prairie-Chicken Range," described in Section VII, Part A. The grasslands should be managed and evaluated as prairie-chicken nesting, brood-rearing, and roosting habitat for ≥3 years prior to reintroduction. Concurrent reintroductions at proximate (<30 km or 19 miles) locations and/or presence of potential satellite population habitat are highly desirable features to

(1) retain some of the individual birds that disperse from release sites and (2) establish a metapopulation structure that increases the overall genetically effective population size and reduces demographic and environmental stochasticity.

Efforts to establish prairie-chicken populations should be mindful of the insight offered by Toepfer et al. (1990: 576):

> "The key to survival of translocated birds in unoccupied quality habitat is successful establishment of individuals, as extensive orientation movements represent responses of individuals, not groups, to being placed in an unfamiliar area. Thus, in a translocation venture, most principles of population dynamics are not operating, and the population will not be functional until the translocated individuals establish territories and reproduce."

Initial releases of translocated birds should be done via summer release methods. This takes advantage of the species' natural tendency to remain relatively sedentary during this period, as well as molting, which may limit dispersal ability. In late winter or early spring following this release, decoys should be placed and recordings of prairie-chicken booming played at likely sites for lek placement. This is intended to (1) induce lekking behavior among translocated males and (2) discourage birds from dispersing (as observed by Rubin 1994). Summer releases of at least 20 birds per year should continue for at least 3 years. Additionally, spring releases of 100 birds per year (even sex ratio) should be made at leks for at least 4 years to assist population establishment.

Donor populations. Prairie-chicken populations should not be harvested of birds for translocation unless the birds removed represent <5% of the total population, and

the population is secure and supported by adequate habitat. Populations of <1,000 individuals should not be used as donor populations. To limit the transmission of disease and parasites, captured birds should be tested prior to translocation according to guidelines promulgated by the Prairie Grouse Technical Council.

Pen-reared & pen-held birds. Greater Prairie-chickens are notoriously difficult to raise in captivity. Further, pen-reared birds are poorly equipped for survival and reproduction in the wild, and are not associated with successful releases (Toepfer et al. 1990, Silvy et al. 1999). Birds captured on leks in Kansas were held in pens for summer release in Illinois, but this attempt failed (Sparling 1979). In pens, prairie-chickens need to be wing-clipped to reduce self-inflicted mortality and injury. Pen held birds also lose weight and muscle mass due to lack of exercise (Toepfer 1988). Thus, these methods are not advised for translocations or reintroductions.

VI Joint Recovery of Prairie Wildlife

A. Ecosystem Restoration & Management

"Ecosystem-based management" is a part of the Illinois Department of Natural Resources' strategic plan (Illinois Department of Natural Resources 2001). Grumbine (1994) identified five specific goals of ecosystem management: maintaining viable populations of all native species, representing all native ecosystem types within protected areas, maintaining ecological processes such as natural disturbance regimes and water and nutrient cycles, protecting evolutionary potential, and accommodating human use within these constraints. Recovery of viable Greater Prairie-chicken populations within Illinois is certainly consistent with ecosystem management, but should be more holistic than this single objective.

The Greater Prairie-chicken is the signature bird of the tallgrass prairie. However, over 99% of the tallgrass prairie ecosystem has been destroyed, primarily for conversion to agriculture (Samson and Knopf 1994), and a great number of tallgrass prairie species are imperiled in Illinois and other formerly-prairie states. The number of threatened or endangered prairie species makes single-species conservation complex and prohibitively expensive. Further, a species-by-species approach may maintain viable populations, but may fail in achieving other goals of ecosystem management. Because the Greater Prairie-chicken is a resident, wide-ranging species that uses a diversity of grassland habitats throughout its life cycle, this bird has been proposed as an "umbrella species." Conservation strategies that maintain viable prairie-chicken populations are likely to encompass the needs of many prairie species with smaller home ranges and narrower habitat requirements (Simpson and Esker 1997, Fitzgerald et al. 2000).

Given the rarity of the Greater Prairie-chicken and many species of associated prairie wildlife, an ecosystem-based approach to recovery at this time will avert considerably more complicated and expensive future conservation strategies. First, prairie-chicken recovery can prevent the need to list additional species as *Threatened or Endangered in Illinois* in the future. Secondly, recovery of prairie wildlife will avert the need for protection of several species under the Endangered Species Act of 1973. For example, Greater Prairie-chickens, Loggerhead Shrikes (*Lanius ludovicianus*) and Henslow's Sparrows (*Ammodramus henslowii*) are among the species that are being, or have recently been, considered for federal listing, and each of these species interacts directly with agricultural lands and practices in Illinois. Effective conservation of prairie

wildlife by state agencies, not-for-profit organizations, and incentives for private landowners will avoid these complex scenarios.

From an ecosystem management perspective, recovery of prairie-chickens should be linked to tallgrass prairie restoration, managed with natural disturbance regimes (fire and grazing), to the extent possible. In Illinois, prairie-chicken conservation has been uncoupled from prairie conservation. Prairie-chicken management at PRSNA is largely based on mimicking redtop bentgrass farming practices which maintained prairie-chickens in southeastern Illinois for several decades (Westemeier 1985, Simpson and Esker 1997). This management approach therefore has "cultural" value not considered in the five goals of ecosystem management. Other non-native grasses (e.g., smooth brome) used in grassland habitat management do not share natural heritage or cultural value, but are inexpensive to establish, simple to manage, and readily utilized by target species.

Mowing is the primary habitat manipulation tool utilized for prairie-chicken management only within Illinois (Simpson and Esker 1997, Svedarsky et al. 1999a). For the Attwater's Prairie-chicken in Texas, mowing is an "emergency" management tool, used only when fire and/or grazing cannot be used (U. S. Fish & Wildlife Service 1993). A representative, remnant tallgrass prairie ecosystem with natural disturbance regimes (fire and grazing by native bison) does not exist, although such a restoration is being attempted in Oklahoma (Smith 1996). Grazing with domestic cattle is an alternative practice consistent with the final goal of ecosystem management, accommodating human use.

Although native plants and natural disturbance regimes are minor components of prairie-chicken management in Illinois, PRSNA has been tremendously successful in providing habitat for a number of other species of special management concern (Simpson and Esker 1997). This observation has two important implications for the Greater Prairie-chicken recovery plan. First, fauna that require large areas, open landscapes and particular habitats can be used as indicators of areas providing some of the habitat needs of Greater Prairie-chickens. Second, a plan leading to the recovery of prairie-chickens will, in effect, achieve the recovery of many species. Sixty (60) joint recovery species are listed in Appendix III.

B. Plants

Since almost all of PRSNA is retired cropland established into grassland, the flora of the site is relatively poor. Only one remnant population of a threatened plant species remains, and two endangered plants have been reintroduced into prairie restorations (Appendix III). Aggressive management using mowing, prescribed fire, grazing and limited tillage may be incompatible with some plant species of special concern. However, within all large management areas, several locations are likely to exist that are not crucial for prairie-chickens where sensitive plants can be given special protection. Prairie restorations that do not have adjacent or included prairie remnants with excellent floras are likely to require reintroductions of several plant species.

C. Invertebrates

As with plants, intense management may not be compatible with some sensitive invertebrates. Most grassland management plans recommend burning on a 3-5 year rotation and leaving some areas undisturbed on an annual basis (e.g., Sample and

Mossman 1997). For flying insects especially, high dispersal ability will reduce the need for reintroductions. At PRSNA, no threatened or endangered invertebrates are known to occur, although some could potentially colonize the site or be discovered (Appendix III). One apparently endemic species of leafhopper (*Chlorotettix sp.*) is known from a small prairie remnant area. The prairie cicada, *Tibicen dorsata*, has been recorded in several of the prairie restorations at PRSNA in Jasper and Marion County, and is perhaps the rarest large insect in Illinois (Bouseman 1997).

D. Vertebrates

No state-listed amphibians and two threatened reptiles are known to occur at PRSNA (Appendix III). Five Kirtland's snakes (*Clonophis kirtlandii*) were released in Marion County in 1994 when their habitat was being destroyed for commercial development (Simpson and Esker 1997). A Blanding's turtle *(Emydoidea blandingii*) was discovered in Jasper County in 1998 (Olson and Louis 1999). The populations of each species are certainly too small to be viable, and translocation is appropriate if adequate habitat and donor populations are available. At PRSNA and other sites, herptiles are unlikely to colonize isolated habitats and translocation may be necessary. Corridors among patches of grassland vegetation and across roadways may be necessary for herptiles. At PRSNA, ornate box turtles (*Terrapene ornata*) disperse into agricultural fields surrounding grasslands. Roadways and tillage are important sources of mortality (Olson et al. 2001, D. Olson and J. Walk, unpublished data).

No threatened or endangered mammals are known to occur at PRSNA (Appendix III), although badgers (*Taxidea taxus*) have been recorded in both Jasper and Marion counties. Small rodents (*Microtus, Peromyscus*, and *Synaptomys spp.*) are

of management interest, primarily as food for endangered predatory birds (northern harrier, short-eared owl, and barn owl, *Tyto alba*; Heske 1999). Mid-sized mammals (opossums, raccoons, striped skunks) are controlled as predators of nests and young of prairie-chickens and other endangered ground-nesting birds.

Considerable attention has been given to the grassland birds at PRSNA. Over the past 30 years, grassland birds have shown steeper, more consistent, and more wide-spread population declines than other groups of birds in North America (Peterjohn and Sauer 1999). PRSNA hosts large breeding populations of several of these declining species (Walk 1997, Kershner 2001, Walk 2001a). Nine threatened or endangered grassland-dependent bird species nest at PRSNA (Appendix III). Several threatened or endangered wetland-dependent birds nest at or migrate through PRSNA (Simpson and Esker 1997). Because of their landscape, area and habitat requirements, endangered grassland-nesting birds are valuable indicators of potential Greater Prairie-chicken habitat (Appendix IV).

Northern Harrier. This species is an abundant winter resident and uncommon, but regular, nesting species at PRSNA. For winter roosting and nesting, harriers prefer undisturbed grasslands (Walk 1998, Herkert et al. 1999). Average VOR of winter roost sites is 2.5 dm (10 inches; Walk 1998). Wintering concentrations and nesting of Northern Harriers are indicators of roosting (primary) and nesting (secondary) habitat for Greater Prairie-chickens.

