Partners in Flight
Bird Conservation Plan
for
The Prairie Peninsula
(Physiographic Area 31)

American Bird Conservancy

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by

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Partners In Flight

Prairie Peninsula Bird Conservation Plan

(Physiographic Area 31)

Executive Summary:

Historically, tallgrass prairie, savanna, and forest habitats were interspersed across the Prairie Peninsula physiographic area. During and following settlement, both prairie and woodlands were converted to pasture, hayfields and cropland. Today, almost 70% of the planning unit is in corn and soybeans. Up to 15% of the area remains in pasture, hay and other grassland habitats, but most of this is concentrated in the eastern third of the planning unit. Only small remnants of native communities still persist.

Although many species of grassland birds are still relatively abundant in the Prairie Peninsula, populations of some species (eg. Greater Prairie-Chicken, Grasshopper Sparrow, and Dickcissel) have declined significantly over the past 30 years, in association with declines in the combined regional acreage of pasture and hayfields.
Also within recent decades, many grass hayfields have been replaced by alfalfa monocultures; because alfalfa is cut earlier and more often than the grasses planted in the past, and nests and nestlings of individuals that choose those sites suffer very high rates of mortality during mowing events. Although some species of grassland birds also will nest in cropland, grassed waterways, and roadsides adjacent to agricultural lands, species diversity typically is very low and, again, reproductive success appears to fall far below that necessary to maintain stable populations. Grassland Bird Conservation Areas, with large blocks of core grasslands and a relatively high percentage of grassland in the surrounding landscape, are recommended as a conservation strategy.

Historically, fires on the open grassland of the prairies burned into forests at varying distances, resulting in a transition zone between prairie and forest. Referred to today as Savannas and Oak-woodlands, these habitats have unique structural characteristics such as canopy trees that are more widely-spaced than those found in closed-canopy forests and an understory comprised largely of grasses and forbs characteristic of the native tallgrass prairie. The Red-headed Woodpecker, a species of high conservation priority in the Prairie Peninsula, are virtually restricted to savanna-woodlands or park-like habitats of a similar structure. Savanna restoration is recommended where soils, topography and floristic composition indicate sites are suitable.

Forest birds in the physiographic area also have suffered from habitat loss, degradation and fragmentation. While trends of some species imply that populations are stable, a more in depth look at the reproductive success of forest birds within the physiographic area indicates that populations in forest fragments probably are being supplemented from immigration, perhaps from less fragmented forests to the south and north of the Prairie Peninsula. Low reproductive success is largely the result of nest parasitism by Brown-headed Cowbirds and nest predation by a wide array of organisms that include snakes, other birds and various species of mammalian predators that flourish in agricultural landscapes. It is estimated that heavily forested landscapes or tracts of forest in the range of 10,000-25,000 ha (25,000-62,500 acres) are needed to mitigate the excessive levels of brood parasitism and nest predation that are found within the planning unit.

The Black Rail occurs in wet meadows, but is largely understudied both in the physiographic area and across its range. Inventory and monitoring of the species is needed. Existing wet meadows should be protected and others restored.

PREFACE:

Partners in Flight (PIF) is a voluntary, international coalition of government agencies, conservation groups, academic institutions, private businesses, and everyday citizens dedicated to “keeping common birds common”. PIF's goal is to direct resources toward the conservation of birds and their habitats through cooperative efforts in North America and the Neotropics. While PIF’s focus generally is limited to the conservation of landbirds, it is intended to complement similar efforts for waterfowl, shorebirds and other taxa. PIF now joins the North American Waterfowl Management Plan, National Shorebird Conservation Plan, and North American Colonial Waterbird Conservation Plan in undertaking the kind of long-range planning necessary to help insure that viable populations of all native bird species continue to exist and that all our native ecosystems have a full and functional avifauna.

The foundation of PIF's bird conservation strategy, known as “The Flight Plan”, is a series of Bird Conservation Plans, of which this document is one. These plans identify species and habitats most in need of conservation, and establish objectives for bird populations and habitats in physiographic areas (ecoregions) and states. The plans not only identify the microhabitat requirements of priority species, but also focus on the types and quality of habitats required by birds at the landscape scale. Conservation actions are recommended and partnerships are formed to accomplish them. Information and recommendations in the plans are based upon sound science and consensus among interested groups and knowledgeable individuals.

Many of the species that are part of the avifauna of the United States migrate through or winter in other countries in the Western Hemisphere where they also face habitat loss, exposure to toxicants and persecution (Basili and Temple 1995, Bird Conservation, Fall 1996). While it is beyond the scope or desire of Bird Conservation Plans to recommend conservation objectives for other countries, PIF is working in concert with like-minded counterparts throughout the hemisphere to deliver integrated bird conservation at an appropriate geographic scale. For more information about Partners in Flight, see the following web site: http://www.PartnersInFlight.org.

Section 1: The planning unit

Background:

The Prairie Peninsula occupies most of northeastern Missouri, central and north-central Illinois, central Indiana and west-central Ohio. It contains part of sections 251C and D (the Central Till Plain) and sections 222G and H (the Central Till Plain, oak-hickory and beech-maple, respectively) of McNab and Avers (1994). The western portion of the physiographic area is a gently rolling glacial plain characterized historically by tallgrass prairie and oak savanna. Forest occurred only along steams and in bottomlands associated with the region's major rivers. Elevation ranges from 180-300 m (600 - 1,000 ft.) Local relief varies from 1- 30 m (3- 100 ft.) but can be as great as 50 m (165 ft.) along river bluffs. The range of elevation is greater in the southern portion of the physiographic area (100 - 300m, 330-985 ft.) where uplands were a mix of forest and tallgrass prairie but oak-hickory forests predominated on steeper slopes. The eastern portion of the physiographic area is relatively flat, with local relief typically less than a few meters. There, tallgrass prairie-woodland associations occurred as scattered patches within a matrix of beech-maple forests (Gordon 1969). Today, approximately 68% of the land is planted to corn and soybeans, and less than 15% is pasture and hay; only small remnants of native communities persist (See mapset at end of document or download maps at: http://www.cast.uark.edu/pif/main/maincont.htm.). The Prairie Peninsula, together with the Dissected Till Plains physiographic area to the west, and the southern portion of the Northern Tallgrass Prairie to the northwest of that, are known as the "corn belt" of the United States.

Conservation issues:

Historically, tallgrass prairie, savanna, and forest habitats were interspersed across the Prairie Peninsula physiographic area (Gordon 1969, Taft 1997). The percentage of prairie in the landscape generally declined from west to east, with most having occurred in the

Missouri and Illinois portions of the physiographic area prior to Euramerican settlement (Transeau 1935, Gordon 1969). During and following settlement both prairie and woodlands were converted to pasture, hayfields and cropland. Roughly two-thirds of Illinois, for example, was covered by tallgrass prairie prior to settlement, but less than 1% remained by 1920 (Warner 1994). Although the pastures and hayfields eventually were comprised primarily of non-native grasses, these surrogate grassland habitats did support populations of species that could be considered “prairie” birds. In fact, ranges of species such as the Dickcissel and Horned Lark quickly expanded into the eastern portion of the physiographic area as forests and woodlands were cleared and non-native grassland habitats became available (Hurley and Franks 1976). Up to 15% of the area in Prairie Peninsula remains in pasture, hay and other grassland habitats today, but most of this is concentrated in the eastern third of the planning unit (See mapset at end of document or download maps at: http://www.cast.uark.edu/pif/main/maincont.htm.).

Although many species of grassland birds are still relatively abundant in the Prairie Peninsula, populations of some species (eg. Grasshopper Sparrow, Dickcissel, Bobolink and Eastern Meadowlark) have declined significantly over the past 30 years (Sauer et al. 1996). Declines of these species within an eight-state region of the Midwest (which included Missouri, Illinois, Indiana and Ohio) were highly correlated with declines in the combined regional acreage of pasture and hayfields during the same time period, suggesting that loss of habitat alone explains a significant portion of the downward trend in grassland bird populations. When loss of pasture acreage was compared to that of hayfields, however, loss of pasture acreage appeared to be the more important factor (Herkert et al. 1996).

