WISCONSIN GREATER PRAIRIE-CHICKEN MANAGEMENT PLAN 2004-2014

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EXECUTIVE SUMMARY

The Greater Prairie-Chicken (*Tympanuchus cupido pinnatus)* (GPC) is a native grouse species historically found in large, open grassland ecosystems across the tallgrass prairie region. Since the turn of the twentieth century this species has been extirpated from almost half of this region and like many other species of grassland birds is in serious decline. Loss and fragmentation of grassland habitat due to intensification of agricultural practices, woodland succession, fire control, and urban development have all worked to make landscapes less and less favorable for GPCs and other grassland obligates. As a result, the GPC is now on the national Partners in Flight Watch List and grassland birds as a whole are the most threatened group of birds both on the breeding and wintering grounds in North America.

For the past 75 years Wisconsin has been involved in a significant effort to maintain its isolated population of Greater Prairie Chickens in central Wisconsin. Conservation efforts spearheaded by leading researchers and public and private groups helped to secure core areas of the remaining GPC habitat. Though successful in maintaining this isolated population in central Wisconsin, recent annual booming ground surveys indicate population declines and local extirpations at the periphery of the GPC range. Woodland succession, rural development, and other land use patterns have changed within core management areas and in the areas between these core areas. This has restricted GPC dispersal, and coupled with a population bottleneck in the 1960's has resulted in lowered genetic variability within the Wisconsin GPC population. Loss of habitat, depressed populations, and lowered genetic diversity are all warning signs that require immediate conservation measures for Greater Prairie-Chickens.

Conservation of GPCs and grassland ecosystems in Wisconsin requires the restoration and continued management of large, open grassland landscapes. These landscapes will require core areas of permanently protected grasslands within a working agricultural landscape. This productive landscape will enhance the effective conservation value of our core GPC management areas already in place by increasing total grassland acreages and providing the open space necessary to facilitate dispersal between GPC sub-populations. Smaller grassland core areas or "stepping stones" will be strategically placed between the larger management areas to help facilitate dispersal and restore genetic diversity within the population.

This management plan builds upon the successes of the GPC effort in Wisconsin and utilizes recent research studies to present a comprehensive strategy to conserve and maintain a population of Greater Prairie-Chickens in Wisconsin. The plan recommends adding 15,000 acres of permanent grassland over the next 10 years. Acquisition and management of these additional properties will be focused on enhancing existing booming grounds not protected within core areas and facilitating dispersal between core areas by developing stepping stone grassland reserves. Genetic heterozygosity will be restored through re-connection of core areas and an immediate assessment of translocation options. Maintaining and promoting a productive, rural agricultural landscape will require effective partnerships with federal, state, county, and local agricultural groups to promote and implement the necessary practices beneficial to farmers and wildlife.

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NATIONAL STATUS

The GPC is unique to North America and is the characteristic bird of the eastern tallgrass prairie. Presettlement ranges of GPC and this ecosystem were essentially identical (Walk 2004). European settlement and subsequent agricultural development allowed the GPC to increase its range beyond the tallgrass prairie east into Ohio and Ontario, westward to Colorado, and northward to Alberta (Schroeder and Robb 1993). Peak populations of GPC followed settlement westward in the mid-late 1800's and early 1900's (Svedarsky et al. 2000). Subsequent intensification of agricultural effort and reforestation resulted in population declines and severe range contractions (Schroeder and Robb 1993, Westemeier and Gough 1999, Svedarsky et al. 2000). This resulted in extirpation of the GPC from Canada and states on the edge of the species range in the U.S.

Currently the GPC still remains in 11 states throughout its range with hunted populations in Colorado, Minnesota, South Dakota, Kansas, and Nebraska (Westemeier and Gough 1999). The GPC is listed as state endangered in Illinois and Missouri and state threatened in Wisconsin and North Dakota (Walk 2004). Global populations were estimated to be approximately 391,000 birds in 1997 (Westemeier and Gough 1999). The population in Illinois is probably most endangered due to its small size and total isolation from populations in other states (Westemeier and Gough 1999). Continued loss and fragmentation of grassland habitat for GPC even at the core of its range is one of many reasons that this species is of extremely high conservation concern (Rich et al. 2004).

WISCONSIN MANAGEMENT HISTORY

Prior to European settlement, the GPC was found in the southern half of Wisconsin in native prairies and savannas, with the original breeding range extending north to River Falls, east to Green Bay, and south to Milwaukee (Schorger 1944). Large-scale logging and subsequent fires in the latter half of the nineteenth century created temporarily open land, and the range expanded northward into previously forested areas. By the beginning of the 20th century, the bird was present in every county (Grange 1948).

GPC populations responded favorably to limited agricultural development throughout its range in Wisconsin. Grass-based agriculture in particular with smaller amount of row crops provided an adequate substitute to the native prairies (Hamerstrom et al. 1957). However; agricultural development quickly became too intense for the GPC and populations within the original prairie range were disappearing throughout the early 1900's (Schorger 1944). At the same time, reforestation and effective fire control caused a range shift southward from the northern range of the GPC population. By 1950, the GPC was extirpated from most of its range in southern Wisconsin, with scattered populations surrounding an area in Portage, Wood, Waushara, and Adams counties (Anderson and Toepfer 1999) (Figure 1). The last GPC hunting season in Wisconsin was held in 1955.