Upland Sandpiper. Buhnerkempe and Westemeier (1988) found Upland Sandpipers (*Bartramia longicauda*) preferred mowed and recently burned (<1 year) areas for nesting. Fields seeded for 1 year and >8 years were preferred, presumably

due to high forb cover. Recently, nests have been found in burned and newly seeded sites (Kershner 2001, E. Kershner and J. Walk, unpublished data). Upland Sandpiper broods are observed in wheat stubble, hayed and grazed areas, and weedy fields (Buhnerkempe and Westemeier 1988). Thus, Upland Sandpiper nests and broods are found in disturbed and mid-height grasslands, and are primary indicators of brood-rearing habitat, and secondary indicators of nesting habitat for prairie-chickens. Upland Sandpipers and Greater Prairie-chickens are limited to similar size grasslands in Missouri (>100 ha, or 250 acres; Samson 1980) and Illinois (>65 ha, or 160 acres; Walk and Warner 1999).

Short-eared Owl. PRSNA hosts a large wintering population of Short-eared Owls. In 1997-1998 and 1999-2000, North American High Counts of this species were recorded at PRSNA (Ortego 1998, 2000). Short-eared Owls are an irregularly nesting species in Illinois, although since 1990, they have bred in most years at PRSNA (Herkert et al. 1999, J. Walk, unpublished data). Both during winter and the nesting season, Short-eared Owls prefer mowed, grazed and recently-seeded grasslands (Walk 1998, Herkert et al. 1999). Winter roost sites had an average VOR of 1.2 dm (5 inches; Walk 1998). Nesting and winter roosting concentrations of Short-eared Owls are therefore primary indicators of appropriate habitat structure for prairie-chicken nesting, and secondary indicators of prairie-chicken brood-rearing and roosting habitat.

Henslow's Sparrow. Like Greater Prairie-chickens, Henslow's Sparrows tend to be sensitive to grassland area (Samson 1980, Walk and Warner 1999, Winter and Faaborg 1999). Unlike prairie-chickens, Henslow's Sparrows appear to be more tolerant of woody vegetation surrounding grassland habitat (J. Walk, personal

observation). This is likely related to prairie-chickens utilizing areas outside of grasslands for many activities, whereas Henslow's Sparrows remain within grasslands (Walk 2001a). A well-developed layer of litter is a key attribute of Henslow's sparrow nesting habitat (Herkert 1994). However, excessive litter cover can negatively influence prairie-chicken nest success (McKee et al. 1998). At PRSNA, Henslow's Sparrows are most abundant in undisturbed and lightly-grazed grasses (Walk and Warner 2000). Therefore, Henslow's Sparrows are a primary indicator of appropriate structure for prairie-chicken roosting, and a secondary indicator of suitable nesting habitat structure.

VII Recovery

A. Definitions

Endangered in Illinois: in danger of extinction within Illinois

Threatened in Illinois: likely to become Endangered in Illinois in the foreseeable future

Significant population: a population averaging >200 individuals for >5 years

Geographically separate population: a population >24 km (15 miles) from another population

Satellite population: a small population (<200 individuals) established by natural colonization, and linked by dispersal to other population(s).

Prairie-chicken Range: a large scale land unit (>100 km^2 or 39 square miles) for conserving a minimum viable population of Greater Prairie-chickens. The center of a prairie-chicken range is a 50 km^2 (19 square mile) ***management landscape*** with the following properties:

1. ≥40% secure grassland land cover, >60% of which is in tracts >0.8 km (0.5 mile) wide and >65 ha (160 acres); grassland tracts exhibit a high degree of connectivity
2. ≥20% hay, pasture, small grains and fallow land cover
3. <10% woodland/forest land cover
4. <10% urban/residential and farmstead land cover
5. Up to 40% row crop land cover

The balance of the prairie-chicken range has similarly low woodland/forest and urban/residential land covers that are deleterious to prairie wildlife management, and a high proportion of land cover in agricultural grasslands, cropland and other uses that have neutral or positive value for prairie wildlife. Land use in the prairie-chicken range will ensure the entire management landscape is highly functional for conserving prairie-chickens and prairie wildlife. The goal is to maintain a spring density of 4 males/km^2 (10.4 males/square mile) within the management landscape, or 2 males/km^2 (5.2 males/square mile) throughout the prairie-chicken range, and thus a spring population of 400 males (800 birds).

B. Objectives and Criteria

Goal: Preserve remnant Greater Prairie-chicken populations, restore and protect habitat, re-establish prairie-chickens in suitable habitat, and monitor population levels to ensure the long-term viability of prairie-chickens and associated prairie wildlife in Illinois.

Justification. The recovery goal is consistent with: 1) the IDNR's legislative mandate to take "all measures necessary for the conservation, distribution, introduction,

and restoration of birds and mammals" (Illinois Compiled Statutes, Chapter 520, Part 5/1.10), 2) the IDNR's Strategic Plan for ecosystem-based management and resource protection for future generations, and 3) the IDNR's 60-year history of leadership and active management for prairie-chicken conservation.

Objective 1. Ensure the long-term preservation of the remnant Greater Prairie-chicken populations at Prairie Ridge State Natural Area.

Criteria. The remnant populations shall be considered secure after (1) a prairie chicken range is established in each Jasper and Marion county, with existing PRSNA grasslands as the foundation for management landscapes, and (2) the two PRSNA populations are linked by satellite populations not isolated by more than 24 km (15 miles), and (3) the estimated population (including satellite populations) averages >1,000 birds (500 displaying males) for 5 years, with population estimates <800 birds in none of those five years.

Justification. In spite of 60 years of public protection of habitat, prairie-chicken populations within Illinois have declined by >90% during that time. The small, remnant populations have been precariously maintained at PRSNA in Jasper and Marion counties on an inadequate amount of habitat to ensure the long-term persistence of these populations. A significant increase in available habitat is required to secure past investments in maintaining prairie-chickens in Illinois. The criteria set forth are based on reasonable population densities, spatial requirements, minimum viable population estimates, a stabilizing metapopulation structure, and accommodation of up to 80% compatible agricultural land use. At least 44 other species of special management concern recorded at PRSNA (Simpson and Esker 1997, Walk 2001a) will benefit from

expansion of this site. Estimated costs for achieving Objective 1 are given in Appendix V.

Objective 2. Downlist the Greater Prairie-chicken to *Threatened in Illinois*, when the population is no longer in danger of extinction in Illinois.

Criteria. The Greater Prairie-chicken is not in danger of extinction in Illinois when:

1. The statewide estimated population averages >3,000 birds (1,500 displaying males) for 5 years. The population estimate must be >3,000 birds in three of the five years, and <2,400 birds in none of the five years. And:
2. The statewide population is represented by at least 3 geographically separate, significant populations. And:
3. The habitat supporting at least 3 geographically separate, significant populations is determined to be adequate and secure to maintain existing populations.

Justification. A 3,000-bird estimated population has been established as the minimum criteria for the Attwater's Prairie-chicken to be classified as federally threatened (U. S. Fish & Wildlife Service 1993). This subspecies is reduced to small, isolated populations, much like the extant prairie-chicken populations in Illinois. A minimum viable population of Greater Prairie-chickens may be 2,500 or more (Appendix I). Three geographically separate, significant populations will reduce the risk of environmental variation or a catastrophe causing extinction of prairie-chickens in Illinois.

Objective 3. Recovery of the Greater Prairie-chicken in Illinois is complete when the species is delisted and not likely to become endangered in Illinois in the foreseeable future.

Criteria. The Greater Prairie-chicken is not likely to become endangered in the foreseeable future in Illinois when:

1. The statewide estimated population averages >5,000 birds (2,500 displaying males) for 10 years. The population estimate must be >5,000 birds in seven of the ten years, and <4,000 birds in none of the ten years. And:
2. The statewide population is represented by at least 5 geographically separate, significant populations. And:
3. The habitat supporting at least 5 geographically separate, significant populations is determined to be adequate and secure to maintain existing populations.

Justification. A 5,000-bird estimated population has been established as the minimum criteria for delisting the Attwater's Prairie-chicken (U. S. Fish & Wildlife Service 1993). A population of this size is likely to maintain its evolutionary potential. Five geographically separate, significant populations will greatly reduce the risk of environmental variation and catastrophe causing the species to become *Threatened in Illinois*, and will demonstrate the ability of wildlife managers to establish prairie-chicken habitat and/or successfully reintroduce populations.

Objective 4. Achieve joint recovery of associated prairie species, while preventing the need to list additional prairie species as *Threatened or Endangered in Illinois.*

Criteria. Criteria for improvement in status and recovery will vary among species. Isolated populations with little or no dispersal opportunity (e.g., plants, amphibians, reptiles) may require hundreds or thousands of individuals to be considered secure. In contrast, relatively small breeding populations of migratory birds that naturally occur at low densities may be adequate for statewide recovery if the species is secure regionally, continentally or globally. Such vagile species are essentially part of regional or continental metapopulations.

Justification. Prairie-chicken management at PRSNA has successfully incorporated management of several species of special concern. The endangered grassland species expected to improve status or recover by establishment and enhancement of habitat leading to Greater Prairie-chicken recovery, without the need for reintroduction, are Upland Sandpiper, Northern Harrier, Barn Owl, Short-eared Owl, and Henslow's Sparrow. Several other species are expected to benefit without reintroduction as well (e.g., American Bittern, *Botaurus lentiginosus*; King Rail, *Rallus elegans*; Loggerhead Shrike). Other species could improve status or recover with successful reintroductions (e.g., prairie rose gentian, *Sabatia campestris*; eastern massasauga, *Sistrurus catenatus*). A full list of potential joint recovery species is given in Appendix III.

C. Prioritized Strategies for Recovery

Objective 1: Ensure the long-term preservation of remnant Greater Prairie-chicken populations at PRSNA.

Task 1. Establish and protect an additional 1,150 ha (2,840 acres) of grassland habitat at PRSNA in Jasper County and an additional 1,520 ha (3,750 acres) of

grassland habitat at PRSNA in Marion County, within Illinois Natural Areas Inventory boundaries.

Detail. Grassland habitat can be established on lands acquired by public agencies, lands acquired by not-for-profit conservation organizations, or on private lands where habitat is secured by long-term leases or conservation easements. Additional habitat should seek to (1) increase average grassland tract size at PRSNA, (2) increase connectivity among grassland tracts, and (3) increase the % permanent grassland in the landscapes to >40%. At the time of land acquisition, funds should be allocated for site improvements (e.g., wooded fence line removal), prairie pasture development, seed materials, and (depending upon availability of staff and equipment at PRSNA) custom seed bed preparation, planting and management.