Also within recent decades, many grass hayfields have been replaced by alfalfa monocultures (Warner 1994). While alfalfa is attractive as nesting habitat to a number of species of grassland birds (Frawley and Best 1991), alfalfa is cut earlier and more often than the grasses planted in the past, and nests and nestlings of individuals that choose those sites suffer very high rates of mortality during mowing events. The overall effect can be so great that too few young are produced to replace the population over time. It was

estimated, for example, that over 80% of the potential Bobolink reproduction in alfalfa fields in a Northern Illinois study area was lost to mowing (Herkert, 1997a); similar results were noted in a New York study (Bollinger et al. 1990). Some species of grassland birds also will nest in cropland, grassed waterways, and roadsides adjacent to agricultural lands, but species diversity typically is very low and, again, reproductive success appears to fall far below that necessary to maintain stable populations (Best 1986, Basore et al. 1986, Bryan and Best 1994, Camp and Best 1994, Best et al. 1995, Stallman and Best 1996, Bergen et al. 1997). If population trends of species such as the Bobolink are to be stabilized, enough nesting habitat must be provided in which a great enough gain in reproductive output can be acheived to balance the lack of reproductive success in suboptimal habitats.

While some species of grassland birds remain fairly common even despite significant long-term declines, one that was once abundant is now threatened with exirpation in two states within the physiographic area (MO and IL) and is extirpated from two others (IN and OH). Greater Prairie-Chickens probably now number less than 500 individuals and occur only in a few small, scattered populations in the northeastern and southeastern parts of the physiographic area (Westmeier and Gough, unpublished data and Missouri Dept. of Conservation, unpublished data). Prairie-chickens are prairie specialists that range over large areas during their annual cycle, utilize large patches of grasslands with varying height and structure within the home range (Drobney and Sparrowe 1977), and whose populations appear to be more stable where grassland landscapes are relatively unfragmented (Ryan et al. 1998). Few, if any, places in the physiographic area currently meet their habitat needs.

Other species that have declined significantly, the Bobolink and Grasshopper Sparrow, appear to be area sensitive and are unlikely to be found in patches of grassland habitat less than 50 and 30 ha (125 and 75 acres), respectively (Herkert 1994a); thus, part of their population declines may have resulted from a reduced availability of habitat patches in a certain size range, as well as the overall loss of grassland acreage mentioned above. Habitat fragmentation effects and patch sizes, therefore, must be taken into account when

developing habitat conservation strategies for at least some grassland birds in the Prairie Peninsula. Henslow's Sparrow, another area-sensitive (Herkert 1994b) and very high priority species (see priority species section, this document), also requires the fairly dense grass cover and deep litter layer characteristic of relatively undisturbed prairies. As with the Greater Prairie-Chicken, little habitat for Henslow's Sparrow exists in the heavily agricultural landscapes of the Prairie Peninsula today.

Historically, fires on the open grassland of the prairies burned into forests at varying distances, resulting in a transition zone between prairie and forest. Referred to today as Savannas and Oak-woodlands, these habitats have unique structural characteristics such as canopy trees that are more widely-spaced than those found in closed-canopy forests and an understory comprised largely of grasses and forbs characteristic of the native tallgrass prairie (Taft 1997). Although most species found in Midwestern savannas can also be found in central hardwood forests or tallgrass prairies, numerous plant taxa may reach their peak frequencies in savanna/woodland ecosystems (Packard 1988, 1991, 1993). A comparison of bird community composition between restored Illinois savannas and closed-canopy forests supports this pattern; 9 out of 30 species of birds were found to be significantly more abundant in the savana-woodland habitats. Of those species, six (Northern Bobwhite, Mourning Dove, Red-headed Woodpecker, Brown Thrasher, Eastern Towhee and Indigo Bunting) have declined significantly range-wide over the past 30 years, although the rates of decline of the dove and bunting were less than 1% per year (Sauer et al. 1996). As with native prairie, less than 1% of the original savanna/woodland acreage is estimated to be present in the Prairie Peninsula today (Jeff Brawn, pers. comm.)

Forest birds in the physiographic area also have suffered from habitat loss, degradation and fragmentation. While trends of some species imply that populations are stable, more in depth evaluations of the reproductive success of forest birds within the physiographic area indicate that populations probably are not-self-sustaining and are being supplemented from immigration, perhaps from less fragmented forested areas to the south and north of the Prairie Peninsula (Robinson et al. 1995, Donovan et al. 1995, Brawn and Robinson 1996). Low reproductive success is largely the result of brood parasitism by

Brown-headed Cowbirds and nest predation by a wide array of organisms that include snakes, other birds and various species of mammalian predators that flourish in agricultural landscapes. It is estimated that heavily forested landscapes or tracts of forest in the range of 10,000-25,000 ha (25,000-62,500 acres) are needed to mitigate the excessive levels of cowbird parasitism and nest predation that are found within the planning unit (Robinson 1996, Thompson et al. 1996).

General conservation opportunities:

Many existing programs that can play a role in the conservation of non-game landbirds in the Prairie Peninsula include but are not limited to the U. S. Department of Agriculture's Conservation Reserve Program (CRP), the North American Waterfowl Management Plan (NAWMP) and the Conservation 2000 Ecosystem Program which is underway in Illinois. While the CRP has been shown to provide nesting habitat for a number of grassland birds throughout the Midwest (see Herkert, 1998) the short-term nature of the set-aside contracts and indeed the lack of guarantees that the CRP program itself will continue to exist is cause for some concern.

The Prairie Peninsula overlaps part of the Upper Mississippi/Great Lakes Joint Venture (UMGLJV) which is partially responsible for implementing the goals of the NAWMP (North American Waterfowl Management Plan). The UMGLJV included conservation of non-game landbirds as an objective in their latest plan update, and have elected to use the PIF list of priority species for over-lapping physiographic areas as targets for conservation activities. Conservation benefits to an even broader list of wetland associated non-game landbirds is now considered when grant proposals seeking funding through the North American Wetland Conservation Act (NAWCA) are reviewed.

The State of Illinois, through the Illinois Department of Natural Resources' Conservation 2000 Ecosystems Program, seeks to support public-private partnerships that can merge natural resource stewardship with compatible economic and recreational uses. The Ecosystems Program supports the formation of Ecosystem Partnerships, i.e. local

coalitions of stakeholders within important watersheds throughout Illinois. The criteria for Ecosystem Partnership designation include requirements that the organization be built around a watershed and involve both public and private participation. The voluntary, incentive-based program specifically encourages participation by private landowners. Grants are provided to the Partnerships for projects that preserve and enhance the region's ecological resources, while addressing local economic and recreational concerns.

Section 2: Avifaunal analysis

General characteristics:

Approximately 125 species of birds breed in the Prairie Peninsula physiographic area. The avifauna reflects the diversity of habitats in the physiographic area: roughly 12% of the species are wetland-associated, 17% are associated with grassland or grass-shrub habitats, 10% are found primarily in riparian areas, and 40% are species of forests, woodlands and savannas. The rest typically are species that inhabit urban areas or that are able to utilize a variety of habitats. Long-term population trends across the area are unknown for a majority of species; slightly less than half have significant 30-year trends as measured by the Breeding Bird Survey (P = 0.10; Sauer et al. 1996).