Wisconsin's commitment to the GPC began in 1928 with the first wildlife research project (Gross 1930) conducted by the newly formed Wisconsin Conservation Commission (now the Wisconsin

Department of Natural Resources). The Wisconsin Prairie Chicken Investigation, under the direction of Dr. Alfred O. Gross along with work by others such as Aldo Leopold, Franklin J. W. Schmidt, and Wallace Grange, paved the way for the pioneering research conducted by Frederick N. and Frances Hamerstrom. Nearly two decades of investigation culminated in the publication of "A Guide To Prairie Chicken Management" in 1957 by the Hamerstroms and Oswald Mattson. This "Guide" outlined the basics for the management program in the Buena Vista Marsh and the outlying areas of Wisconsin. The plan used extensive research to guide managers as to the daily and seasonal habitat, breeding, and food requirements of the GPC. The primary recommendation from the guide was to purchase and manage permanent grassland reserves scattered in small 40 acre parcels throughout the Buena Vista Marsh drainage district. This concept of ***ecological patterning*** focused on embedding nesting and brooding cover within the larger, productive agricultural matrix dominated by the blue grass seed industry. This ecological pattern was set up to promote a productive, well dispersed chicken population within the financial constraints of owning and managing land for wildlife (Hamerstrom et al. 1957).

As a result of the Hamerstroms' early work, the private sector including the Society of Tympanuchus Cupido Pinnatus (STCP), the Dane County Conservation League, and the Wisconsin Society for Ornithology stepped forward and provided the capital to purchase land for management as grassland reserves. These purchases helped secure a future for the GPC in Wisconsin. Throughout the 1950's, 1960's and into the 1970's nearly 14,000 acres of land were purchased for grassland management on the Buena Vista, Leola, and Paul Olson Wildlife areas (WDNR 1995).

In the "Guide to prairie chicken management" (Hamerstrom et al. 1957) a pattern of grassland habitat improvement and maintenance was proposed through rotational disturbance. Management in the early 1960's concentrated on acreage that had been reverting to brush and timber. Bulldozers, chainsaws, rotary mowers and broadleaf herbicides were all used to restore grasslands. By the mid-1960's, fire was also being used to stimulate grass and retard brush invasion. As additional acreage was acquired, the management effort expanded to keep pace. Throughout the late 1960's and early 1970's, a major grassland restoration effort was accomplished largely with bulldozer and herbicide. The program has been fine-tuned since then and has incorporated some new techniques to meet changing conditions, but the principles outlined in this work still apply. Periodic disturbance of the grassland and sedge meadow acreages through carefully timed burning, farming, grazing and haying maintains vigorous grassland habitat and retards brush invasion (WDNR 1995).

Continued research within Wisconsin documented dispersal of GPC from the Buena Vista/Leola area to the Carson-Sherry Area (now Paul Olson Wildlife Area) and the Mead Wildlife Area (Westenmeier 1971, Hamerstrom et al. 1973). Building on the successes on the Buena Vista Wildlife Area, Hamerstrom et al. (1973) recommended that the Paul Olson Wildlife Area (PO), be put under management without further delay. They reasoned that the PO serves not only to produce a healthy population of GPC, but also to facilitate dispersal between Mead and Buena Vista. This interchange was determined to be important to the overall metapopulation structure of the regional GPC population. Wisconsin responded by expanding its GPC management program on the Mead, Paul Olson and McMillan Marsh Wildlife Areas. In particular, managers at the Mead Wildlife Area converted 896 acres of agricultural cropland within the wildlife area to

grassland reserves and have removed treelines and hedgerows to maintain corridors of open space for GPC conservation.

Populations of the GPC declined throughout the 1950s and early 1960s (Figure 2), finally stabilizing at a mean of 151 cocks throughout the 1960's (Anderson and Toepfer 1999). Acquisition and management of the grassland reserves eventually stabilized the GPC population in Wisconsin. As management increased within the GPC range, the GPC emerged from this population bottleneck and increased to a point well above the minimum level for a healthy population (Toepfer 1988, Anderson and Toepfer 1999). Greater Prairie Chickens probably would have been extirpated from Wisconsin had not considerable effort been expended by a host of public and private partners throughout central Wisconsin.

1995 Management Plan and Review

The Wisconsin DNR renewed their commitment to providing a viable population of GPC in Wisconsin with the 1995 Management Plan (WDNR 1995). The 1995 GPC management plan identified six 10-year objectives, 51 accompanying strategies, and 17 data and research needs. Strategies were intended to direct work activities toward accomplishing the six major objectives. The major objectives were aimed at increasing and securing additional GPC habitat in the GPC core areas as well as expanding grassland habitat in the Northern Range. The management plan also laid out a number of research needs that have been addressed since the plan. Accomplishments toward these objectives include:

- The first objective (maintain a 1000 bird minimum population) has been achieved.
- Currently, 22,300 acres are managed as grassland within the core prairie chicken properties short of the objective of 26,000 in the 1995 plan. Budgetary restrictions and barriers to acquisition have limited the expansion of GPC management. This objective focused on fulfilling the necessary habitat requirements on several traditional Core Areas. Acquisition was completed on nearly 2,000 acres in the past 8 years, but the target of developing 5,000 new acres of grassland on the 4 listed core properties was not accomplished. Most notably only 200 of the goal 1,500 acres on the PO were acquired.
- Additional GPC habitat is under development, mostly off of the core areas in Clark, Marathon, Portage, Taylor, and Wood Counties as a result of implementation of the Conservation Reserve Enhancement Program (CREP), Grassland Reserve Program (GRP), tree removal and other Federal Farm Bill programs. The development and implementation of private lands programs since the 1995 plan bodes well for the future of GPC in Wisconsin.
- The 1995 recommendation was for an additional 2,300 acres on private lands adjacent to Mead through a Habitat Restoration Area being implemented. This well thought out and visionary approach to secure the chicken, from PO to the outlying areas, was not seen as a Department priority, by the Bureau of Wildlife Management, at that time. In 1993, area biologists voiced major concerns in regards to population trends in the Mead to Unity / Colby sector of the range, but again no action was taken.
- A Core Area of 6,000 acres in the Unity area was recommended in 1995 as well as having been recommended in the 1990 HRA proposal. No action was taken on establishing an acquisition project there.
- The timing and effectiveness of management techniques are being evaluated and improved

constantly as more is learned. The incidental take provisions of the endangered resources administrative code were developed to allow proper habitat management while protecting the population.