Task 2. Develop adequate equipment and staff to establish and manage lands administered as PRSNA. This task is to be completed concurrently with Task 1.

Detail. Prairie Ridge State Natural Area has developed a staffing plan that identifies increased personnel needed as additional lands are established and managed at Prairie Ridge. At present, only one full-time biologist is managing and administering both the Jasper and Marion county units, with actual (if not official) responsibilities including, but not limited to budget, agricultural leases, habitat planning, establishment and management, site and equipment maintenance, monitoring and documenting endangered/threatened species populations, pursuing land acquisition and grants for habitat improvement at PRSNA and adjacent private land, and accomodating visitors and information requests. Sufficient equipment will be needed for preparing seed beds, planting, harvesting seed, and management activities (prescribed fire,

mowing) for large areas (refer to Equipment List prepared by PRSNA staff). Fencing and development of water sources will be required to effectively utilize grazing as a management tool.

Task 3. Increase synergy of protected grassland and adjacent lands by developing cooperative agreements and incentive programs for private landowners.

Detail. PRSNA's design is strongly dependent upon prairie-chickens utilizing agricultural lands for many life needs. As fewer needs are met on private lands, additional management pressure is placed on protected grasslands. Foraging and display habitat are currently available and not limiting in PRSNA landscapes. Elimination of wooded fencerows, establishment of idle grasslands, proper pasture composition and management, and availability of fallow, hay, and small grain brood-rearing areas are readily identifiable actions that can be achieved through these mechanisms. Optimally, >20% of PRSNA landscapes would be maintained as agricultural grasslands, fallow areas, and small grains. If brood-rearing habitat must be largely maintained on PRSNA lands, the land base achieved in Task 1 will be insufficient to achieve Objective 1 criteria.

Task 4. Establish grassland habitat at satellite locations through cooperative agreements, private land incentives, conservation easements, and/or land acquisition.

Detail. At least 200 ha (500 acres) of habitat should be established in blocks >32 ha (80 acres) at each of ≥3 locations. Satellite locations known from the PRSNA region over the past 40 years are described in Appendix VII (see also Figure 4).

Task 5. Develop a program for monitoring prairie-chickens and other species at PRSNA. This task is to be completed concurrently with previously identified tasks.

Detail. At present, prairie-chickens are monitored only by spring lek surveys that are highly dependent upon volunteers. Other species are monitored incidentally or by researchers visiting the site. Additional staff (see PRSNA Staffing Plan) could conduct surveys to monitor populations of special concern species on the site and coordinate with universities and research institutions to address specific information needs (e.g., evaluation of genetic viability, reproductive success, survival, dispersal, habitat use) of prairie-chickens and other species.

Task 6. Develop wildlife viewing opportunities, outreach and conservation education programs, adequate facilities for visitors, and other public uses compatible with the objectives of this plan at PRSNA. This task is to be completed concurrently with previously identified tasks.

Detail. PRSNA is a popular destination for wildlife watching, particularly in spring when prairie-chickens are displaying. Hundreds of visitors per week are common in March and April even though none of the site has been open for public access (a 40-acre area, owned by Illinois Audubon Society, with an interpretive trail has recently been opened). A very limited number of visitors gain access to blinds to watch prairie-chicken courtship, and many of these are accommodated by volunteer guides. A conservation educator could administer a spring blind visitation program, lead site tours, and host classroom groups to take advantage of the considerable education and outreach opportunities present at PRSNA. A headquarters with visitors' center, accessible restrooms and adequate office space is necessary. Additional interpretive trails should be developed. Visitor services should be provided in Marion County as well as Jasper County. It is intended that as additional habitat is established at PRSNA

and the status of prairie-chickens and other prairie wildlife improves, other public uses compatible with the goals of this plan will be adopted on parts of PRSNA (Appendix VI).

Task 7. Classify the remnant prairie-chicken populations as secure when the habitat and population criteria for Objective 1 have been met.

Detail. Prairie-chicken populations have the capacity to grow rapidly under favorable conditions, and can recover from small population size. However, the effective size of the remnant populations is quite small. Genetic and demographic constraints and suboptimal environmental conditions may delay or prevent population recovery. Translocations may be required to expedite recovery when adequate habitat is available.

Objective 2. Downlist the Greater Prairie-chicken to Threatened in Illinois.

Progress on Objective 2 can be made after Objective 1 is met by completing Tasks 1 through 7.

Task 8. When Objective 1 is met, three categories of prairie-chicken habitat must be evaluated for promoting the next stage of recovery:

1. Opportunities for expanding available habitat at PRSNA.
2. Protecting and enhancing habitat naturally colonized by prairie-chickens during successful completion of Objective 1.
3. Translocation of prairie-chickens into existing, unoccupied grassland habitat unlikely to be colonized by natural dispersal.

Detail. The next stage of recovery involves both an increase in total prairie-chicken population and an increase in the number of existing, significant populations. Increasing available habitat at PRSNA would increase total population size. Enhancing

habitat at satellite populations and successful establishment of translocated populations would lead to an increase in total population size and an increase in the number of significant populations. However, the economic and sociopolitical costs of these alternatives are likely to vary considerably. This evaluation stage will identify the appropriate direction(s) for the next stage of recovery.

Task 9. Develop habitat to support, and then establish additional geographically separate, significant prairie-chicken populations.

Detail. At least three geographically separate, significant populations with adequate habitat is a minimum requirement for successfully completing Objective 2. Satellite populations of PRSNA may be developed into these significant populations. Translocations may be appropriate at this stage. Translocation methods and minimum habitat requirements at translocation sites should meet the criteria established in Section V, Part E of this plan, modified by improvements in translocation experience and scientific knowledge of the species.

Task 10. Establish or enhance additional habitat for existing prairie-chicken populations to allow total population size to meet or exceed criteria for completing Objective 2.

Detail. Depending upon the amount of habitat available to existing prairie-chicken populations and synergy of adjacent lands with protected grasslands, additional grassland habitat may need to be established or enhanced to achieve a stable population large enough to meet Objective 2 criteria.

Task 11. Downlist the Greater Prairie-chicken from *Endangered in Illinois* to *Threatened in Illinois* when habitat and population criteria for Objective 2 have been met.

Detail. When the prairie-chicken in Illinois is supported by adequate habitat to support the number of populations of the size and stability defined by Objective 2 criteria, the species is not in danger of extinction in Illinois. This level of recovery warrants a change of status from Endangered to Threatened.

Objective 3. Delist the Greater Prairie-chicken in Illinois.

Progress on Objective 3 can be made after Objective 2 is met through completion of Tasks 8 through 11.

Task 12. When Objective 2 is met, two categories of prairie-chicken habitat must be evaluated for promoting the next stage of recovery:

1. Opportunities for expanding available habitat at existing population locations.
2. Translocation of prairie-chickens into existing, unoccupied grassland habitat unlikely to be colonized by natural dispersal.

Detail. This task is parallel to Task 8. Successful completion of Task 8 can be used as a template for completing Task 12.

Task 13. Develop habitat to support, and then establish additional geographically separate, significant prairie-chicken populations.

Detail. The final stage of recovery requires at least 5 geographically separate, significant populations. This task is parallel to Task 9, and methods for completing Task 9 may be useful for completing Task 13.

Task 14. Establish or enhance additional habitat for existing prairie-chicken populations to allow total population size to meet or exceed criteria for completing Objective 3.

Detail. This task is parallel to Task 10.

Task 15. Delist the Greater Prairie-chicken from *Threatened in Illinois* when habitat and population criteria for Objective 3 have been met.

Detail. When the prairie-chicken in Illinois is supported by adequate habitat to support the number of populations of the size and stability defined by Objective 3 criteria, the species is unlikely to become endangered in Illinois in the foreseeable future. This level of recovery warrants delisting from *Threatened* status.

Task 16. Monitor the recovered population of Greater Prairie-chickens in Illinois in perpetuity.

Detail. The recovered population should be monitored through annual surveys of displaying males at a minimum. Monitoring of genetic integrity of populations, demography, movements and habitat use are appropriate for ensuring effective management and population security. Prairie-chicken management should be proactive to prevent a future population reduction that warrants relisting of the prairie-chicken as *Threatened in Illinois*.

Objective 4. Achieve joint recovery of associated prairie species.

Progress on Objective 4 should be made concurrently with meeting Objectives 1, 2 and 3, but should not delay accomplishment of these objectives.

Task 17. Evaluate the potential for and conduct well-planned scientific reintroductions for species of special concern onto grassland habitat established for

Greater Prairie-chicken recovery when colonization through natural dispersal is unlikely.

Detail. A large amount of excellent habitat for a number of prairie species of special concern will be created as recovery of the Greater Prairie-chicken progresses (see Appendix III). Many of these (especially plants, amphibians and reptiles) have limited dispersal capacity. Reintroductions that do not jeopardize extant donor populations are appropriate to establish new populations of these species.

Task 18. Monitor responses of grassland and wetland species of special management concern on grasslands established or enhanced through prairie-chicken recovery.

Detail. It is anticipated that many species of special concern will respond favorably to grassland habitat establishment and enhancement. Changes in status (e.g., *Endangered* to *Threatened*, or *Threatened* to delisted) will be warranted for several of these species.

VIII Site Evaluations

A team of biologists identified seven areas for evaluation as existing or potential Greater Prairie-chicken habitat (Fig 4). These sites were selected based on historical, current, and/or potential significance for prairie wildlife, including prairie-chickens.