Those species with significant population trends (p=0.10) of 1% or greater during a thirty-year period (1996-1996), and that occur on at least 10 BBS routes can be categorized as follows:

Species utilizing landscapes that are a mixture of grassland and forest fragments:

Species	Population trend
Red-tailed Hawk	+ 9.1
American Kestrel	+ 4.7
Red-bellied Woodpecker	+ 1.6
Brown-headed Cowbird	+ 1.1

Species that benefit from disturbed ground and waste grain:

Species	Population trend
Killdeer	+ 5.9
Common Grackle	- 1.2

Species tolerant of or benefitting from urban, suburban and farmstead habitats:

Species	Population trend
Eastern Phoebe	+ 3.3
House Finch	+ 47.6
Chipping Sparrow	+ 6.8
Northern Cardinal	+ 1.1
Red-bellied Woodpecker	+ 1.6
Baltimore Oriole	+ 1.2
Cedar Waxwing	+ 5.4
Carolina Wren	+ 4.5
House Wren	+ 1.7
Tufted Titmouse	+ 1.5
Black-capped Chickadee	+ 2.1
American Robin	+ 1.7
Rock Dove	- 1.6
Common Nighthawk	- 9.7
Chimney Swift	- 1.9
Purple Martin	- 4.2
House Sparrow	- 2.3
Northern Mockingbird	- 2.6

Forest specialists:

Species	Population trend
Rose-breasted Grosbeak (woodlands and young successional forest)	+ 3.5
Northern Parula	+ 5.3
Yellow-billed Cuckoo	- 4.0
Whip-poor-will	- 12.6

American Redstart	- 6.1
Yellow-breasted Chat (early successional)	- 3.4

Open Woodland/Savanna specialists:

Species	Population trend
Red-headed Woodpecker	- 2.0
Great Crested Flycatcher	- 1.8
Eastern Bluebird	+ 1.7
Eastern Kingbird	- 2.5

Grassland specialists:

Species	Population trend
Eastern Kingbird	- 2.5
Bobolink	- 7.9
Eastern Meadowlark	- 2.8
Vesper Sparrow	- 1.9
Savanna Sparrow	- 3.0
Grasshopper Sparrow	- 7.0
Dickcissel	- 3.8
Field Sparrow	- 3.2
Loggerhead Shrike	- 7.2
Northern Bobwhite	- 2.1

Wetland specialists:

Species	Population trend
Mallard	+ 7.4
Wood Duck	+ 8.0
Canada Goose	+ 41.7
Great Blue Heron	+ 8.4
Yellow Warbler	+ 5.1

Riparian specialists:

Species	Population trend
Belted Kingfisher	+ 3.4
Northern Rough-winged Swallow	+ 2.9

Note that species associated with fragmented habitats or rural and urban development typically are doing well in the physiographic area, while those utilizing native habitats such as grasslands, savannas and forests generally are in decline. Birds associated with wetland and riparian habitats also are increasing, perhaps in response to a focus on those habitats following the creation of the North American Waterfowl Management Plan.

Priority Species:

Species are considered of conservation priority for PIF physiographic area Bird Conservation Plans if they meet one of several criteria established by the Partners in Flight Species Prioritization Technical Committee (see Appendix 1). These criteria variously emphasize the species' vulnerability to extinction range-wide, the species population trend in the physiographic area and the degree to which the planning unit in question is a center of abundance for that species. Species that have a large proportion of their population breeding in the planning unit, but that are not declining, are not in need of immediate conservation measures, but should be considered of high conservation responsibility and their needs considered in long-range planning. Species for which the planning unit is a center of abundance and that also show significant declining population trends warrant more immediate conservation attention.

The priority species for the Prairie Peninsula physiographic area are given in Table 1.

Table 1. Partners in Flight Priority Species for Physiographic Area 31: The Prairie Peninsula.

Species	Criteria	Total Score	AI	PT	BBS Trend	% Pop.
Greater Prairie-Chicken	Ib	27	2	3	na	<1
Black Rail	Ib	26	3	3	na	na
Henslow's Sparrow	Ib	26	3	3	-18.3	4.0
Cerulean Warbler	Ib	25	2	3	-9.4	<1
Dickcissel	Ib	24	4	5	-3.8**	5.1
Red-headed Woodpecker	Ib	23	5	5	-2.0**	9.2
Bell's Vireo	Ib	23	2	3	-2.9	<1
N. Bobwhite	IIa	21	4	5	-2.1**	5.7
Chimney Swift	IIa	21	4	5	-1.9**	6.9
Field Sparrow	IIa	21	4	5	-3.2**	6.4
Yellow-billed Cuckoo	IIa	20	3	5	-4.0**	2.2
Eastern Wood Pewee	IIa	20	3	5	-1.1*	3.4
Great Crested Flycatcher	IIa	19	3	5	-1.8**	1.8
Grasshopper Sparrow	IIa	19	3	5	-7.0**	3.1

Criteria: see Appendix 1.

Total score: see Appendix 1.

AI = area importance score; see Appendix 1.

PT = population trend score; see Appendix 1.

BBS = Breeding Bird Survey trend, measured as mean % change per year for the years 1966-1996, for this physiographic area.

* = significant at 0.10; ** = significant at 0.05; na = not available.

% pop = percentage of the species population residing in the planning unit.

Section 3: Habitats and objectives

Habitat-species suites:

Priority species are grouped by suites into habitat types as shown in Table 2.

Table 2: Priority species by habitat type in Physiographic Area 31: The Prairie Peninsula.

Species	Habitat	Total Score	AI	PT	TB
Greater Prairie-Chicken	GR	27	2	3	4
Henslow's Sparrow	GR	26	3	3	4
Dickcissel	GR	24	4	5	4
Grasshopper Sparrow	GR	19	3	5	3
Bell's Vireo	GR - SH	23	2	3	4
N. Bobwhite	GR - SH	21	4	5	3
Field Sparrow	GR - SH	21	4	5	3
Black Rail	WE	26	3	3	4
Cerulean Warbler	RDF	25	2	3	4
Red-headed Woodpecker	RDF	23	5	5	3
Chimney Swift	RDF	21	4	5	3
Cerulean Warbler	DF	25	2	3	4
Yellow-billed Cuckoo	DF	20	3	5	3
Eastern Wood Pewee	DF	20	3	5	3
Great Crested Flycatcher	DF	19	3	5	2
Red-headed Woodpecker	SA	23	5	5	3
Eastern Wood Pewee	SA	20	3	5	3
N. Bobwhite	SA	21	4	5	3
Field Sparrow	SA	21	4	5	3
Great Crested Flycatcher	SA	19	3	5	2
Chimney Swift	U	21	4	5	3

Habitat codes: GR = grassland; GR-SH = grasslands with a shrubby component; WE = wetlands; RDF = riparian deciduous forest; DF = deciduous forest; SA = savanna/woodland; U = urban.

Total score: see Appendix 1.

AI = area importance score; see appendix 1.

PT = population trend score; see Appendix 1.

TB = threats breeding score; see Appendix 1.

Grasslands:

Ecology and conservation status:

Prior to European settlement, tallgrass prairie covered roughly 60% of the Missouri and central Illinois portions of the physiographic area, and 40% of the uplands in the southern Illinois portion (McNab and Avers 1994). Today, almost 70% of the physiographic area is planted in corn and soybeans. Prairie now covers less than 1% of the land surface, although surrogate grasslands such as pasture and hayfields occupy approximately 15% of the area (See mapset at end of document or download maps at: http://www.cast.uark.edu/pif/main/maincont.htm). While those kinds of grasslands provide habitat for some species of grassland birds, the vegetation structure of heavily grazed pastures is not attractive to PIF species of conservation priority (Johnson et. al. 1999) and eggs and nestlings in early-mown hayfields are virtually annihilated when hay is cut and harvested (Herkert, 1997a; Bollinger et al. 1990). Grasslands that have resulted from the Conservation Reserve Program (CRP), however, may be helping to stabilize declines of priority species such as Grasshopper Sparrow and Henslow's Sparrow (Herkert 1997b, Herkert 1998). However, there is no assurance that the program will continue to be offered in the long-term, and surveys have indicated that much of this land will revert to cropland once contracts expire (Kurzejeski et al. 1992).

Bird habitat requirements:

Open grasslands: Greater Prairie-Chicken, Henslow's Sparrow, Dickcissel, Grasshopper Sparrow

Greater Prairie-Chickens:

Although Greater Prairie-Chickens probably numbered in the millions in the physiographic area in the mid-19th century (Illinois State Historical Society 1985), only small, isolated

populations in Missouri and Illinois persist today (Westmeier and Gough, unpublished data, Missouri Department of Conservation, unpublished data). As elsewhere in the Midwestern U. S., the loss of adequate nesting and brood-rearing habitat in the Prairie Peninsula is the single most important factor that led to the species' decline (Wisdom and Mills 1997; Westemeier et al. 1998). Because small, isolated populations have been found to exhibit low genetic diversity and a consequent reduction in nest success, it may be necessary to import birds from areas of the Midwest with more intact populations to enhance the species' recovery (Westemeier et al. 1998).

Greater Prairie-Chickens are basically non-migratory, although home ranges of prairie-chicken flocks may be greater than 800 hectares (2,000 acres) during certain times of year (Robel et al. 1970, Horak 1985). Horak (1985) recommended that at least one-third of the land within the range of a flock of prairie chickens be kept in permanent grassland, with an interspersion of 75% grassland and 25% cropland considered optimum.