· At least two GPC transplant proposals have been evaluated since 1995. Neither was approved for implementation at that time although both had very positive qualities and may be reviewed in the future.

· There has been a management shift on Mead to establish more grassland and re-evaluation of other publicly owned properties in the GPC range is necessary. Over 900 acres on Mead have been converted from cropland to grassland.

· Research projects supported by a wide range of cooperators and partners, particularly STCP have addressed several of the listed research needs in the 1995 GPC Plan. Some of those reports include: Golner (1997), Keenlance (1998), Niemuth (2000), Bellinger (2001), Halfmann (2002), Bellinger et al. (2003), Johnson et al. (2003), Niemuth (2003), Toepfer (2003).

Many of the projects undertaken within the guidance of the 1995 plan have helped to formulate a clearer strategy for the future of GPC in Wisconsin. The results of this new research, continued habitat management, and population monitoring have been essential in the development of this management plan. Habitat strategies and guidance not accomplished in the 1995 plan are now incorporated, with renewed commitment, into the 2004 plan.

Conservation Tools

Since the 1995 plan, new conservation tools have been developed and implemented within the project area to protect and enhance grassland ecosystems. Grassland protection/enhancement efforts are now possible through a variety of programs from the Federal Farm Bill and other sources.

The Conservation Reserve Enhancement Program (CREP) has been adjusted within the range of the GPC in Wisconsin to target long-term private lands grassland protection. Any lands with a cropping history located within 1000 feet of a riparian corridor are eligible for the CREP program. All told, 5,000 acres of land are targeted for CREP within this area, greatly enhancing existing grassland efforts within the GPC range.

The U.S. Fish and Wildlife Service (USFWS) manages a small number of private lands easements as permanent grasslands within the GPC range. Currently the WI-DNR is working collaboratively with the USFWS to expand efforts on private lands within the GPC range to maintain open space, grassland nesting cover, and offer incentives for private landowners within the region.

Some of the biggest gains in grasslands within central Wisconsin are coming from grass-based agriculture. Acreages of farmland in rotational grazing are increasing yearly. This exciting development will greatly enhance efforts on nearby lands managed as nesting habitat for GPC. To enhance efforts for grass-based agriculture, the Grassland Reserve Program (GRP) was created as part of the most recent Federal Farm Bill. The GRP program pays farmers a short-term rental fee or a long-term payment to maintain their acreages in grass-based agriculture. In addition, the GRP program requires a management plan to be created, offering the department a

chance to offer management guidance to benefit nesting and brooding grassland birds. Rotational grazing and the GRP program will greatly enhance private land efforts in the area and will reduce the overall effort needed from the department and other conservation partners towards creating a grassland landscape for GPC.

These and other tools are helping with the continuing effort to create the open space and grasslands necessary for GPC conservation. Partnerships between public and private lands interests within the range of the GPC will continue to work on making all programs more friendly for farmers and the wildlife that depend on them.

Importance of Farming

Currently, much of the land within the GPC range is farmed. It is likely that the success of the proposed project not only lies with protecting and restoring grassland habitat, but also in the future of agriculture here. Indeed, even if the Department and partners meet their short-term habitat protection goals, if most of the surrounding farmland is converted to forest or residential development then it is likely that populations of many grassland species will continue to decline. As such, a critical component of this project will be to work creatively with the farming community and organizations involved in farmland and grassland protection to develop agreements and easements that mutually benefit the economic health of farms and the ecological needs of grassland species.

GRASSLAND MANAGEMENT FOR GREATER PRAIRIE CHICKENS

General Habitat Needs

Conservation of the GPC requires planning on both a local and landscape scale because of their area sensitivity (Samson 1980, Sample and Mossman 1997, Winter and Faaborg 1999) and differing habitat requirements throughout their life cycle (Hamerstrom et al. 1957, Toepfer 2003). Within a GPC management area in Wisconsin, habitat for nesting and brood rearing is provided through management of permanent grassland reserves. Associated agricultural land provides open, short grass areas for leks, winter feeding areas and facilitates dispersal within a management area. All of these conditions must be present within a GPC management area. The amount and juxtaposition of these various habitats will determine the overall GPC populations within a management area.

Greater Prairie-Chicken Landscapes

Throughout their range, GPC require large grassland landscapes with high amounts of open space (Schroeder and Robb 1993). Total grassland acreage in a landscape appears to be a rough index to habitat quality, in that the densest populations are shown to be in those areas which are 55-60% or more grassland (Hamerstrom et al. 1957, Westemeier 1971). Westemeier (1971) determined that on the BV marsh higher amounts of long-term and permanent grassland cover within a mile of a booming ground resulted in higher numbers of male GPC on the booming grounds. The number of males at a lek within the northern range of the GPC in Wisconsin also correlated positively with the amount of grassland cover at multiple spatial scales surrounding

the lek (Neimuth 2000). These results mesh well with other studies that have found large acreages of nesting and brooding habitat within 1-2 miles of a lek (Schroeder and White 1993, Svedarsky 1988, Merrill 1999, Neimuth 2003)

To date, current GPC management and acquisition has been based on the ecological patterning model set forth by Hamerstrom et al. (1957) and Grange (1948). Both authors recommended scattering a "checkerboard" of permanent grassland reserves throughout the BV management area. These grassland reserves would be managed as nesting and brooding habitat and would function well within a predominantly grass-based agricultural landscape. The goal would be to spread acquisition out in order to ensure dispersal over the largest area possible (Hamerstrom et al. 1957). Embedded within this agricultural matrix would be enough habitat for nesting, brooding, leks, and winter food sources. Simultaneously, fragmentation of open space from woodlots, tree lines, powerlines, and rural development must all be kept to a minimum.