A. Prairie Ridge State Natural Area

Status. Prairie Ridge State Natural Area (PRSNA) currently hosts the only remnant populations of Greater Prairie-chickens in Illinois. The populations number around 100 birds in each Jasper and Marion counties, and have been relatively stable since translocations ended in 1996 (Jasper) and 1998 (Marion). PRSNA is about 1,330 ha (3,300 acres) of grassland habitat (850 ha in Jasper County, 480 ha in Marion County), with a target acreage of 1,600 ha (4,000 acres) in each county. The opportunity for expanding PRSNA is good, as willing sellers approach IDNR staff regularly. Recent sales of land have been for around $2,000/acre in Jasper County and $1,400/acre in Marion County. The entire site is managed for prairie wildlife, particularly threatened and endangered species. PRSNA is a key site in Illinois for endangered grassland birds. Recent breeding populations in Jasper County include 4 to 6 pairs of Upland Sandpipers, 3 to 7 pairs of Northern Harriers, 1 pair of Barn Owls, 1 to 3 pairs of Short-eared Owls, and 70 to 100 singing male Henslow's Sparrows. Populations of the same species are somewhat smaller in Marion County, reflecting a considerably smaller amount of protected grassland habitat: 1 to 4 pairs of Upland Sandpipers, 1 to 4 pairs of Northern Harriers, 1 pair of Barn Owls, 0 to 2 pairs of Short-eared Owls, and 20 to 60 singing male Henslow's Sparrows. Up to a few dozen pairs of Loggerhead Shrikes are located annually on and near PRSNA grasslands in each county.

Display and foraging habitat for prairie-chickens are readily available on adjacent private lands, although nesting, brood-rearing and roosting habitat must be provided almost entirely by PRSNA grasslands. The area is a Conservation Priority Area for the

Conservation Reserve Program (CRP), which may provide additional grassland habitat on private lands in the near future.

Management Challenges. Infrastructure, staff and equipment are inadequate to effectively manage the site at its current size, although a much larger amount of grassland will be necessary to ensure long-term preservation of the remnant prairie-chicken flocks. With a single biologist currently on staff at PRSNA, habitat planning, establishment and management on recently acquired lands will suffer without an immediate increase in human resources. Already, most requests for site visits and presentations on conservation of prairie wildlife are denied.

Encroachment of woody vegetation and tall fescue are constant threats to the habitat. Intensification of agriculture in the area since the 1960s has escalated the need for managed grassland. Genetic and demographic problems faced by the remnant prairie-chicken populations in the early-mid 1990s have been addressed, although chronic small population size may require periodic translocations to prevent inbreeding depression. Nest predation and parasitism of prairie-chickens by pheasants are perceived as potential problems that are adequately controlled by present methods. An egg-laying facility in Marion County has been suggested as a disease source for prairie-chickens.

Actions for Greater Prairie-chicken recovery. The Habitat Plan by Simpson and Esker (1997) calls for establishment of at least 770 ha (1,900 acres) and 1,170 ha (2,900 acres) of additional grassland habitat at PRSNA in Jasper and Marion counties, respectively. New habitats should increase average grassland tract width at PRSNA (>0.8 km or 0.5 mile) and increase connectivity among grasslands (particularly for

prairie-chicken brood movements and less mobile taxa) while maintaining some grassland/cropland interspersion (for foraging and display habitat). A target population of 500 birds is possible on this land base, but would not likely be a long-term (>50 years) viable population. Poor habitat synergy with adjacent private lands will increase the area of protected habitat required to provide nesting, brood-rearing and roosting needs of a viable population, whereas excellent compatibility with adjacent lands would increase the number of birds supported on this land base. Therefore, incentives for private landowners to provide idle grassland habitat, fallow areas, moderately grazed pastures, hay mowed after 1 July, and small grains (over-seeded with legumes and not double-cropped to soybeans) are highly desirable. Further, assistance in converting wooded fence lines into clumps of shrub habitat on private land will improve the open character of these grassland landscapes while enhancing or maintaining small game and wintering habitat.

Incentives for private land habitat or establishment of protected habitat at satellite population sites are necessary to establish a metapopulation structure and provide a mechanism for dispersal and gene flow among the remnant populations. At least 3 satellite locations occupied by prairie-chickens, supported by >200 ha (500 acres) of suitable nesting habitat in blocks >32 ha (80 acres), is an appropriate goal.

At present, facilities at PRSNA are inadequate to handle the relatively small number of visitors. Infrastructure and personnel improvements are critical for hosting a larger number of visitors and taking advantage of the excellent conservation education opportunities at PRSNA. Equipment and staff are also currently inadequate to

effectively manage PRSNA, and additions will be necessary as the land base is expanded.

B. Southwestern Perry County Strip Mine Lands

Status. A tremendous amount of reclaimed strip mine grassland occurs in Perry County and southwestern Illinois. At present, the IDNR has acquired and is developing the roughly 6,500-ha (16,000 acres) "Ark Land" site. Much of this area is in grassland habitat, with large amounts of cropland, wetland/open water, and barren land as well. Management and use of this site has yet to be determined, although compatible uses for dog field trials, a waterfowl refuge, public hunting and fishing, and grassland wildlife management are being sought. Preliminary surveys of the site in 2001 indicate a large breeding population of Henslow's Sparrows (likely 100s of pairs) on the site, and probable breeding by Northern Harriers (Walk 2001b). Large numbers of wintering Short-eared owls and Northern Harriers have also been reported (T. Esker, personal communication).

Management Challenges. Encroachment of woody vegetation is the most serious threat to grassland habitat on reclaimed strip mines. Invasive autumn olive (*Eleaganus umbellata*) and tree plantings seriously threaten to degrade the open landscape character of large parts of the Ark Land property. Large areas of tall fescue provide poor habitat for grassland wildlife. Other large areas are still being reclaimed following mining. At present a high degree of uncertainty remains regarding the future management of the site, including the use of prescribed fire, grazing and haying.

Potential for Greater Prairie-chicken recovery. Tracts of grassland large enough to support prairie-chickens exist in Perry County. Much of the undisturbed grassland is

being degraded by woody encroachment, whereas other areas are overgrazed. In 1979, an attempt to reintroduce prairie-chickens in this region failed (Sparling 1979). Prior to a reintroduction attempt, appropriate grassland management regimes (prescribed burning and grazing) and adequate protection from human disturbance must be established on a large amount of habitat (>2,000 ha, or 5,000 acres). Woody vegetation would need to be essentially eliminated from this area and greatly reduced in adjacent lands to provide a large, open prairie-chicken range (>100 km^2 or about 39 square miles).. Large, open grassland areas with nearby open cropland and pasture currently exist on the Denmark unit of the Ark Land site, and on Arch of Illinois property north of the Ark Land site. The local abundance of cattle would facilitate the use of grazing to achieve proper grassland structure within a management landscape.

C. Prairie Parklands Macrosite

Status. Midewin National Tallgrass Prairie (MNTP), Will County, Illinois, was established by the Illinois Land Conservation Act of 1995, by which the U. S. Army transferred 6,105 ha (15,080 acres) of the former Joliet Army Ammunition Plant to the U. S. Forest Service. Less than 3% of the site is covered with remnants or patches of native vegetation. Although appropriate management of the site is still being discussed, current plans call for a minimum of 3,850 ha (9,500 acres) to be maintained in 6 open, unfragmented grassland areas of 200 to 1,200 ha (500 to 3,000 acres; U. S. Forest Service 2001). Due to the large and increasing human population in northeastern Illinois, demands for access and recreation opportunities are expected to be tremendous. The U. S. Forest Service and the Illinois Department of Natural Resources employ about 30 people at MNTP. MNTP hosts Illinois' largest population of Upland Sandpipers (40-50 birds), as well as 30-40 pairs of Henslow's Sparrows, about 10 pairs of Loggerhead Shirkes, and an estimated 700 breeding Bobolinks (*Dolichonyx oryzivorus*).

Goose Lake Prairie State Park (GLPSP), Grundy County, is the largest remnant tallgrass prairie in Illinois (1,027 ha or 2,537 acres). The site hosts large breeding populations of Henslow's Sparrows (~50 pairs), and Northern Harriers and Short-eared Owls have occasionally nested here. The site also hosts a number of state-listed wetland species, such as American Bitterns, Least Bitterns (*Ixobrychus exilis*), King Rails, Pied-billed Grebes (*Podilymbus podiceps*), and Blanding's Turtles. Much of GLPSP is managed as a natural area with a rotation of prescribed burning and control of encroaching woody vegetation.

Des Plaines State Fish & Wildlife Area (DPSFWA; roughly 2,000 ha or 5,000 acres) is located between MNTP and GLPSP, and hosts 10-15 pairs of breeding Henslow's Sparrows. However, little of the site is open grassland habitat. DPSFWA is managed for multiple uses, including a pheasant rearing facility and put-and-take pheasant hunting program.

In total, about 16,200 ha (40,000 acres) are in public or corporate ownership in the Prairie Parklands macrosite. Much of the area near the Des Plaines, Kankakee, and Illinois Rivers is forested. Urbanization of the region is occurring rapidly, with the human population expected to double in about 20 years.

Management Challenges. Developing management protocol acceptable to diverse interest groups appears to be a challenge at MNTP. Removal of fragmenting woody vegetation and restoration of native plant communities are large tasks for the future. Throughout the Prairie Parkland, encroachment of woody vegetation and invasive, nonnative plants threaten to degrade grassland habitat without active control through prescribed burning, grazing, herbicides, and manual and mechanical removal. Limited areas of toxic contamination occur in MNTP and corporate lands in the Prairie Parkland.

Potential for Greater Prairie-chicken recovery. A very large amount of public and corporate-owned lands in the macrosite offers good potential for managing grassland habitat and restoring prairie wildlife. Ring-necked pheasants are abundant at GLPSP, released at DPSFWA, and uncommon at MNTP. Land use is an interspersion of urban areas, wooded habitats, grassland and agriculture.

A gross examination of the macrosite revealed the portion west of Illinois Route 53 was too wooded and urbanized to be considered for a prairie-chicken reintroduction. The eastern portion of MNTP may have good potential for prairie-chicken reintroduction when grassland restoration and wooded fence line removal is complete. The surrounding landscape is open and agricultural, although subdivision and urbanization are expected to surround MNTP in 10 years. This change is not compatible with prairie-chicken reintroduction and management. Whether accomplished by acquisition, conservation or scenic easements, or other incentives, a large, grassland-agricultural landscape (>100 km^2 or about 39 square miles) with a minimum amount of wooded and urban land cover must be secured prior to a prairie-chicken reintroduction attempt.

Several utility transmission lines border and cross the eastern portion of MNTP, which may adversely affect prairie-chickens. Birds may avoid areas near these lines, or collide with them during inclement weather. The military legacy of the Joliet Army Ammunition Plant—roads, rails, and ammunition storage bunkers—raises the question of how prairie-chickens might respond to this infrastructure, although much of this is likely to be removed.