Female prairie-chickens mate with males on leks (or "booming grounds") located on open, exposed sites with sparse vegetation. Females typically nest within 0.3 -1.1 km (0.2 - 0.7 mi.) of the leks if there is adequate habitat, in grasslands 25-70 cm (10 - 21 in.) in height (Drobney and Sparrowe 1977, Schroeder and Robb 1993). Nest success in agriculture-related habitats (eg. wheat, fallow fields, field edges, exotic grass, sweet clover, disced fields) has been found to be lower than nest success in native prairie or mixed-grass pastures (Jones 1963, Ryan et al. 1998). Of 20 nests found during a Kansas study all were within 22 meters (20 yards) of some type of edge, 75% were in native bluestem pastures, and all were in the open with no trees or shrubs nearby (Horak 1985). McKee et al. (1998) found that nest success at their Missouri study sites was highest when litter cover was less than 25%, and forb cover was greater than 5%, and recommended that rotational controlled burns be a regular part of the management for this species. Light grazing also seemed to improve habitat structure for Greater Prairie-Chickens and can be part of a beneficial management regime (Drobney and Sparrowe 1977; Christisen 1985, Horak 1985).

Broods need cover they can walk through and see over, so brood habitat should be somewhat shorter than nesting habitat. Of 23 broods observed in a Missouri study, all were seen in cover that had been grazed, mowed or burned prior to the growing season but had not been disturbed that year (Skinner et. al. 1984). In Kansas, broods often were seen within 55 m (60 yds) of an edge. While broods were found in prairie pastures, they also were associated with lands that were formerly or presently cultivated (Horak 1985). In Missouri, winter roosts typically are located within tall, dense grass cover (Skinner et. al. 1984), with native prairie preferred (Drobney and Sparrowe, 1977). Sites where extensive roost habitat was located near grain fields were preferred in Kansas (Horak 1985).

Ryan et al. (1998) compared habitat use and population dynamics of prairie-chickens in a prairie mosaic and a contiguous prairie landscape in southwestern Missouri. Over 27 years, the contiguous prairie landscape supported a stable population, whereas the population in the mosaic landscape declined. In the contiguous landscape, hens nested closer to leks, and a much greater percentage of nests were found in native prairie where nest success was significantly higher than in crop or hay fields. No nests were found in prairie units <65 ha (160 acres), the minimum size of tract recommended for prairie-chicken management units by Kirsch (1974), Sampson (1980), and Horak (1985). Mean daily movements of females and brood range sizes were significantly greater in the mosaic than contiguous landscape. The authors concluded that landscapes composed entirely of small prairie patches, regardless of total prairie habitat available, may be inadequate for conserving Greater Prairie-Chickens.

In a Minnesota study, only 35 of 389 leks were used by booming males during 6 or more years of an 11-year period (1986 through 1996). However an average of 50% of the total male attendance among all sites was on these ” traditional” leks, even though the traditional leks averaged only 33% of all leks available in a given year. No traditional lek was located within 1.6 km (1 mi.) of a patch of forest greater than 30 ha (75 acres), and no leks were found within 2 km (1.2 mi.) of a forested stream corridor. There was a higher proportion of grassland idled under the USDA Conservation Reserve Program, a lower proportion of cropland, and a lower proportion of rural residences near leks than around

randomly chosen, non-lek points; no traditional lek was found within 1.6 km (1 mi.) of any town (Merrill et al. 1999).

Henslow's Sparrow, Dickcissel, Grasshopper Sparrow:

Both the structure of the vegetation and the size of a given tract of grassland can affect the attractiveness of that site to the species in this suite (Henslow's Sparrow, Grasshopper Sparrow; Herkert 1994a and 1994b; Johnson et al. 1999) or the reproductive success of individuals nesting in that site (Dickcissels, Winter 1998). Because area requirements of Henslow's Sparrows and Grasshopper Sparrows are relatively large (55 and 30 ha, respectively), management for these species should be focused first upon tracts of grassland as large or larger than those sizes. However, patterns associated with fragment size can be confounded with edge effects, as small fragments have a greater proportion of edge habitat (area within 50 m of the edge of the patch) than larger fragments. Several studies have shown that nesting success of grassland-nesting birds is lower when nests are placed in close proximity (e.g. within 50-60 m) to a woodland edge (Johnson and Temple 1990, Berger et al. 1994, Winter 1998). Of the two species focused upon by Winter, Dickcissel and Henslow's Sparrow, the effect appeared most pronounced in the latter, even though the species nested more frequently in the core area of grasslands rather than near woody cover (Winter 1998). Dickcissels also had lower nesting success close to woody edges, although the effect of fragment size on it's nesting success was more pronounced than the effect of proximity to edge. The frequency of brood parasitism of Dickcissel nests also was highest within 50 m of shrubby edge. Fates of Dickcissel and Henslow's Sparrow nests were not related to distance to roads or edges bordered by crop fields (Winter 1998). Deslisle and Savidge (1996) used behavioral cues to examine reproductive success for Grasshopper Sparrows in Nebraska, and found no difference in reproductive success between territories within 100 m of an edge and those in the interior. However, Grasshopper Sparrows appeared to avoid nesting within 50 m of edge habitat. Recent work in remnant prairies in eastern Kansas (Jensen and Finck, unpublished data) showed that nest predation and brood parasitism of nests of Grasshopper Sparrows and Dickcissels were not significantly greater within 100 m of either wooded or agricultural

edges than those found at greater distances from edges, but again, Grasshopper Sparrows seemed to avoid nesting within close proximity to edges.

Characteristics of each species' preferred habitat and the species' response to management are given in Table 3.

Table 3. Henslow's Sparrow, Dickcissel, and Grasshopper Sparrow habitat characteristics and responses to management (from Johnson et al. 1999, unless otherwise noted).

Species	**Area sens.[a]**	**Preferred mgmt.[b]**	**Forb comp.[c]**	**Litter depth**	**Grass cover**
Henslow's Sparrow	>55 ha (140 acres)	B, M, G	moderate	deep (>2cm)	Dense and tall with standing, dead residual vegetation
Dickcissel	RS	B, M	high	moderate	dense, moderate to tall
Grasshopper Sparrow	>30 ha (85 acres) RS	B, M, G	neutral	low-moderate (<2cm)	intermediate height; interspersed with patches of bare ground

.[a] Area sens: refers to the size of tract at which the probability of the species occurrence equals 50% of it's maximum (estimates from Herkert 1994, an IL study). Area requirements may vary depending upon percentage of grass cover and isolation of tracts in the surrounding landscape (Horn and Koford, unpublished data, Winter 1998). RS indicates that a positive relationship has been documented between tract size and reproductive success (from Winter 1998, for Dickcissels, a southwestern MO study; Johnson and Temple 1990, for Grasshopper Sparrows in MN). See text in the Grassland Population Objectives section of this plan for further discussion of factors affecting reproductive success.

[b] Preferred mgmt. indicates that a species shows a positive response to burning (B), mowing (M) or grazing (G), within 3 years of the treatment. Grasshopper Sparrow and Henslow's Sparrow abundance is related to the number of years since the last burn. Grasshopper Sparrows in IL showed a preference for tallgrass prairie in the year following the burn; Henslow's Sparrows prefer grasslands >2 years post-burn. Densities of all species are affected by the encroachment of woody vegetation. Dickcissel abundance is reduced when grazing is combined with burning or haying. "G" in all instances indicates light grazing only. *Management should never be applied during the breeding season, mid-May through August.*

[c] Forb comp. refers the relative abundance of non-graminoid, herbaceous vegetation. Neutral means that the species doesn't exhibit a preference with regard to forb cover.

Grasslands with a shrubby component: Bell's Vireo, Northern Bobwhite, Field Sparrow

Each of the species in this suite inhabits grasslands with shrubs or brushy areas interspersed (Best 1979; Skinner 1984; Brown 1993; Jacobs and Wilson 1997). Both Bell's Vireo and the Field Sparrow usually nest in shrubs and are highly susceptible to cowbird parasitism (Ehrlich et. al. 1988; Brown 1993; Jacobs and Wilson 1997). Tract size has not been shown to influence the attractiveness of a site to Field Sparrows, but nest success was higher in the interior of old fields than closer to edges in an Illinois study; in the same study, Bell's Vireos only were detected only in patches greater than 50 ha (75 acres) and thus appear to be area-sensitive in fragmented landscapes (Robinson et al. 1999).