At the time of their publication, Hamerstrom and Hamerstrom (1957) recognized that private land use would govern the size and extent of needed public grassland management to conserve the GPC in Wisconsin. They suggested an average of one 40 acre grassland reserve per section (3200 acres) to provide nesting and brooding cover for the conditions on the BV marsh at that time. They recognized that this number would likely change and the scatter-pattern would have to be adjusted if private land use became more inhospitable to GPC (Hamerstrom et al. 1973). With the loss of grass-based agriculture in the 1960's and 1970's, this situation was already occurring and some local managers were advocating for larger grassland reserves (Mattson 1965).

A number of states have modeled their GPC plans after this system of ecological patterning. Managers in Illinois designed the Prarie Ridge State Natural Area to consist of 1600 acres of permanent grasslands in 40-160 acre patches within a larger management area (Sanderson et al. 1973, Walk 2004). The authors of this plan recognized that this model would be heavily dependent on the surrounding agricultural matrix and that an intensification of agriculture would result in a need for larger grassland acreages (Walk 2004). In a similar "mosaic" landscape in Missouri, GPC populations declined over a 27 year period, but were stable in a continuous prairie landscape (Ryan et al. 1998). GPC in the scattered, or mosaic landscape had larger movements, longer brood movements, and lower survival rates compared to birds in the continuous prairie landscape (Burger 1988, Ryan et al. 1998). Thus, Missouri advocates core grasslands of >520 ha surrounded by additional scattered grassland tracts (Mechlin et al. 1999). It's important to note that most, if not all, GPC models and landscapes are heavily dependent on the surrounding agricultural matrix. ***Requirements for large total grassland acreages within a GPC area don't change, but the contribution of private, working lands to that acreage will largely dictate the size and amount of grassland reserves needed by the conservation organizations.*** The Hammerstrom model of scatter patterning was created at a time when the agricultural landscape contributed heavily to the total amount of grassland in the landscape. This situation has long-since disappeared and thus changes have been and will continue to be made to conserve the GPC and grassland bird populations.

Since the ecological patterning concept was "hatched" and put to use in Wisconsin, other studies from throughout the range of the GPC have helped to further refine and identify a landscape

model for GPC habitat. Merrill et al. (1999) found that locations of GPC leks in Minnesota were associated with smaller amounts or residential-farmstead, smaller amounts and patches of forest, and greater amounts of CRP grasslands within a 1.6 km radius around the lek. In addition, traditional leks were associated with larger patches of grasslands with irregular shapes than were temporary leks. GPC leks in Wisconsin were found to correlate positively to total grassland and wetland acreages and were negatively correlated with amount of forest cover (Niemuth 2003). GPC nest success in Missouri was higher in larger patches of grassland cover and in more contiguous grassland landscapes (McKee et al. 1998). The sum total of most landscape scale research indicates that larger blocks of grassland reserves, more grassland within a landscape, and connectivity within a metapopulation through a series of stepping stones or statellite populations are all necessary to maintain a viable GPC population.

Conceptual Model for GPC core management areas

Management of Greater Prairie Chicken core areas should consist of the following landscape components (from Hamerstrom et al. 1957, Sample and Mossman 1997):

- a large area (10,000 to 50,000 acres) of open landscape not more than 20% wooded with wooded tracts in small, scattered blocks and a limited number of linear treelines.
- a core of permanent managed grassland at least 2,000 acres in size for every 10,000 acres of GPC range.
- a minimum of 30% of the open lands in permanent grassland, including the core and scattered blocks of grassland at least 80 acres or larger in size.
- scattered blocks of long-term grass cover (e.g. CRP, CREP and pasture) totaling an additional 15-20% of the open landscape;
- tracts of sedge meadow and/or shrub-carr for winter cover; and
- adequate winter food supply.

Stepping Stone Management Areas

To facilitate the movement of GPC between these Core Areas, broad open landscapes dominated by agriculture are needed. Within these open corridors, the Department seeks to establish smaller "**Stepping Stone Areas**" that are also a mix of permanently protected grasslands nested within farmlands in a similar proportion to the Core Areas (~25% grasslands). The Department intends to center these Stepping Stone Areas primarily around concentrations of active booming grounds or areas harboring high quality habitat. Although these may vary somewhat in size and shape, they would generally be 2,000 to 3,000 acres (about 1 to 1½ mile radius) and contain approximately 500 acres of protected grassland reserves. Over the next ten years, the Department proposes to establish up to ten Stepping Stone Area between the four Core Areas. These stepping stone areas will link isolated populations to reduce the risk of genetic drift, stabilize overall population demographics, and increase the effective population size by establishing a metapopulation structure (Walk 2004).

Where these Stepping Stone Areas are eventually established within the corridors will also be a function of landowner interest, land use, parcel size, and land cover. That is, as lands are protected within the corridors, a Stepping Stone Area will begin to form. The goal will be to "fill

in" a Stepping Stone Area (i.e., reach the goal of protecting 25% of the area as grassland) rather than acquire a series of small parcels scattered throughout the corridors between the Core Areas. This will take careful coordination and communication between partners working on both public and private lands.