D. Lost Mound National Wildlife Refuge

Status. The Lost Mound National Wildlife Refuge (LMNWR) was formerly part of the Savanna Army Depot. About 3,600 ha (9,000 acres) will be transferred from the Department of the Army to the U. S. Fish & Wildlife Service. This site includes about 1,400 ha (3,500 acres) of grassland, mostly remnant sand prairie, plus about 400 ha (1,000 acres) of grassland on adjacent lands. These grasslands have a long history of cattle grazing, suspended in 1999. Future management will use prescribed fire and grazing to achieve grassland management objectives. A management plan is being developed to restore the site as nearly as possible to a native prairie-savanna community. Prairie wildlife resources of the site include probably 2 breeding pairs of Upland Sandpipers, 5-6 pairs of Henslow's Sparrows (observed for the 1st time in 2001), possibly breeding Northern Harriers, and a disjunct population of about 5 pairs of Loggerhead Shrikes. Grasshopper Sparrows (*Ammodramus savannarum*) and Western Meadowlarks (*Sturnella neglecta*) are the most common grassland birds (Wenny 2001).

Management Challenges. The legacy of Savanna Army Depot remains at LMNWR with 437 "igloos" (earth-covered ammunition storage bunkers), 110 km (68 miles) of rail and 240 km (150 miles) of gravel roads. The goal is to remove most of the rail and gravel roads. Localized areas of toxic contamination occur, as does unexploded ordinance in some of the upland area. In the past, overgrazing has been detrimental to prairie wildlife. Until a grazing and prescribed burning program is instituted to reduce fuel build up, the risk of wildfire is somewhat high. Invasive, nonnative vegetation is a moderate threat to the grassland habitat, as is encroachment of woody vegetation. Photos of the area from the early 20th century show a

considerably less wooded landscape (Gleason 1910), but visualize an appropriate restoration goal.

Potential for Greater Prairie-chicken Recovery. LMNWR and adjacent lands include marginally sufficient grassland for consideration of prairie-chicken reintroduction (1,800 ha or 4,500 acres). The structure of the sand prairie vegetation is good to excellent for the species. A major question would be prairie-chicken response to igloos. In some aspects, the igloo fields resemble "built-up" areas that would discourage prairie-chickens (Merrill et al. 1999). However, all sides of the igloos except for the faces are earth-covered and support grassland vegetation.

The landscape surrounding LMNWR is less than ideal for prairie-chickens. Mostly, this is a forested landscape with the open sand prairie and some agricultural area perched between the Mississippi River and floodplain forests to the west and forested bluffs to the east. Open agricultural lands (rowcrop, pasture, hay) are found along the southern and eastern edge of LMNWR. Because of this landscape context, prairie-chickens may not use much of LMNWR's grassland area. A possible disease concern is a captive duck propagation center near Hanover, IL.

E. Nachusa Grasslands

Status. This site, owned and managed by The Nature Conservancy, is based on a remnant prairie. Through land acquisition and diligent restoration since 1986, Nachusa Grasslands has expanded to over 485 ha (1,200 acres). The target size of the site is 1,200 ha (3,000 acres). The entire site is open for public access, and restoration of native plant communities has been the focus of restoration and management efforts. About 20 pairs of Henslow's Sparrows nest at Nachusa Grasslands. Upland Sandpipers are occasional breeders, and Northern Harriers are a possible nesting species.

Management Challenges. Invasive plants are the greatest threat to the remnant and restored prairie areas of Nachusa Grasslands. Woody vegetation is removed where appropriate (e.g., fence lines). Urbanization is moving near Nachusa Grasslands from the Dixon area. The goal is to acquire the target acreage "before the bulldozers come" (J. Stacy, personal communication).

Potential for Greater Prairie-chicken recovery. The amount of grassland habitat would need to be expanded by about 1,600 ha (4,000 acres) for prairie-chicken reintroduction to be considered. Relative proximity to Green River Conservation Area (about 32 km or 20 miles) offers the possibility of one of these sites serving as a satellite population to the other. Abundance of Ring-necked Pheasants is a major concern for Lee County prairie-chicken restoration. Urbanization of the region bodes poorly for prairie-chicken management. Within Nachusa Grasslands, scattered brush would need to be reduced for prairie-chicken habitat. Limited grazing might also be warranted to

achieve proper vegetation structure if the site is identified for a prairie-chicken reintroduction attempt.

At present, the area around Nachusa Grasslands is diversified agriculture, and with some removal of wood lots and fence lines, could become an open grassland-agriculture landscape attractive for sensitive prairie wildlife (particularly to the east of Nachusa Grasslands). Proper grazing management would vastly improve the value of the significant pasture acreage near Nachusa Grasslands.

F. Green River State Wildlife Area

Status. Initially purchased at least in part to preserve prairie-chickens, Green River SWA, a 1,040-ha (2,565 acre) site, has not hosted this species since about 1960. Public hunting is the primary management objective at GRSWA, and 16 cultivated food plots are scattered throughout the site. Field trials and a put-and-take pheasant hunting program have both recently been suspended at GRSWA. A shooting preserve operates on the north side of the area. Some of the site is good quality remnant sand prairie. Woody vegetation is being controlled, but dominates the east and northeast portions and fragments open areas throughout GRSWA. Land surrounding GRSWA is primarily rowcrops and, except along the Green River, treeless. Some idle and agricultural grasslands occur on the west side of GRSWA. The Maytown Habitat Area (65 ha, 160 acres) and Sand Prairie Habitat Area (128 ha, 316 acres), each managed for upland game, occur within 8 km (5 miles) of GRSWA.

Management Challenges. At present, woody vegetation fragments and borders areas that could be large open grassland areas valuable to prairie wildlife.

Potential for Greater Prairie-chicken Recovery. At just over 1,000 ha (2,500 acres), GRSWA is too small to support a viable population for Greater Prairie-chickens. The structure of little bluestem (*Schizachyrium scoparium*) prairie remnants appears excellent for prairie-chickens, whereas moister areas would require grazing or mowing to achieve proper structure. Most of the grassland areas are in fragments too small or too wooded to be well-used by prairie-chickens and other sensitive grassland birds. High disturbance from public hunting pressure is incompatible with prairie-chicken reintroduction, but without this hunting pressure, the abundance of pheasants at GRSWA would increase. Experience at PRSNA suggests prairie-chickens and pheasants cannot coexist on relatively small reserves in Illinois. The landscape surrounding GRSWA is open and would provide foraging and display habitat, but lacks nesting, brood-rearing, and roosting habitat.

G. Iroquois County Conservation Area

Status. The initial purchase at Iroquois State Wildlife Area (ICSWA) was made in 1944 to protect declining prairie-chicken populations. Prairie-chickens were extirpated from the area by 1960, and public hunting has become the primary use. A put-and-take pheasant hunting program operates on the site. The 1,004-ha (2,480 acres) site includes the 194-ha (480 acre) Hooper Branch Nature Preserve, a remnant black oak (*Quercus velutina*) savanna. The northern and eastern portions of ICSWA are black oak forest, while the western and southern portion is an expansive sedge meadow, wet prairie and marsh complex. A total of 13 threatened or endangered species have been recorded at ICSWA. The proposed Grand Kankakee Marsh National Wildlife Refuge may create a large amount of additional grassland and wetland habitat near ICSWA.

Management Challenges. Encroaching woody vegetation and nonnative, invasive plants are the main threats to grassland habitat at ICSWA. Recent efforts have reversed many areas of woody succession. Wildfire periodically occurs throughout the Kankakee Sands ecosystem. Over-grazing occurs on much of the surrounding black oak savanna.

Potential for Greater Prairie-chicken Recovery. The situation at ICSWA is similar to GRSWA. The site is too small for prairie-chicken reintroduction, and is bordered and fragmented by woody vegetation that eliminates the open grassland aspect required by prairie-chickens and other sensitive grassland birds. A public hunting focus and put-and-take pheasant program are incompatible with prairie-chicken reintroduction. Most of the surrounding landscape is open, but provides little potential nesting, brood-rearing or roosting habitat. Within ICSWA, much of the grassland area is too rank for prairie-chickens, and grazing, mowing or haying would be required to achieve appropriate habitat structure.

H. Potential Greater Prairie-chicken habitat identified by "Indicator Species"

Breeding season occurrences from 1990 to 2000 of five Illinois endangered grassland birds were solicited from the Illinois Natural Heritage Database. These five species were the Greater Prairie-chicken, Northern Harrier, Upland Sandpiper, Short-eared Owl, and Henslow's Sparrow. Concentrations of these species were analyzed at two levels of resolution: by county and by township.

Jasper and Marion counties were the only counties in Illinois with recent breeding season records of all five of the species considered. Because the remnant Greater

Prairie-chicken populations only occur at PRSNA in these two counties, other counties were not expected to host all five species.

However, none of Illinois' 102 counties hosted the remaining four species. Five counties had records of three species (Champaign, Lee, McHenry, Vermillion, and Will), and four counties had records of two species (DuPage, Effingham, Jo Daviess, and Winnebago).

The township level is approximately the size of a minimum prairie-chicken range proposed in this document, and is therefore an appropriate scale for examining concentrations of these indicator species. Only one township in Illinois was represented in the Natural Heritage Database by recent records of all five species (T6N, R9E; Jasper County). This is the Jasper County unit of PRSNA. Two townships in Marion County had records of four of the five species (T4N, R3E and T3N, R3E). These townships encompass the PRSNA grasslands in Marion County. Two townships in Will County (T34 n, R9E and T33N, R9E) had occurrences of three species (Northern Harrier, Upland Sandpiper, and Henslow's Sparrow). This area is commonly known as MNTP. Two townships in Lee County (T22N, R10E and T19N, R8E; "Nachusa Grasslands" and "GRSWA," respectively), one township in DuPage County (T38N, R9E), and one township in McHenry County (T446N, R8E) each hosted two species.

This exercise affirms the crucial role PRSNA plays in preserving Illinois' endangered grassland birds, and emphasizes the need for improving and/or expanding grassland habitat at other sites in order to harbor intact or nearly intact grassland bird communities. This method did not reveal significant concentrations of grassland birds that biologists failed to recognize *a priori*. Indeed, the two methods revealed many of

the same sites. A shortcoming of this method is incomplete reporting of known occurrences to the Illinois Natural Heritage Database. Some of these species may have wider distributions than reflected in the database. For example, at PRSNA in Marion County, Henslow's Sparrows are known to occur, but documentation was not found in the database.