Bobwhites nest on the ground in open grassland, usually within 15-20 m of openings such as roads, fields, etc. but use shrubby areas for roosting and winter cover. Preferred nesting areas have roughly a 2 yr accumulation of vegetation. Preferred brood habitat typically is found in areas with more open bare ground than nesting areas, and where continuous cover roughly 1-1.5m above ground is provided. Adults have been shown to move broods up to 500m from nesting to brood-rearing cover. Chicks forage predominantly upon insects in the first few weeks of life, but later shift to a diet of seeds and plant material. Bobwhite forage on vegetation that can be reached from the ground and also roost on ground. Avian and mammalian predators appear to be the primary source of mortality, although many agrochemicals have been shown to have lethal and sublethal effects on captive birds, and also could be impacting populations in agricultural areas. Populations also can be negatively affected by deep winter snows and prolonged periods of cold during extreme winters (the above reviewed by Brennan, in prep). In a recent Illinois study, Northern Bobwhites were found only in fields greater than 15 ha (38 acres) and thus appear to be moderately area-sensitive (Robinson et al. 1999).

Population objectives and habitat strategies:

Population objectives:

Three of the priority grassland species, the Dickcissel, Northern Bobwhite and Field

Sparrow, have high area of importance scores and have declined significantly at annual rates of 2-1 to 3.8% from 1966-1996 (Table 1). When species decline in parts of their range where their abundance is relatively high, more individuals are lost to the total population than in areas with the same rate of decline but smaller, or less dense populations. While the Grasshopper Sparrow has a more moderate abundance relative to other areas of its range, average annual declines of 7.0% over a 30-year period (Table 1) also could have resulted in the loss of a large proportion of individuals from the total population. The population objective is to stabilize or increase the populations of each of these species throughout the physiographic area.

Henslow's Sparrow, one of the highest priority species in all the Partners in Flight physiographic areas where it occurs (Partners in Flight prioritization scheme database: http://www.rmbo.org/pif/pifdb.html), is another example of a species in the Prairie Peninsula with a moderate area of importance score that also has experienced steep rates of decline within the physiographic area (Herkert 1997b). Unlike the Dickcissel, Field Sparrow and other species mentioned above, it now has a very patchy distribution in the Prairie Peninsula (Peterjohn and Rice 1991; Herkert 1994b; Jacobs and Wilson 1997, Castrale et al. 1998) although historically it also was common and widespread (Herkert 1994b). The population objective is to stabilize current populations, and to enhance or restore enough habitat of adequate quality that the population will increase in the future.

Although Bell's Vireo's area of importance score is relatively low for the physiographic area, its relative abundance in the western Illinois and the Missouri portion of the physiographic area is similar to that in most of its midwestern range (Price et. al. 1995). In Missouri, the species reaches its highest relative abundance, and is fairly well distributed, in the area of the State that lies within Prairie Peninsula (Jacobs and Wilson 1997). Although Breeding Bird Survey data do not show a significant decline in the physiographic area, the species' population size and reproductive success should be monitored in those areas where it occurs.

Greater Prairie-Chickens have been extirpated from Indiana and Ohio. In 1994, only two

small populations existed in southern Illinois. Since then, reintroductions of individuals from Kansas, Minnesota and Nebraska resulted in an increase both in numbers and fitness in one of those populations (Westemeier et. al. 1998). Small numbers of males continue to be counted on booming grounds in northwestern Missouri (Missouri Dept. of Conservation, unpublished data), but the species was recently listed as Endangered in the State and the persistence of the populations in the Missouri portion of the physiographic area is in jeopardy. The population objective for Greater Prairie-Chicken in the Prairie Peninsula is to maintain at least one population with sustained viability in each of the two states where the birds are still extant.

Habitat strategies for priority species in open grasslands:

Research on factors affecting density and reproductive success of grassland-nesting birds (including the Greater Prairie-Chicken, Henslow's Sparrow, Dickcissel, and Grasshopper Sparrow) in the midwestern United States was reviewed by Fitzgerald et. al. (in press) and used to develop recommendations for applied habitat conservation. While more research is necessary, especially regarding the feasibility of making recommendations for one planning unit based upon results of data collected in another, the following conservation implications were derived from the review:

1. The density of birds within a given tract of grassland is related to the structure of the habitat within the patch, and for some species, the size of the tract and surrounding landscape. The availability of habitat needed by each species in a suite of priority bird species will vary both temporally and spatially with management practice, time since disturbance, etc. A given tract of grassland may be suitable for only a subset of priority species at any given time. Management may be more effective when applied to larger tracts than small, although this needs further evaluation. Winter (1998) suggests that management of isolated tracts of prairie alone will have little effect on densities of either Dickcissels or Henslow's Sparrows unless the tract is >100 ha or forest cover in the surrounding landscape is reduced. In landscapes with large amounts of grass cover, management will be effective on both small and large

patches.

2. Increasing or decreasing the amount of grassland within a given planning unit or region can affect the population trends of at least some species of grassland birds. Efforts to increase total acreage of grassland in a region as part of a larger habitat strategy to increase or stabilize grassland bird species must take into account variation in the needs of individual species (see number 1, above). Loss of tracts above a certain size, as well as declines in total grassland acreage could be responsible for declines of grassland birds.

3. Density of at least some high-priority species of grassland birds can be positively affected by the total acreage, and negatively affected by the degree of fragmentation and isolation of grassland tracts within a 5 km radius of the site; density also may be negatively affected by the presence of woody vegetation within the site, immediately adjacent to the site and within a 5 km radius of the site. However, more research is necessary to determine how this may vary regionally. The influence of landscape at spatial scales greater than 5 km from a given tract has not been investigated.

4. Reproductive success may vary with habitat structure for some grassland-nesting species, and be negatively associated with close proximity to woody edges. Management should therefore decrease the amount of woody habitat within and along the edges of prairie fragments.

5. Therefore, conservation efforts should attempt to:

   a. satisfy the largest area requirement of the focal species in question,

   b. focus management first on larger tracts,

   c. seek to protect or create landscapes in which tracts of suitable habitat (in

reference to both structure and size) are clustered, the total amount of grassland in the matrix is above some minimum threshold and the total amount of forest is below in below some minimum.

The Partners in Flight Grassland Bird Conservation Area model:

The Partners in Flight Grassland Bird Conservation Area (BCA) model is based upon general principles of grassland bird ecology as described by Sample and Mossman (1997) and a general understanding of the habitat needs of the Greater Prairie-Chicken and high priority grassland-nesting passerines at both the patch and landscape scale. The model calls for a 4,000 ha management unit at the center of which is an 800 ha block of grassland referred to as the “core”. The core is centered upon one or more prairie-chicken lek or leks and managed in tracts 65 ha or larger. Burning at 3-5 year intervals and light grazing are acceptable management practices. Management is coordinated so that the preferred structure for prairie-chicken nesting, brood-rearing and roosting cover are each provided in one or more tracts in any given year.

The 3,200 ha surrounding the core is the “matrix”. The matrix contains at least another 800 ha of grassland habitat, resulting in a conservation unit comprised of at least 40% grassland. Half of the grassland tracts in the matrix are 40 ha or larger, with the assumption that minimum area requirements of high priority passerines will be met by patches of this size in the moderately grass-covered landscape. The presence of woody vegetation is considered “hostile” to bird density and reproductive success, and covers no more than 1% of the core or 5% of the matrix. Cereal and row crops may occupy the remaining area within the matrix and are assumed to have a neutral impact on bird density and reproductive success.

In geographic areas where prairie-chickens are not included the species suite, 800 ha core areas are less relevant, because core size is based upon the home range of Greater Prairie-Chickens. However, grassland with structure suitable for at least some members of the species suite should still occupy 40% of the BCA, with half of the acreage in tracts

40 ha or larger. Management of grassland tracts should be coordinated to insure that the structural needs of all the species in the suite are provided in any given breeding season.