Benefits to other Grassland Wildlife

Conservation of grassland habitat for GPC will conserve habitat for a number of grassland birds and wildlife. Since the Greater Prairie-Chicken is area sensitive and has specialized requirements for different stages of its life cycle, it makes an excellent choice as an umbrella species for grassland management in central Wisconsin (Poiani et al. 2001). The range of the GPC in central Wisconsin has been identified as one of the highest priority landscapes to manage for grassland birds and wildlife (Sample and Mossman 1997). Grassland birds as a guild have shown the highest rates of population decline in North America since the beginning of the Federal Breeding Bird Survey (Sauer et al. 2004). In Wisconsin, once common grassland birds such as Eastern Meadowlark and Upland Sandpiper have shown persistent, long-term population declines. Western Meadowlark, one of Wisconsin's most common birds in 1966, has declined by over 90% in less than 40 years and is now a rare bird in many portions of its former range. This landscape contains populations of nearly every grassland bird species in Wisconsin, as well as populations of Regal Fritillaries and Karner Blue Butterflies (state endangered) and five other invertebrate species of special concern in Wiscconsin, Franklin's Ground-Squirrel, and a number of rare and endangered plants. Projects like these that are directed at the conservation of a number of species of concern help conservation partners do more with less overall effort.

GREATER PRAIRIE-CHICKEN STATUS IN WISCONSIN

Population and Range

GPC populations have fluctuated widely in Wisconsin within the last 30 years and show mixed trends within GPC core areas (Figure 2). Since the 1995 GPC Management Plan (WDNR 1995) annual population surveys indicate that the overall number of GPC has been relatively stable (Anderson and Toepfer 1999, Toepfer 2003, Keir 2004). A mean of 600 breeding cocks was found rangewide during 1994-2003 (Anderson and Toepfer 1999, Keir 2004). However; the number of individual booming grounds and the overall range has contracted significantly with the loss of booming grounds in the northern and western portion of the GPC range in Wisconsin (Toepfer 2003, Keir 2004). On the northern range (NR), the decline has been the greatest. Since 1991, there has been a 53% decline in the number of booming grounds and a 75% reduction in the number of booming males. *This decline has resulted in over 90% of the booming males residing on or closely associated with the four GPC Core Areas (Keir 2004).*

Much of this range and population concentration can be attributed to habitat loss within the northern range and land use changes on and between the managed GPC areas. Although a considerable increase in woody vegetation has occurred throughout the GPC range, the managed areas have maintained GPC populations due to the considerable grassland reserve that exists within those areas (Table 1). Niemuth (unpublished manuscript) found that distance between

leks in secondary, unmanaged populations was greater than on managed core areas, and landscapes surrounding leks in secondary areas had less grass and wetland cover, more forest and forage cover and greater patchiness than primary areas. The trend towards more woodland and less grassland on the northern range is also largely indicative of the land use trends in the areas between the managed GPC areas. For example, the corridor of land between the Paul Olson Wildlife Area and the Buena Vista grasslands was approximately 19% wooded cover in 1951, but by the early 1990's was more than 35% wooded, an increase of 75% (Keir, pers. comm.). Many of the booming grounds that once existed between Paul Olson and BV (Westemeier 1971) are now woodlots or have been abandoned because of increasing amounts of woody cover (Keir pers. comm.).

Table 1. Land use comparison in managed and unmanaged portions of Greater Prairie-Chicken (GPC) range. Numbers are percent of area in each habitat type (after WDNR 1993).

	Intensive GPC management				Little or no GPC management			
	Leola Marsh WMA		Buena Vista Marsh WMA		Paul J. Olson WMA		Northern Range	
Habitat type	1991	1998	1991	1998	1991	1999	1991	2002
Row crop	29	29	31	37	14	17	16	29
Hay	0	0	7	0	28	25	32	20
Grazed land	14	9	18	14	11	6	7	5
Grassland	13	18	25	25	8	14	8	8
Woodland	21	29	8	13	17	25	13	21
Other	23	15	11	11	22	13	24	17

Dispersal

Juvenile and adult dispersal from natal nesting sites is important in maintaining genetic diversity within the overall GPC population (Halfmann 2002, Toepfer 2003). GPCs are known to occasionally disperse over long distances with female movements greatly exceeding those of males (Hamerstrom and Hamerstrom 1949, Halfmann 2002). However; the bulk of the GPC population typically moves much shorter distances. In Wisconsin, 65% of juveniles that left their natal area terminated dispersal at the nearest subpopulation (Halfmann 2002). Once established on a booming ground most adults show high fidelity to leks and nesting areas among years (Toepfer 1988, Schroeder and Robb 1993). Niemuth (2000, 2003) determined that proximity to the nearest lek was an important predictor of lek presence and of the number of males attending the lek. ***These studies suggest that GPC disperse through a metapopulation structure or framework in a series of short stepping stone movements rather than through larger range-wide movements.*** Only in years with high recruitment (or translocations) does dispersal appear great enough for range expansion and colonization of new habitats (Toepfer 2003).

As part of a long-term research effort in the late 1990's, Toepfer (2003) and Halfmann (2002) documented essentially no dispersal or movement of GPC between Buena Vista/Leola and Paul

Olson/Mead Wildlife Areas. This stands in stark contrast to previous research in the same areas which reported that these GPC management areas were all interconnected through regular dispersal movements (Hamerstrom et al. 1973, Westemeier 1971). In fact, until this research was completed, most experts assumed that dispersal was still occurring between the core areas (Anderson and Toepfer 1999). Changing land use trends both on and between managed GPC areas are increasingly detrimental to GPC dispersal (Table 1). In a recent landscape scale study of GPC in Wisconsin Niemuth (unpublished manuscript) found that dispersal cost, where forested cover was more expensive for greater prairie chickens to traverse than open landscapes, was a stronger predictor of lek presence and attendance than straight-line distance. ***The majority of evidence indicates that more woodlands and rural development are contributing to the long-term decline of open space and indicate increasingly greater isolation within an already isolated population (Toepfer 2003)***.