Incomplete documentation of these indicator species prohibited the extension of this exercise outside of Illinois. Published and unpublished accounts of prairie wildlife from adjacent states (Indiana, Iowa, Missouri, Wisconsin) affirm prairie-chickens are the most conservative member of this group of species and that the habitat, area and landscape features influencing each species, as considered here, are valid. Site evaluations and analysis of occurrence of indicator species in Illinois both demonstrate that no site in Illinois is currently appropriate for a prairie-chicken reintroduction attempt.

IX Summary

The Greater Prairie-chicken is a tallgrass prairie species of conservation concern throughout its range, and is listed as *Endangered in Illinois*. Due to its wide-ranging habitats and diverse habitat needs, the prairie-chicken is a good umbrella species for prairie wildlife. At present, prairie-chickens only remain at Prairie Ridge State Natural Area in Jasper and Marion counties in Illinois, where habitat is inadequate to support viable populations. Suitable habitat does not currently occur at other sites in Illinois. This plan outlines the methods and resources necessary for the recovery of the Greater Prairie-chicken and associated wildlife in Illinois.

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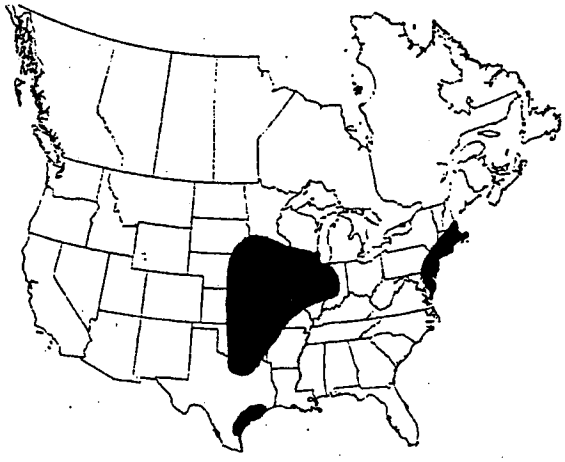
A.



B.

C.

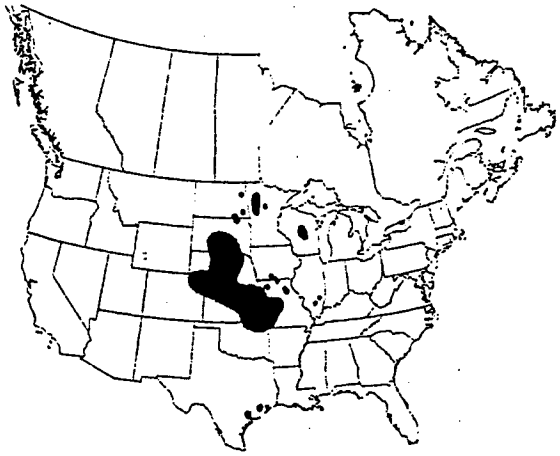


Figure 1. Range of the Greater Prairie-Chicken in 1800 (A), 1900 (B), and 2000 (C).

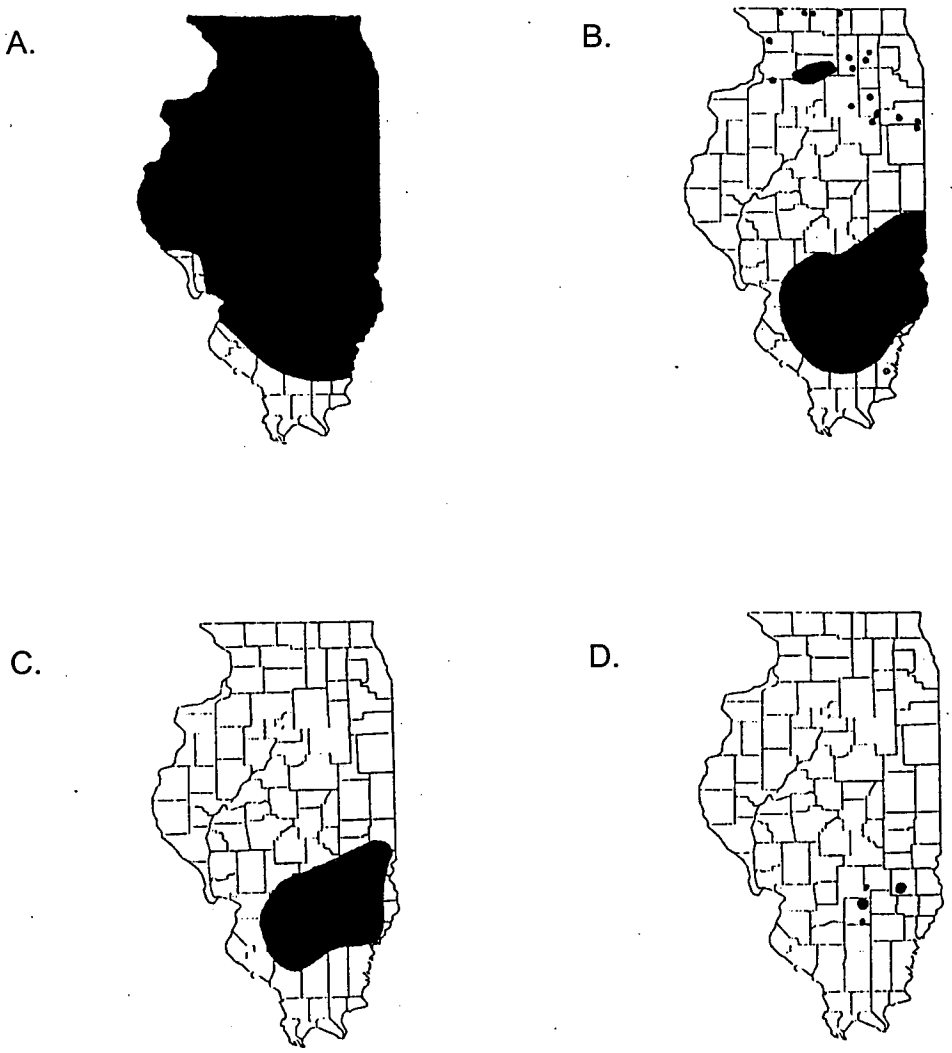


Figure 2. Distribution of Greater Prairie-chickens in Illinois: 1900 (A), 1940 (B), 1960 (C), 2002 (D).

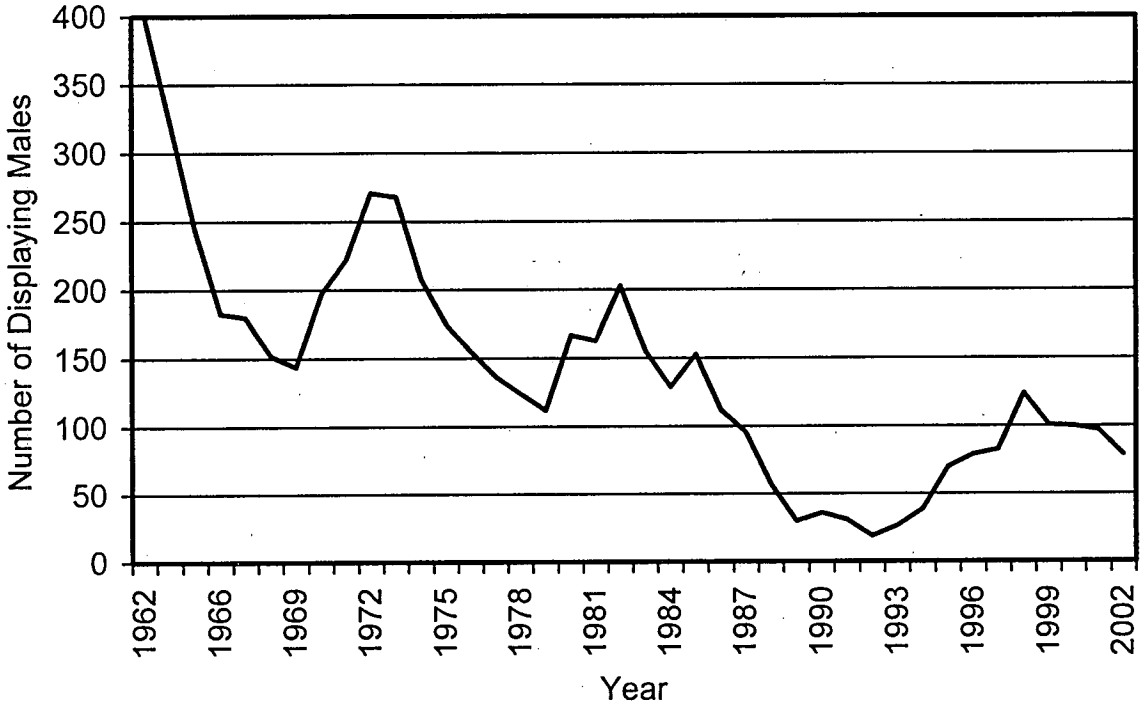


Figure 3. Total number of displaying male Greater Prairie-chickens in Illinois, 1962-2002. Translocation of 518 birds occurred from 1992 to 1998.