Underlying assumptions of the PIF Grassland Bird Conservation Area model are being tested in the Northern Tallgrass Prairie physiographic area, and results of that research will be used to further define the BCA concept. Although more research is needed to determine the effectiveness of the BCA model as a tool for conserving grassland nesting species in the Prairie Peninsula, our existing knowledge of habitat requirements of grassland-nesting birds provides a basis for these current management guidelines.

Habitat strategies for priority species in grasslands with a shrubby component:

Each of the species in this suite inhabit grasslands with some degree of woody vegetation, such as shrubs or small trees. However, the amount of woody vegetation attractive to each species varies somewhat, and not all species are likely to be found in the same tract of habitat, unless it is relatively large with some degree of spatial heterogeneity (Robinson et al. 1999). Recent work in Illinois shrublands indicates that species such as Bell's Vireo, Northern Bobwhite, and Field Sparrow are most abundant where scattered patches of shrubs are embedded in a grassland matrix, with Bell's Vireo preferring low, wet areas. Although there have been few consistent indications of area sensitivity in Field Sparrows, Northern Bobwhites in Illinois were found only in fields greater than 15 ha, and Bell's Vireos were detected only in patches greater than 50 ha (75 acres; Robinson et al. 1999). Therefore, management for these species should concentrate on fields above those sizes. Management that maintains grass cover without destroying all existing woody vegetation should favor species in this suite, although landscapes where a patchwork of mostly early successional fields and grasslands are separated by linear woody habitats such as hedgerows and forest corridors are characterized by high rates of nest predation.

Grassland conservation opportunities:

The Conservation Reserve Program has been shown to benefit grassland-nesting

passerines in the Midwestern United States (Herkert 1997b; Herkert et. al. 1996, Herkert 1998) but the program's longevity remains in question. While management practices that favor grassland and grass-shrub birds, such as rotational burns or mowing every few years are relatively easy to implement on public lands, private land-owners are less likely to adopt practices that idle grasslands during the period between treatments. Although no such programs currently exist, incentives that enhance pasture lands through reduced stocking rates or rotational grazing should be developed and their ability to support priority species should be tested.

Evaluation of assumptions - research and monitoring:

1. Additional research is needed on the fundamental assumptions of the grassland Bird Conservation Area model. In particular (a) is nesting success consistently influenced by patch size? (b) does the amount of grassland in the surrounding landscape influence nest success within specific patches? and (c) does forest cover negatively impact grassland bird nest success within patches?

2. Additional research is needed on the effects of various management practices (i.e. burning, haying and grazing) on the nest success of grassland birds breeding within managed grasslands in the region.

3. More information is needed on the effects of scale on grassland bird response to habitat management (i.e., is bird response to management similar on large and small patches? Or in landscapes with high and low levels of grass in the surrounding landscape?).

4. Increased monitoring of Henslow's Sparrow populations is needed. This species is inadequately monitored by the Breeding Bird Survey within this region, so a more intensive monitoring strategy needs to be designed and implemented to evaluate the successes or failures of bird conservation measures aimed at bolstering populations of this species.

Outreach:

Private lands incentive and outreach programs will be key to the success of bird conservation in the Prairie Peninsula, where the vast majority of land is in private ownership. While meeting minimum area requirements of species such as Northern Bobwhites, Henslow's Sparrows, Bobolinks, Bell's Vireo, etc. will be challenging, these are species that may benefit from programs intended to convert fescue to native grass and forb mixes, idle grasslands in conjunction with rotational burning, grazing or mowing, or reduce cattle stocking rates and promote improvements in pasture structure.

Savanna/Woodland:

Ecology and conservation status:

Savannas and woodlands of the Prairie Peninsula derived both from trees and shrubs invading prairies during periods of fire absence and from prairies invading woodlands during periods of increased fire frequency (Nuzzo 1985, Taft 1997). As a result, the structure of habitats present in the ecotone may have ranged from open prairie with a few scattered trees to forests with a high percentage of canopy closure. Savannas today generally are defined as areas with a well developed herbaceous ground cover composed principally of prairie species and tree densities ranging from 1 per acre to roughly 50% canopy closure; the term " woodland" refers to sites with a comparable understory, but with canopy closure of 50-80% (Packard 1993,Taft 1997). Fire-adapted tree species such as bur oak (*Quercus macrocarpa*), black oak (*Q. velutina*), northern pin oak (*Q. ellipsoides*), and white oak (*Q. alba*) dominate the canopy in both instances (Nuzzo 1985). For the purposes of this document, these habitats will be considered jointly and referred to as savanna/woodland.

Prior to European settlement, fire frequency varied spatially and temporally with fluctuations in climate and population densities of native Americans (McClain and Elzinga

1994), influencing the proportion of woody-to-herbaceous plants in savanna/woodland ecotones (McPherson 1997). Frequent fires, for example, likely resulted in a more open savanna by burning back young oaks and other woody vegetation. During longer, fire-free intervals needed to allow oak recruitment into the canopy (Johnson 1993), savanna/woodlands probably had a more well-developed shrub component in the understory (Nuzzo 1985). Several species of birds that have exclusive or important habitat associations with Illinois savanna/woodland habitats (e.g. Northern Bobwhite, Eastern Towhee, Indigo Bunting, from Brawn 1998) are dependent upon the presence of a brush or shrub layer for nest sites or other cover during at least some part of their annual cycle (Ehrlich et al. 1988).

While savanna/woodland habitats are known to be floristically diverse, the faunal composition of savanna-like habitats is less well known. Although there is in general a paucity of globally rare species in savanna/woodland habitats, many species have become regionally rare (Taft 1997). Numerous plant taxa may reach their peak frequencies in savanna/woodland habitats rather than in prairies or closed canopy forests (Packard 1988, 1991, 1993). Differences in bird community structure between savanna/woodland and forest habitats in an Illinois study were significant, with 63% of the variation between bird communities in fire-disturbed savanna/woodland habitats and closed-canopy woodlands accounted for by habitat type. Species such as Northern Bobwhite, Red-headed Woodpecker, Eastern Towhee, Indigo Bunting, Summer Tanager and Baltimore Oriole were significantly more abundant in savanna/woodland habitats (Brawn 1998). Unfortunately, more than 99% of the original 11,000,000 - 13,00,000 ha (27,500,000 - 32,500,000 acres) of savanna/woodland in the Midwest have been converted to cropland or degraded by fire suppression and over-grazing (Nuzzo 1985); without restoration, opportunities to focus management in the kinds of habitats in which these bird species reach their highest relative densities will continue to be compromised.

Bird habitat requirements:

PIF priority species of savanna/woodland birds in the Prairie Peninsula include: Red-headed Woodpecker, Northern Bobwhite, Field Sparrow, Eastern Wood Pewee, and Great-crested Flycatcher. The savanna/woodland species suite requires the presence of large, decaying trees as well as a shrubby understory and herbaceous ground layer (Table 4).

Table 4. Habitat associations of PIF priority savanna/woodland species in the Prairie Peninsula.

Species	Ground cover - grass-dominated	Shrub layer	Canopy	Other
Red-headed Woodpecker				Nests in cavities in relatively large trees; hawks insects as well as gleaning from bark and foliage and sometimes feeds on fruit.
Northern Bobwhite	N, F	C, F?		
Field Sparrow	N, F	N, F		
Eastern Wood-Pewee		N	N	sallies for flying insects from perch in canopy
Great-crested Flycatcher				Nests in cavities in relatively large trees; sallies for flying insects from perch in canopy

N = nest; F = forage; C = cover

Information on Red-headed Woodpecker from Hamel 1992; Northern Bobwhite from Hamel 1992; Field Sparrow from Johnson et al. 1998; Eastern Wood-Pewee from McCarty 1996; Great Crested Flycatcher from Hamel 1992;

Population objectives and habitat strategies:

All of the priority species in the savanna/woodland suite have declined significantly in the Prairie Peninsula at annual rates of 1-3% (Table 1; Sauer et al. 1997) during the 30-year period of the Breeding Bird Survey, 1966-1996. During the second half of the BBS period (1980-1996) Red-headed Woodpeckers declined by 4.1% annually and Field Sparrows by 3.4%. Populations of Northern Bobwhite, Eastern Wood-Pewee and Great Crested Flycatcher seem to have stabilized during these more recent years. Given that restoration of the landscape conditions that created savanna/woodland habitat is unfeasible in what is now basically an intensively managed agricultural system, it is reasonable to set as population objectives maintenance of stable (or perhaps in some cases increasing) populations of all of the priority species in the Prairie Peninsula's savanna/woodland suite. (Table 1; Sauer et al. 1997)