Genetics

Historically, the range of the GPC was contiguous and interconnected as one large metapopulation (Johnson et al. 2003). This connectivity promoted gene flow within the metapopulation and allowed the GPC to respond to evolutionary stimuli. Comparisons of genetic diversity between Wisconsin populations of the early 1950s to larger populations in other states suggest no significant differences, however; recent samples from the four GPC management areas show that Wisconsin's GPC is now genetically unique from the rest of the national range (Johnson et al. 2004). The majority of GPCs in Wisconsin are currently found on four management areas that are 3 to 12 km apart. Despite this close proximity, genetic analyses indicate that there is significant genetic subdivision among the four contemporary management areas (Johnson et al. 2003). In contrast, there was no genetic subdivision in the same four areas 50 years ago (Johnson et al. 2003.). These results suggest that further habitat fragmentation and isolation of GPC populations within a relatively small area has helped reduce contemporary levels of genetic variability by decreasing the number of individual birds breeding in the total population and stimulating the effects of genetic drift (Templeton et al. 2001, Frankham et al. 2002) within existing management areas.

Contraction of range, a population bottleneck, and isolation of sub-populations prompted a detailed evaluation of GPC genetics within the Wisconsin range (Toepfer 2003). Results from these studies indicate that populations of GPC within Wisconsin have lost genetic variation as a consequence of genetic drift (Bellinger et al. 2003, Johnson et al. 2003). A historical comparison between the genetics of GPC collected on the BVM in 1951 with blood from birds caught 1997-2000 indicated that there has been a 26% reduction in microsatellite DNA allelic composition since 1951 (Bellinger et al. 2003). Presumably the low GPC populations in the period following the early 1950s, both on and surrounding the BV, resulted in a population bottleneck and stimulated genetic drift. With increased habitat fragmentation, the exchange of genetic material between the now isolated sub-populations of GPC on the managed areas has been further reduced (Johnson et al. 2004).

Concerns that the population may have lost, or could lose in the future, genes related to fitness must be addressed (Wright 1969, Lande 1998, Reed and Frankham 2003) . To date there is no available data that suggests that the Wisconsin GPC population is suffering from a loss of alleles

related to fitness (Bellinger et al. 2003). However; other case histories exist indicating the perils of continued genetic drift and long-term population isolation for Greater Prairie Chickens. GPC populations in Illinois were once loosely connected through grasslands on private lands over a large area. By the mid 1980's the GPCs were limited to only two wildlife preserves and had been genetically separated by hundreds of miles from populations in Illinois and other states. As a result both fitness, as measured by fertility and hatching rates of eggs, and genetic diversity declined significantly (Bouzat et al. 1998). Fitness and genetic diversity were restored after an intensive translocation program with birds from out of state (Westemeier et al. 1998). Although Wisconsin GPC populations have not reached the same level of genetic depression as the Illinois population had, concerns exist that Wisconsin is headed in the same direction (Johnson et al. 2004).

Summary of Current Status in Wisconsin

1. Secondary, or satellite populations of GPC adjacent to those in managed areas are declining or have completely disappeared.
2. Land use trends on and between core GPC management areas continue to become less and less conducive to GPC dispersal.
3. The above conditions, coupled with a historical population bottleneck, have resulted in lowered genetic diversity in Wisconsin GPC as compared to the rest of the national range and the creation of distinct, isolated populations within the GPC range.

WISCONSIN OUTLOOK

The next phase of GPC management in Wisconsin is to guarantee the viability of the population in the face of rapidly changing and increasingly detrimental land use practices within the GPC range. Future GPC management will require innovative conservation practices through governmental and non-governmental partnerships and new strategies for habitat development within the GPC range. Securing the GPC population in Wisconsin requires three things: 1) The development of a large interconnected range of *suitable* habitat; 2) Restoring genetic heterozygosity; and 3) Retaining agriculture as a predominant characteristic of the landscape. All are the top priorities of this plan. The objective is the conservation and management of the fragmented sub populations of GPC as a single metapopulation. A large, connected population distributed over an area large enough to ensure security from catastrophe will be capable of maintaining population viability.

PROGRAM GOAL

Maintain a viable population of Greater Prairie Chickens in Wisconsin.

TEN YEAR GOALS

1. Restore, monitor, and maintain genetic diversity within WI GPC population.
2. Reconnect core areas by creating and maintaining smaller stepping stone grasslands strategically placed to facilitate GPC dispersal.
3. Increase and improve GPC habitat on and between core areas to support approximately 90 booming grounds distributed throughout GPC range.
4. Help maintain and promote predominantly agricultural use of GPC range.
5. Continue management on current GPC management areas.
6. Establish and grow partnerships for grasslands and grassland wildlife.
7. Raise public awareness for grasslands and GPC conservation.
8. Continue to evaluate potential sites for selection as GPC translocation areas.
9. Develop, identify and define GPC population recovery parameters.

HABITAT IMPLEMENTATION – Goals #1, 2, 3, 4, 5, 6

The following sections list and describe the habitat objectives and implementation strategies for each of the GPC core management areas and the areas connecting those core management areas. In the short-term (2004-2014), connectivity and population viability are best achieved by establishing 9,100 – 15,000 acres of new permanent grassland (Table 2) within strategically targeted areas of the GPC range. This acreage will provide additional security to high-density GPC populations, secure grassland around extant NR booming grounds, and establish complexes of booming grounds between these populations. Actual acres conserved will depend heavily on the level of agency Stewardship Funds available and partner participation, available land, and cooperation and support of local residents. The proposed figure (9,100 – 15,000 acres) amounts to less than 5% of the total land base in the proposed project areas and must be strategically located and supported by an open, productive agricultural landscape.