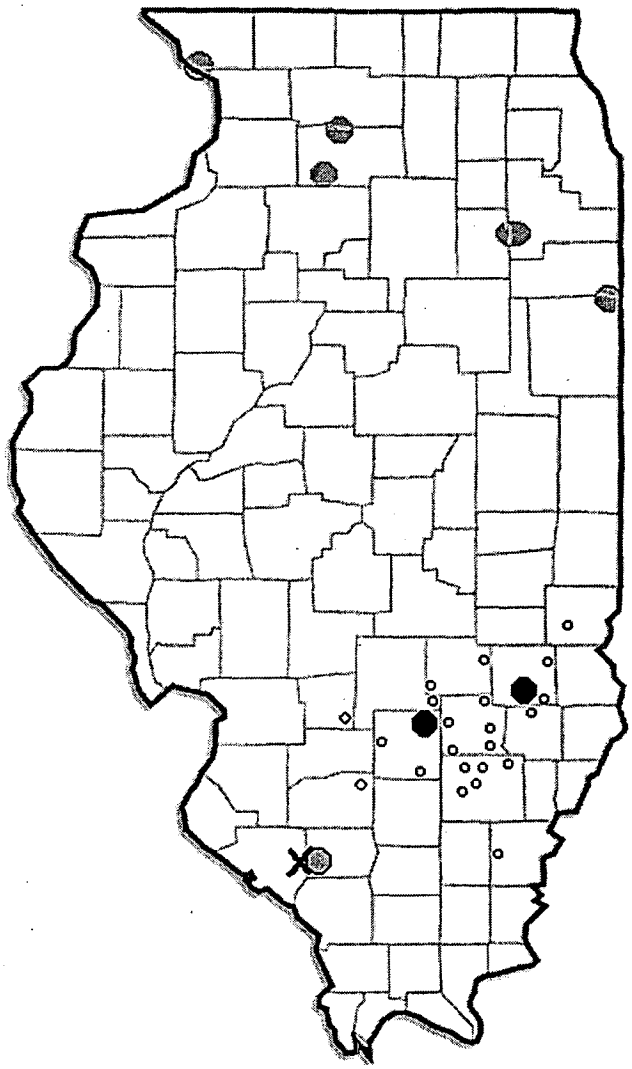


Figure 4. Locations in Illinois of remnant Greater Prairie-chicken populations at Prairie Ridge State Natural Area (black circles), sites evaluated for potential prairie-chicken reintroduction (gray circles), site of an unsuccessful reintroduction attempt (X), and satellite populations during the PRSNA era (1962-2002; small hollow circles).

Appendix I

Determination of genetically effective population size, N_e, for Greater Prairie-chickens

The effects of skewed sex ratio, nonrandom mating, and not all individuals breeding is estimated by the equation:

$$N_e = (4N_mN_f)/(N_m + N_f)$$

where N_m is the number of breeding males and N_f is the number of breeding females (Meffe and Carroll 1994). In the best-case scenario, 40% of males successfully mate (estimate of all males >1 yr old), and the sex ratio is 1.1:1. This results in an N_e that is 58% of the census population. In the worst-case scenario, 10% of males successfully-mate (approximation of 1 dominant male at an average lek of 11 males) and the sex ratio is 1.6:1. This results in an N_e that is 21% of the census population. This calculation does not account for variance in reproductive success among females (which is considerable due to nest failure and brood mortality) or annual population fluctuation. It is reasonable that the genetically effective population size in Greater Prairie-chickens may be <20% of the census (or actual) population size. A genetically effective minimum viable population of 500 requires a census population of 860 to >2,500 birds.

Appendix II

Guidelines for Interagency Prairie Grouse Translocation Projects: Trapping Request Protocols and Prioritization of Requests

Prepared by the Prairie Grouse Technical Council, September 1991

(DRAFT)

Rationale

Management of small prairie grouse populations has often involved translocating wild birds from large populations to either augment existing populations or establish new populations in unoccupied habitat. Although the past success of these efforts has been mixed, translocation will likely remain a standard part of managing small grouse populations in isolated habitats.

Interagency translocations of prairie grouse obviously require cooperation between donor and recipient states and provinces. To help facilitate this cooperation and to specify translocation priorities for international, national, and regional prairie grouse conservation, the following guidelines concerning trapping request protocols and request prioritization criteria were formulated by the Prairie Grouse Technical Council. These guidelines help identify information and services that donor and recipient states can generally expect from each other. However, states are not bound by these guidelines, and are instead expected to use them as a resource to formulate protocols that best suit their individual needs and responsibilities within the context of prairie grouse conservation priorities at regional and range-wide scales.

Trapping Request Protocol

Although each donor state has a unique administrative protocol for processing wildlife trapping and translocation requests, there are a few common expectations. First, the translocation request should be accompanied by a detailed project proposal, including the planned timetable for translocation activities, number and sex of birds requested, and any plans

for subsequent population monitoring and program evaluation procedures in the recipient state. Proposals containing specific plans for achieving a minimum viable population of birds are particularly encouraged. Requests should generally be received by the source state agency no later than January 1 of the year of the planned trapping activities; earlier requests are preferred. The source state should acknowledge receipt of the request within two weeks and identify the date by which a decision will be made concerning the request. When officially notifying recipient states in writing of permission to trap, source states should detail timetables for all reporting and permitting requirements, and identify staff members with which to coordinate trapping activities.

Request Prioritization Criteria

Occasionally, donor states and provinces can and will be faced with choosing among several worthy requests for birds during a particular time frame. Presently, donors prioritize requests based on criteria unique to their administration's objectives and interests, which may or may not incorporate consideration for regional prairie grouse conservation. Further, even if donors wished to consider larger-scale issues, there is currently no documented consensus among grouse managers regarding range-wide grouse conservation priorities and objectives.

To address this information need, the following list of objectives and characteristics of translocation projects are presented in priority order, followed by a brief discussion of the rationale behind these priorities.

The recommended priorities for project objectives are:

1) Increase the size or genetic diversity of an existing, small, isolated population of a federally listed threatened or endangered species, subspecies, or population.
2) Establish a new population of a federally listed threatened or endangered species, subspecies or population in vacant but suitable habitat.

3) Establish captive flocks for research requiring the use of surrogate species as part of recovery programs for federally listed threatened or endangered species, subspecies, or populations.
4) Increase the size or genetic diversity of an existing small, isolated population not federally listed as threatened or endangered.
5) Establish a new population of a species not federally listed as threatened or endangered in vacant but suitable habitat.
6) All other possible uses of translocated birds.

The above priorities reflect an emphasis on aiding management of federally listed species and providing direct assistance to maintain small but extant populations. Although a few pasts translocation efforts have involved management of federally listed species the number of listed species, subspecies, and populations will likely increase in the future.

If two competing requests with similar objectives are received, other factors could be considered. In order of importance, we suggest source states give priority to projects involving 1) species listed as threatened or endangered in the recipient state, 2) collateral data collection (e.g., intensive post-release population monitoring, blood samples for disease or genetic evaluation), 3) fewer numbers of birds, and 4) direct or in-kind payments to source states from recipient states.

Appendix III

Potential Prairie Species for Joint Recovery with Greater Prairie-chickens

Species	Status in Illinois	Status at PRSNA
Plants		
Mead's Milkweed, *Ascepias meadii*	Endangered	--
Grass Pink Orchid, *Calopogon tuberosus*	Threatened	--
White Lady's Slipper, *Cyrinpedium candidum*	Endangered	--
Prairie Bush Clover, *Lespedeza leptostachya*	Endangered	--
Blazing Star, *Liatris scatiosa nieuwlandii*	Threatened	Remnant (Jasper)
Prairie White Fringed Orchid, *Platanthera leucophaea*	Endangered	--
Prairie Rose Gentian, *Sabatia campestris*	Endangered	Reintroduction
Royal Catchfly, *Silene regia*	Endangered	Reintroduction (Jasper)
Eastern Blue-eyed Grass, *Sisyrinchium atlanticum*	Endangered	--
Spring Ladies Tresses, *Spiranthes vernalis*	Endangered	--
Prairie Spiderwort, *Tradescantia bracteata*	Endangered	--
Ear-leafed Floxglove, *Tomanthera auriculata*	Endangered	--
Buffalo Clover, *Trifolium reflexum*	Endangered	--
Invertebrates		
Red-veined Prairie Leafhopper, *Aflexia rubranura*	Threatened	--
Leafhopper, *Chlorotettix sp.*	Endemic	Endemic (Marion)
Small Prairie Cicada, *Ciadetta calliope*	Rare[1]	--
Large Prairie Cicada, *Tibicen dorsata*	Rare[1]	Present
Pyrota mutata (parasitic beetle of native bees)	Rare[1]	--
Nemognatha lurida (parasitic beetle of native bees)	Rare[1]	--
Zonitis vittiqera (parasitic beetle of native bees)	Rare[1]	Present (Marion)
Macrosigon dimidiatum (Hyperparasitic beetle of wasps)	Rare[1]	Present (Marion)
Macrosiagon limbatum (Hyperparasitic beetle of wasps)	Rare[1]	Present
Arogos Skipper, *Atrytone arogos*	Endangered	--
Eryngium Stem Borer, *Papaipema eryngii*	Endangered	--
Regal Fritillary, *Speyeria idalia*	Threatened	--
Andrena rudbeckiae (native bee)	Rare[1]	Present (Marion)
Melissodes boltoniaei (native bee)	Rare[1]	--
Melissodes coloradensis (native bee)	Rare[1]	Present (Jasper)
Melissodes comptoides (native bee)	Rare[1]	Present (Jasper)
Melissodes dentiventris (native bee)	Rare[1]	--
Melissodes wheeleri (native bee)	Rare[1]	--
Vertebrates		
Crayfish Frog, *Rana areolata*	Status poorly known	Breeding
Ornate Box Turtle, *Terrapene ornate*	Status poorly known	Breeding
Blanding's Turtle, *Emydoidea blandingii*	Threatened	Present (Jasper)
Kirtland's Snake, *Chlonophis kirtlandii*	Threatened	Reintroduction (Marion)
Eastern Massasauga, *Sistrurus catenatus*	Endangered	--
Pied-billed Grebe, *Podilymbus podiceps*	Threatened	Migrant
American Bittern, *Botaurus lentiginosus*	Endangered	Breeding (Jasper)
Least Bittern, *Ixobrychus exilis*	Threatened	Breeding
Northern Harrier, *Circus cyaneus*	Endangered	Breeding
Greater Prairie-chicken, *Tympanuchus cupido*	Endangered	Breeding
Northern Bobwhite, *Colinus virginianus*	Conservation priority[2]	Breeding
Black Rail, *Laterallus jamaicensis*	Endangered	Migrant
King Rail, *Rallus elegans*	Endangered	Breeding
Sandhill Crane, *Grus Canadensis*	Threatened	Migrant
Upland Sandpiper, *Bartramia longicauda*	Endangered	Breeding

Barn Owl, *Tyto alba*	Endangered	Breeding
Short-eared Owl, *Asio flammeus*	Endangered	Breeding
Red-headed Woodpecker, *Melanerpes erythrocephalus*	Conservation priority[2,3,4]	Breeding
Loggerhead Shrike, *Lanius ludovicianus*	Threatened	Breeding
Bell's Vireo, *Vireo bellii*	Conservation priority[2,3,4]	Breeding
Sedge Wren, *Cistothorus platensis*	Conservation priority[4]	Breeding
Field Sparrow, *Spizella pusilla*	Conservation priority[2,4]	Breeding
Henslow's Sparrow, *Ammodramus henslowii*	Endangered	Breeding
Grasshopper Sparrow, *Ammodramus savannarum*	Conservation priority[2,4]	Breeding
Dickcissel, *Spiza americana*	Conservation priority[2,3,4]	Breeding
Bobolink, *Dolichonyx oryzivorus*	Conservation priority[3,4]	Migrant
Eastern Meadowlark, *Sturnella magna*	Conservation priority[4]	Breeding
Franklin's Ground Squirrel, *Spermophilus franklinii*	Status poorly known	--
Badger, *Taxidea taxus*	Rare	Present

[1] Insect of Rare Occurrence in Illinois: Bouseman 1997
[2] Partners in Flight Priority Species for the Prairie Peninsula: Fitzgerald et al. 2000
[3] National Audubon Society Watch List: National Audubon Society 2001
[4] Migratory Nongame Birds of Management Concern, Region 3: U.S. Fish & Wildlife Service 1995

Appendix IV

Species Indicating Potential Greater Prairie-chicken Habitat

Habitat Type:

Nesting	Brood-rearing	Roosting	Area	Landscape
SEOW	**UPSA**	**NOHA**	**UPSA**	**UPSA**
UPSA	SEOW	**HESP**	**HESP**	**SEOW**
NOHA		SEOW	NOHA	NOHA
HESP			SEOW	

(Primary indicator species are in bold-faced type)

Area refers to species that have been consistently reported from the Midwest as sensitive to grassland area, preferring or requiring larger habitats.