Recent work by Brawn (1998) in savanna/woodland habitats in the Prairie Peninsula indicated that 10 of 12 species of birds experienced greater nesting success in woodlands that were restored by prescribed burning than in undisturbed closed-canopy forests, although size of tract had little effect. Because tract size does influence reproductive success of forest birds (see the section of this plan on forests birds) and large, forested tracts are relatively rare in the Prairie Peninsula (Thompson et al. 1996), it is recommended that savanna restoration be focused on sites less than 800 ha (2000 acres) with soils, floristic composition, topography and other indicators used to determine those locations that likely were savanna/woodlands prior to European settlement. On sites greater than 100 ha (250 acres) “landscape burns” or fires that are allowed to burn the tract differentially with respect to aspect, slope, moisture gradients, etc. should be employed to get a mosaic of habitats and some variation in the proportion of woody-to-herbaceous understory plants at the landscape scale. Again, many of the species of birds that attain their highest relative abundances in savanna/woodland habitats require the presence of shrubs or small trees in the understory, and this habitat component must be maintained in the landscape if the savanna/woodland avifauna is to benefit.

None of the species in this suite, perhaps with the exception of the Red-headed Woodpecker, are completely restricted to savanna/woodland habitats, and conservation efforts in other habitat types (such as forests for Eastern Wood-Pewees or grass/shrub habitats for Field Sparrow and Northern Bobwhite) can help to provide habitat in sufficient quantity to stabilize their regional populations. Management for these species as a component of savanna/woodland restoration might be most efficient, however, since those habitats appear to support at least some priority species at higher relative abundances and because nest success appears to be better than in closed canopy forests (Brawn 1998).

Conservation opportunities:

The bird conservation community should partner with agencies and organizations with savanna restoration programs. Guidelines in the Habitat Strategies section of this document should be promoted.

Evaluation of assumptions - research and monitoring:

The most definitive work to date on savanna/woodland birds in the Prairie Peninsula is that of Brawn. The following list of research needs is derived from his 1998 report to the Illinois Natural History Survey.

1. What are the effects of restoration on other components of biodiversity and how do these relate to trends in bird populations? Data on arthropod abundance and its effect on foraging efficiency and reproductive success are especially needed.

2. How do in-transient migrant birds use savanna/woodland habitats?

3. How important is the landscape context of savanna restoration? Are there area effects on avian community structure and viability?

Outreach:

The bird conservation community should join in outreach efforts with agencies and organizations promoting savanna restoration programs. Guidelines in the Habitat Strategies section of this document should be promoted.

Forests:

Ecology and conservation status:

Prior to European settlement, closed-canopy forests in the Prairie Peninsula largely were confined to areas with steep slopes and to stream and river valleys (McNab and Avers 1994). Forests graded into more open-canopy savanna/woodland habitat in areas where fires burned (Transeau 1935, Nuzzo 1985, Taft 1997). With the exception of the Cerulean Warbler, each of the PIF priority forest bird species also commonly inhabit savanna/woodland habitats in the Prairie Peninsula (Brawn 1998). While Cerulean Warblers typically are associated with extensive tracts of bottomland forest, a small population has been found in upland oak habitats in Illinois as well (S. Robinson, pers. comm.) Thus, the suite of forest bird species in the Prairie Peninsula appears well adapted to the gradients of forest/woodland habitats that characterized the region historically.

Only 13% of the Prairie Peninsula remains forested today, and most of that occurs as fragments in an agricultural matrix (See mapset at end of document or download maps at: http://www.cast.uark.edu/pif/main/maincont.htm). Forest fragmentation can negatively affect forest birds in a number of ways. Species richness has been shown to be negatively

affect forest birds in a number of ways. Species richness has been shown to be negatively associated with the size and isolation of fragments (Galli et al. 1976, Askins et al. 1987) with smaller woodlots typically dominated by ecological generalists (Martin 1981, Ambuel and Temple 1983, Blake 1983). This pattern appears to be exacerbated when the degree to which forests patches are isolated increases and where habitat structure in the surrounding matrix is in sharp contrast to the forest patch (Blake and Karr 1987, Freemark and Collins 1992). In Illinois, area of the forest tract accounted for 87-98% of the variation in species numbers among woodlots; number of species/area did not reach an asymptote even when patch size reached 500 ha (1250 acres). However, small isolated tracts in Illinois did contain most of the bird species expected in a forest bird community where the forest patch overlapped a major ravine system (Blake and Karr 1984, 1987; Robinson 1988, 1992). Although most studies of species area/relationships use total area of the forest patch as the predictor variable, the birds may actually be responding more to the total amount of core area, or acreage of forest greater than 100m (309 ft.) from an edge (Temple 1986).

Species that typically inhabit only relatively large fragments are called “area sensitive”. Some species are area sensitive because they have relatively large home ranges (e.g. Pileated Woodpecker, 53-160 ha, Renken and Wiggers 1993; Forman et al. 1976), while others require areas of forest orders of magnitude greater than the area of their territories (Ambuel and Temple 1983) for reasons that remain largely unknown. However, even when patch sizes are large enough to attract area-sensitive species, densities and mating success may be compromised until an even greater size threshold is reached. For example, populations of Kentucky Warblers and Ovenbirds in north-central Missouri were one-half as dense in two 300 ha (750 acre) forest fragments than in tracts greater than 800 ha (2000 acres) and pairing success of the Ovenbird was reduced in the smaller patches (Wenny 1993, Van Horn et.al. 1995).

A number of studies in the Midwest indicate that levels of nest parasitism and predation are greater (Temple and Cary 1988, Brittingham and Temple 1983) and that mating success is lower (Gibbs and Faaborg 1990, Van Horn et al. 1995) near edges of forest than in the interior. However, in extremely fragmented forest landscapes where there may

be no truly functional habitat interior (Robinson and Wilcove 1994), cowbirds and nest predators can saturate forests tracts (Marini et al. 1995, Heske 1995, Thompson et al. in press). As a result, nesting success can be so low that populations are unable to replace themselves; immigration of individuals from less fragmented landscapes where reproductive success is high is needed to sustain local breeding populations, a phenomena known as source-sink dynamics (Robinson et al. 1995, Donovan et al. 1995). Because immigration masks local reproductive failure, species richness and population trends within patches can appear constant (Brawn and Robinson 1996).

Bird habitat requirements:

PIF priority species of forests birds in the Prairie Peninsula include: Yellow-billed Cuckoo, Chimney Swift, Eastern Wood-Pewee, Great Crested Flycatcher and Cerulean Warbler. Each species in the suite utilizes a different combination of substrates for nesting and foraging (Table 5).

Table 5. Nesting and foraging substrates utilized by PIF priority forest bird species in the Prairie Peninsula.*

Species	Ground	Understory	Mid-canopy	Upper canopy	Other
Yellow-billed Cuckoo		N	N, F	F	also forages on fruits and small vertebrates such as reptiles and amphibians
Chimney Swift					nests on cliffs, and in hollow trees (AOU 1983); aerial forager.
Eastern Wood-Pewee			N	N	sallies for flying insects from perch in canopy
Great-crested Flycatcher					nests in cavities; sallies for flying insects from perch in canopy
Cerulean Warbler				N, F	more likely to be found in extensive tracts of bottomland hardwood forests.

* information from Hamel 1992 unless otherwise noted.

N = nest; F = forage; MAR indicates a minimum area requirement. See Population Objectives section for more information.

In order to attract a suite of bird species to a particular tract of land, the habitat structure within that tract must provide suitable nesting and foraging substrates and other resources that each of the priority species needs to persist. Therefore management of forested tracts within the Prairie Peninsula should strive to provide a multi-layered canopy with cavity trees present. All of the priority species are primarily insectivores, although the diet of a few species is supplemented by fruit. Encouraging the presence of native fruiting trees, shrubs and vines also can provide a source of food for birds during migration (Moore et. al. 1995; Parrish 1997). Although patch size is an issue in terms of attracting area sensitive species to a given site (see the *Population objectives/habitat strategies* section of this plan), the structure of the vegetation within a patch is not necessarily associated with patch size (Blake and Karr 1987).