The 10-year goals (Table 2) were determined by analyzing recommendations in the best professional judgment of experts, work load impacts (assuming no additional FTE time), sociological factors present on the landscape, and real estate sales data in the area. The goals reflect what experts developing this plan considered biologically necessary, economically feasible, and reasonable benchmarks. This proposal promotes conservation easements that may incorporate agricultural options, and utilizes partners and federal Farm Bill programs to help secure the grassland, both significant factors that will influence the success of this effort.

Buena Vista Marsh and Leola Marsh

BVM and Leola contain 60% of the grassland publicly owned in the GPC range and have 55% of the booming males and 45 – 50% of the total booming grounds. Both areas are close to fitting the conceptual model for a GPC core management area described above. This management plan calls for continued maintenance of high-quality nesting and brooding habitat through periodic disturbance and targeted tree removal to restore open space. This plan also calls for a 1,500 acre acquisition/protection goal of permanently managed grassland reserve (Table 2). Targeted areas should be 80 acres or larger and situated to enhance nesting cover near a booming ground. This acreage can be done through public or private partnerships and should be targeted to enhance key areas not currently under protection, including parcels between the wildlife areas. This goal will allow managers to be flexible in the face of ever-changing ecological conditions.

Buena Vista/Paul Olson Corridor

The corridor between the BV and PO Wildlife areas (Figure 3) has become increasingly more wooded over time and is a barrier to GPC dispersal. This plan calls for 3-4 (1,500 – 2,000 acres) strategically placed stepping stones in the corridor between these two areas to re-connect the GPC subpopulations. These areas will need to have a great deal of existing open space and should build upon any existing private grassland opportunities. Since no active booming grounds exist in this corridor, managers will have to place stepping stones within an available open landscape near existing booming grounds on the managed areas to facilitate dispersal. Removing select woodlots and treelines will be key in this landscape to restoring movement between the stepping stones and the managed areas.

Paul Olson Wildlife Area

The Paul Olson Wildlife Area currently hosts a large portion of the overall GPC population in Wisconsin, but has very little permanently protected grassland reserves. This area is also key to facilitating dispersal between the BV area and the rest of the GPC range. Due to its importance this management plan calls for a ten year acquisition/protection goal of 3,500 acres within the boundary of the area. Parcels should be 80 acres or larger and situated within one mile of an active or historic booming ground. Management efforts should build on the successful efforts by private landowners in the area and target key woodlots or fence rows to improve the open space within the wildlife area.

Paul Olson/Mead Corridor

Since genetic interchange between PO and Mead still exists, it is assumed that there is still some amount of dispersal between these core areas. However, there are very few active booming grounds left between the areas, which might have negative implications for dispersal in the long-term. This management plan calls for the establishment of 3-4 stepping stones (1,500-2,000 acres) in the corridor between PO and Mead (Figure 3). These areas should target large areas of existing open space and would be enhanced by existing grasslands on private lands. Managers will target parcels 80 acres or larger within one mile of an active or historic booming ground and key tree lines or woodlots should be removed to restore open space.

Mead Wildlife Area

Mead has been managed for prairie chickens since its conception, with increased emphasis in the late 80's and 90's. Prescribed burning, mowing, herbicide treatment, and forest removal have all been part of a program to secure needed sedge meadow and upland grassland habitat. GPC grassland goals fit very well with waterfowl nesting needs and thus, expanded management for GPC and waterfowl is planned. This plan calls for an additional 1,000 acres of grassland reserves in parcels 80 acres or larger, to be developed to enhance nesting cover near active booming grounds. In addition, tree removal and grassland reserves will be targeted to enhance connectivity between booming grounds on the property and in adjacent areas.

Mead/Northern Range Corridor

The existing booming grounds on the Northern Range are very isolated from each other and from those on the Mead Wildlife Area. In order to facilitate dispersal and re-establishment of booming grounds in the Northern Range, this plan calls for the establishment of 3 stepping stone areas (1,500 acres) strategically placed in the NR/Mead corridor (Figure 4). These areas should target large areas of existing open space and would be enhanced by existing grasslands on private lands. Managers will target parcels 80 acres or larger within one mile of an active or historic booming ground and key tree lines or woodlots should be removed to restore open space.

Northern Range

The Northern Range (NR) (Figure 1) is an area with low GPC densities northwest of Mead that contains no publicly managed grasslands. The overriding issue within the northern range is a lack of grassland reserves for nesting and brooding cover. Niemuth (2003) found that the amount of grassland strongly influences GPC numbers and the amount of grassland in the NR was less than that in the managed Core Area of BVM. He also concluded that the habitat in the NR was more fragmented than that in BVM. Many of the historical booming grounds have become inactive over the last two decades and as of the summer of 2004, only 3 booming grounds were active (Jim Keir pers. comm.). Land use trends in the northern range are similar to other areas within the GPC range. In the last decade woodlands and row crops have increased as a percentage of the landscape, while agricultural grasslands have decreased (Table 1). Despite these trends, there is still an adequate amount of open space and ample opportunity to add grassland acreages on both public and private land near existing and historical booming grounds. Long-term goals for

this area are to create a core or series of core GPC areas within a productive agriculture landscape.

This management plan calls for the acquisition/protection of 4,000 acres of grassland reserves within the NR. Every effort should be made to target large parcels as this area's existing grasslands tend to be small and fragmented. Parcels will be strategically placed in open landscapes within one mile of an existing or recently active booming ground. The goal is to have at least 500 acres of protected grassland reserves within a mile of a booming ground, with some long-term effort to create a larger core or complex of multiple booming grounds such as exists on the other core management areas. Private land initiatives that promote grass-based agriculture near grassland reserves will enhance and broaden GPC conservation efforts within this core area.