Landscape refers to species that are considered sensitive to landscape composition, preferring or requiring landscapes with high grassland land cover and a little or no woody vegetation.

Abbreviations:

HESP = Henslow's Sparrow, *Ammodramus henslowii*

NOHA = Northern Harrier, *Circus cyaneus*

SEOW = Short-eared Owl, *Asio flammeus*

UPSA = Upland Sandpiper, *Bartramia longicauda*

Appendix V

Schedule and Estimated Costs for Objective 1

Schedules and cost estimates are not made for Objectives 2 and 3, as progress on these objectives is based on accomplishment of Objective 1, and any such schedules or cost estimates are highly speculative. Similarly, a schedule and cost estimate are not made for Objective 4. Although to be completed concurrently with Objective 1, recovery of other species depends on appropriate actions for these species. This level of detail is beyond the scope of this plan.

In this schedule, additions and improvements are made to PRSNA and satellite habitats in 11 years. Actual completion of Objective 1 depends upon population response by prairie-chickens, which may require longer than 11 years.

Task 1. Habitat establishment and protection at PRSNA.

- Establish 500 acres/year in each Jasper and Marion County, within Illinois Natural Areas Inventory boundaries as identified in the Habitat Plan, until target acreage is reached
- Increase budget at PRSNA to accommodate habitat development and management of additional land base
- Complete task by Year 6 (Jasper County) and Year 8 (Marion County)
- Estimated Cost: $2,000/acre (Jasper County) and $1,400/acre (Marion County for land acquisition. Conservation easements may be

attractive to landowners at 10 times annual land rental rates, or 40-60% of acquisition cost.

Task 2. Achieve goals identified in the PRSNA Staffing Plan and Equipment List.

Task 3. Improve private lands habitat within Natural Areas Inventory boundaries.

- Replace wooded fence lines in Jasper or Marion County or near satellite populations with patches of native shrubs, as prescribed by managers, using an incentive program and/or IDNR resources
- Begin incentive program to provide brood habitat (improved hay or pasture, small grains overseeded with legumes, fallow) on private lands in the year following completion of Task 1 in each county. Provide 200 acres during the 1st year of incentives, 400 acres the second, and maintain 500 acres in each county thereafter
- Task 3 is continued as necessary to provide appropriate brood habitat on private lands near PRSNA
- Estimated Cost: Compatible/improved agricultural practices are estimated to be attractive to private landowners at annual rental rates for cropland (roughly $100/acre).

Task 4. Establish or protect satellite population habitat.

- Begin establishing habitat at 3 locations by Year 4
- Establish 200 acres in the first year at each site, adding 100 acres/year until 500 acres are protected at each site
- Complete satellite land acquisition in Year 7; continue private land incentives as necessary to maintain satellite habitat

- Estimated Cost: Varies as habitat is protected by land acquisition, conservation easements (costs estimated above in Task 1) or annual rental (cost estimated above in Task 2).

Task 5. Institute monitoring program for threatened and endangered species.

- Complete this task in Year 1
- Estimated Cost: 1 Full-time Position Natural Resources Coordinator

Task 6. Build a new headquarters/visitor center for PRSNA.

- Build a new headquarters building for PRSNA; this is consistent with completing Task 2
- The Natural Resources Coordinator (Task 5) is utilized to provide visitor education services of this task
- Complete this Task by Year 4
- Estimated Cost: $1,000,000

Task 7. Classify prairie-chickens as secure.

- Meeting of criteria described for completion of Objective 1 should be known based on Task 5 results
- The earliest that Task 7 could be completed is Year 11; prairie-chicken population response may require a longer period

Appendix VI

Potential Public Recreation at Prairie Ridge State Natural Area

Public recreation opportunities at Prairie Ridge State Natural Area are closely tied to environmental education opportunities. At present, the marginal land base, exceptionally high concentrations of threatened, endangered and sensitive species, inadequate staffing, and absence of facilities in Marion County, preclude IDNR from capitalizing on these opportunities. Nevertheless, a number of recreational/education efforts are being made at PRSNA, and are supported by a site brochure, wildlife viewing guide, various checklists and special efforts of site staff.

Present Public Opportunities	Restrictions
Wildlife viewing	Public roadways throughout PRSNA
Hiking, Nature Study	Interpretive trail, wetland-viewing platform at Robert Ridgway Grassland Nature Preserve in Jasper County
Prairie-chicken viewing from blinds	By special arrangement with site staff; extremely limited to about 5 groups/year
Spring Bird Count	1-day event, accompanied by site staff
Christmas Bird Count	1-day event, accompanied by site staff
Scientific research	By permit issued by IDNR, Illinois Nature Preserves Commission and Endangered Species Protection Board, as appropriate

Other special arrangements with site staff

As additional habitat is protected at PRSNA, a number of public uses will be considered for non-core or peripheral tracts, provided staffing resources are available at PRSNA, and IDNR prairie wildlife biologists determine these activities are compatible with the objectives of this Plan. All activities will be restricted with respect to specific locations, breeding seasons and presence of threatened, endangered or sensitive species.

Possible activities for Non-Core Areas	**Additional restrictions**
Wildlife viewing / Bird watching	
Nature study	
*Photography	
Hiking	Trail availability and condition
Gathering (nuts, berries, mushrooms)	Limited number of permits
Furbearer Hunting	Limited number of permits, limited season
Furbearer Trapping	Limited number of permits, limited season
Waterfowl hunting	Limited number of permits, limited season
Deer hunting (archery & firearm)	Limited number of permits, limited season

*Excludes special access to blinds for photographing prairie-chickens. With a secure population of prairie-chickens (see criteria for this definition in Section VII, Part B, Objective 1) and adequate staffing (see PRSNA staffing plan), an expanded, guided, and public prairie-chicken viewing program would be feasible. Until that time, prairie-chicken viewing, not including roadside viewing, will continue to be offered on an extremely limited basis, if at all. To minimize disturbance, no lek should be visited more than 2-3 days per week.

Appendix VII

Potential Satellite Population Locations in Southeastern and South-Central Illinois

County	Site name	Last Occupied by Prairie-chickens
Bond	Hookdale	1967
Clark	Martinsville	1968
Clay	Bible Grove	1976
	Clay City	1966
	Oskaloosa	1993
	Sailor Springs	1968
	Xenia	1965
Effingham	Dieterich	1965
	Loogootee	2002
Fayette	LaClede	1971
Jasper	Hunt City	1995
	West Liberty	1967
Marion	Fairman	1973
	Kell	2002
Richland	Onion Hill	1993
Washington	Hoyleton	1981
Wayne	Cisne	1968
	Geff	1969
	Johnsonville	1966
	Mt. Erie	1983
	Sims	1969
White	Enfield	1998

Appendix VIII

Supporting Organizations

As a popular, charismatic species, Greater Prairie-chickens create strong support for prairie conservation action. In Illinois, a large number of organizations have provided key support for preserving the remnant flocks of prairie-chickens. This support has come in the form of funding, land acquisition or "pre-acquisition," resource protection, and research. Cultivating relationships among these organizations and public agencies will be a key element of successful recovery of Greater Prairie-chickens in Illinois.

State Agencies

Illinois Department of Natural Resources - Responsible for land acquisition and management of PRSNA grasslands; Secure prairie-chickens for genetic management plan; Support prairie-chicken research; Law enforcement patrol of PRSNA area to protect prairie-chickens and sensitive wildlife; Assist private landowners in creating/managing habitat

Illinois Natural History Survey – Research for prairie wildlife conservation

Illinois Nature Preserves Commission – Protect critical habitats as dedicated nature preserves and land and water reserves, including 562 acres of PRSNA as dedicated nature preserves and 2,133.3 acres of land and water reserves

Endangered Species Protection Board – List and protect threatened and endangered species; Provide technical support for monitoring, research and management of listed species

State Universities – Eastern Illinois University and University of Illinois have supplied undergraduate interns and graduate researchers to PRSNA

Soil and Water Conservation Districts (Jasper and Marion Counties) – Assist with C2000 Grants for Landowner Incentive payments for the Conservation Reserve Program

Federal Agencies

U. S. Fish & Wildlife Service – Award challenge grants for wetland construction; Evaluate species for protection under the Endangered Species Act of 1973

U. S. Department of Agriculture, Natural Resource Conservation Service – Technical assistance in wetland/waterway construction; Cooperation in developing Conservation Priority Area for the Conservation Reserve Program at PRSNA

Private Organizations

Illinois Audubon Society – Generate broad-based support for prairie wildlife conservation; Active participant in land acquisition at PRSNA in Jasper and Marion County

The Nature Conservancy – History of acquiring and pre-acquiring lands for PRSNA

National Fish & Wildlife Foundation – Awarded matching funds for land acquisition at PRSNA

Grand Victoria Foundation – Awarded matching funds for land acquisition at PRSNA

AmerenCIPS – Public utility company owning land adjacent to PRSNA in Jasper County; 200 acres traditionally associated as part of PRSNA