Other Sites

The Dewey Marsh Wildlife Area is primarily wetland which is comprised of both marsh and bog. The surrounding upland is dominated by aspen with areas of oak and pine. In the fall of 1976, an extensive wildfire burned approximately 4,500 acres with succession in the uplands occurring rapidly after the fire. GPC are present on the wildlife area in very limited numbers. They appear to be present only because of the large open wetland/sedge meadow area. This area is somewhat disjunct from the other management areas and upland succession to woodlands makes management for GPC very difficult. Because of this, the Dewey Marsh Wildlife Area was not included within the overall scope of this plan.

The McMillan Marsh Wildlife Area currently provides winter habitat for GPCs that use private land to the north and east of Marshfield during other seasons. Many upland areas of the property were farmed in 1984, but by 1993 all cropping had ceased on the property and fields converted to grass. Soils on McMillan are also very heavy and woody encroachment into open fields is rapid. Currently there is little open grassland on the property as most has succeeded to woody vegetation. For these reasons the McMillan Wildlife Area was not considered a priority GPC management site. Grassland acquisition/protection will be focused on the existing and historic booming grounds near McMillan to facilitate dispersal and increase GPC populations within the NR.

Past and future grassland restoration efforts on landscapes throughout Wisconsin warrant serious consideration for GPC re-introduction in the near future. For example, much grassland/prairie work has been done on the Military Ridge Prairie Heritage Project in Dane and Iowa counties. This innovative grassland partnership has used both public lands and private lands conservation strategies to create a landscape that now approaches the conceptual model for GPC conservation. Sites such as these may provide opportunities for the long-term expansion of GPC populations in Wisconsin.

Table 2: Proposed protection goals for the Central Wisconsin Grassland Conservation Area

Core Areas	**Currently approved protection goal (acres)**	***Currently protected lands***			**Long term grassland protection goal (acres)**	**Grasslands still to be protected (acres)**	**Ten year goal (acres)**
		Grassland (acres)	**Other habitats (acres)**	**TOTAL (acres)**			
Buena Vista – Leola Marsh	15,860	13,860	0	13,860	15,500	1,640	1,500
Paul Olson	2,000	1,350	650	2,000	10,000	8,650	3,500
George Mead	31,800	7,300	22,500	29,800	9,500	2,200	1,000
Northern Booming Grounds	0	0	0	0	10,000	10,000	4,000
subtotal	*49,660*	*22,510*	*23,150*	*45,660*	*45,000*	*22,490*	*10,000*
Stepping Stone Areas	**Currently approved protection goal (acres)**	***Currently protected lands***			**Long term grassland protection goal (acres)**	**Grasslands still to be protected (acres)**	**Ten year goal (acres)**
		Grassland (acres)	**Other habitats (acres)**	**TOTAL (acres)**			
A total of up to 10 Stepping Stones located between the four Core Areas	0	0	0	0	5,000	5,000	5,000
TOTAL	**49,660**	**22,510**	**23,150**	**45,660**	**50,000**	**27,490**	**15,000**

GENETIC DIVERSITY – Goals #1

Central to the success of this management plan, is the long-term genetic viability of the GPC population in Wisconsin. Recent research suggests that genetic diversity has been lowered in Wisconsin and genetic drift will continue to reduce genetic diversity within the isolated sub-populations. This plan calls for an immediate genetics action plan to analyze the dangers of increased genetic drift and formulate a process for reversing those declines. This process will bring together experts to analyze the benefits and risks of GPC translocations from other regions and will formulate an effective approach for restoring genetic heterozygosity to the WI GPC population.

CENTRAL WISCONSIN GRASSLANDS PARTNERSHIP – Goals #4,6,7

Implementation of this management plan will require coordinated efforts from state, federal, local, non-governmental and private partners. This plan calls for the establishment of a cooperative partnership between all parties interested in conserving grasslands and maintaining a productive, working agricultural landscape. The partnership will serve to facilitate communication between partners concerning ongoing conservation efforts and broaden the scope of future efforts. Better coordination of public and private lands efforts will ensure that conservation effort and dollars are spent in the most efficient manner.

To facilitate this partnership, this plan calls for the hiring of a Greater Prairie Chicken Conservation Coordinator. This coordinator will work with all partners to implement the goals and strategies outlined in this plan. The coordinator will work with area wildlife staff and local conservation partners to target key parcels for GPC conservation through a variety of public and private lands options. The coordinator will also work with the general public and interested partners to increase the awareness for grasslands and GPC conservation.

GREATER PRAIRIE CHICKEN RECOVERY PLAN – Goals #9

This plan calls for work to begin on a GPC Recovery Plan. The purpose of the recovery plan will be to assess the parameters required for downlisting the GPC from Threatened to protected and for the establishment of an annual hunting season in Wisconsin. This effort will require a Population Viability Analysis (PVA) that analyzes recovery both in terms of de-listing and harvestable population. The Recovery Plan will give us better long-term population and habitat goals that the overall partnership can work towards.

GREATER PRAIRIE CHICKEN TRANSLOCATION/RE-INTRODUCTIONS – Goals #8

As grassland conservation efforts continue to expand throughout Wisconsin, sites may become suitable for GPC establishment. The Wisconsin DNR Prairie Grouse Committee will evaluate GPC translocation projects into these areas. These areas should be somewhat secure and have long-term objectives compatible with Prairie Grouse conservation.

PLAN EVALUATION

This plan will require careful evaluation in order to measure success and allow managers to adapt to rapidly changing ecological conditions and opportunities. This plan recommends the following general approaches required for plan evaluation:

- Continue annual booming ground population surveys
- Continue to monitor habitat changes and accomplishments throughout the GPC area
- Re-evaluate GPC dispersal, genetic diversity, and fitness parameters as plan is implemented
- Monitor overall grassland bird response to implementation of the plan.
- Assess landowner and public response/opinions to GPC conservation efforts in the region.

LIST OF FIGURES

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