Population objectives and habitat strategies:

With the exception of the Great Crested Flycatcher, all of the Prairie Peninsula's priority forest bird species have declined significantly at rates of -1.5 to -3.6% across the Eastern United States during the last 30 years (Sauer et al. 1997). All species also declined significantly during the same time period within the Prairie Peninsula, with the possible exception of the Cerulean Warbler which is too rare within the region to be adequately sampled by the BBS (Table 1; Sauer et al 1996). However, population trends in the Prairie Peninsula may not be an accurate measure of the self-sustainability of forest bird populations. Studies of nesting success within the physiographic area indicate that many forest bird populations are unable to produce enough young to balance adult attrition even in the largest forested tracts (up to 2200 ha) in Illinois; it is only because of immigration of individuals from outside the region that bird populations appear stable at some sites (Robinson et al. 1995; Brawn and Robinson 1996). Therefore, framing population objectives in terms of stabilizing or increasing trends is inappropriate for the physiographic area. Instead, any opportunity to create or sustain conditions that increase reproductive success of forest birds should be pursued.

The primary factors negatively affecting number of young fledged in the Prairie Peninsula

are nest predation and brood parasitism. Both are higher in fragmented landscapes and where the matrix around forest patches is dominated by row crop agriculture, conditions typical of the Prairie Peninsula (Robinson et. a. 1995, Robinson 1996). Robinson et. al. (1995) found high levels of parasitism in tracts as large as 2,200 ha (3,300 acres) in Illinois but substantial reductions in predation and parasitism in tracts in the size range of 10,000-25,000 ha (25,000-62,500 acres). While little potential exists for restoring acreage of this size within the physiographic area, smaller tracts of forest may be able to support populations of less “cowbird-vulnerable” species of forest birds, especially if cowbird densities could be reduced in the matrix surrounding the patches.

Cowbirds, like other organisms, need both foraging and breeding opportunities, and are thought to be limited by whichever is in shortest supply (Robinson et. al. 1995). Cowbirds forage in pastures, row crops and lawns, but not in taller grassland, shrub or forest habitats (Robinson 1996). Females are known to move up to 7 km (4 miles) from feeding areas to breeding sites, although 1.2 km (.75 miles) is average. Therefore, an attempt should be made to reduce foraging habitat within at least a 1.5 km buffer around forest reserves managed for birds. These matrices should consist of taller natural vegetation such as natural grassland, shrubland, savanna/woodland or forest that mimic historical vegetation patterns. Allowing edges of forest tracts to grow up in shrubs or other natural vegetation so that edges are less abrupt may also help to reduce predation and parasitism in forest patches (S. Robinson, pers. comm.).

While small tracts of forest may not be able to support viable populations of forest birds in the Prairie Peninsula, small tracts can provide valuable stopover habitat for in-transient migrant birds needing to replenish fat supplies as they move between breeding and wintering grounds (Moore et. al. 1993; Moore et. al. 1995). Because migrants feed both on fruit and insects, forest management techniques that foster adequate production of these should improve the tracts suitability as stopover sites.

Forest bird conservation opportunities:

Programs and other opportunities to consolidate forest patches into relatively large tracts should be pursued in the physiographic area. Populations need to be monitored as restoration occurs, especially to see if reproductive success is improved. Although the value of the region's forest remnants as migratory stopover sites needs to be better quantified, management of medium and small tracts should encourage the growth of native trees and shrubs that enhance the fruit and insect food base for migrating birds.

Evaluation of assumptions - research and monitoring:

1. Although nest predation and brood parasitism are known to be greater in forest tracts embedded in a matrix of row-crops than in those surrounded by high percentages of forest cover, the effects of other kinds of land-use, such as grassland or urban environments, needs further study.

2. Where reforestation does occur, changes in relative abundance and nesting success of forest birds need to be monitored and compared with those in existing tracts.

3. The value of the region's forests and forest remnants as migratory stopover sites needs to be better quantified.

4. Although research has indicated that forest bird populations in forest fragments in the Prairie Peninsula suffer low reproductive success and appear to be sustained by immigration from more heavily forested regions to the north and south, little is known about the dispersal and dispersal mechanisms of forest birds. Research that addresses these phenomena is needed.

Outreach:

Outreach efforts should seek to foster understanding about the plight of forest birds in the physiographic area, the factors that are having negative impacts and practices that can mitigate those impacts.

Wetlands:

The only Partners in Flight species of priority in wetlands of the Prairie Peninsula is the Black Rail. This is a very secretive species that nests in wet meadows, and little is known of its distribution or abundance in the physiographic area (Jim Herkert and Vern Kleen, pers. comm. for Illinois; John Castrale, pers. comm. for Indiana and Julie Shieldcastle, pers. comm. for Ohio). Therefore, the conservation objective for the species is to increase inventory and monitoring of both breeding and migrating individuals until a better understanding of it's status in the Prairie Peninsula is attained.

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Appendix 1: The Partners in Flight Prioritization Scheme and criteria for the development of priority species lists.

The Partners in Flight Species Prioritization Scheme was first developed in 1991, and has been continually reviewed and refined in the years following its inception (Carter et al., in press). The system ranks each species of North American breeding bird based upon seven measures of conservation “vulnerability”. These factors include; 1) relative abundance (interspecific); 2) size of breeding range; 3) size of non-breeding range; 4) threats to the species in breeding areas; 5) threats to the species in non-breeding areas; 6) population trend; and 7) relative density (intraspecific) in a given planning unit compared to the maximum reached within its range. Each species is given a score of 1-5 in each category, with 1 indicating the least amount of vulnerability with regard to that parameter and 5 the most. Scores in each category are then summed to produce a composite score potentially ranging from 7-35. Species with relatively high overall scores are considered most vulnerable to extinction (although they often are not endangered at present) and need at least to be carefully monitored throughout their ranges. Scores for PIF species are posted on the internet at: http://www.rmbo.org/pif/pifdb.html under “Partners in Flight prioritization process”.

Perhaps one of the most influential factors that comes into play when identifying species of conservation priority is the species' population trend. Species whose populations are declining rangewide may or may not be declining in a given planning unit. It is important to focus active management in those areas where declines should be stabilized or reversed and to identify the factors responsible for stable or increasing trends in other areas so that similar conditions can be achieved where needed. Again, a declining trend has the greatest affect on a species' total numbers where the populations are greatest, so population trend and measures of abundance often are considered together.

Another measure of a species' importance in a given planning unit is the percentage of its population that occurs there. Physiographic areas with large percentages are able to take greater conservation responsibility for that species because affecting an increase or decrease in a population trend has greater potential impacts in areas where numbers of individuals are greater. For example, many more individuals are lost by a sustained 3% per year decrease in an initial population of 10,000 than in a population of 100. The rationale for giving an Area Importance score in the PIF prioritization scheme is similar, although it is a relative density score that is independent of the size of a given planning unit while percentage of population is not. Thus, relative density could be the same in a 100,000 and 200,000 sq. kilometer planning unit, but the percentage of the population would be twice as great in the latter.

After taking into account the factors described above, a list of criteria were developed by which species in a given planning unit are identified as priority species. Species are listed only under the first criteria they meet, although they may qualify with regards to two or more. The criteria are as follows:

1a. Its total score (based upon the Partners in Flight Prioritization Process) in the physiographic area is 28 or greater and it occurs in the region in manageable numbers.

1b. Its total score (based upon the Partners in Flight Prioritization Process) in the physiographic area is 22-27 and it occurs in the region in manageable numbers.

This set of criteria are meant to highlight the species that appear most vulnerable based upon the combination of the seven factors used in the prioritization scheme.

2a. Its total PIF score is 19-21, with the sum of Area Importance and Population Trend equal to or greater than eight. Thus, species with moderate total scores and moderate relative densities in the planning unit are included only if their population trends are declining significantly. Species with high relative densities in the area are included if the population trends is unknown or declining.

2b. Its total PIF score is 19-21, and the percentage of the population breeding in the physiographic area is greater than 9%. (See appendix 2). Conditions in physiographic areas that have relatively large proportions of individuals of a given species have a greater ability to influence the species' global population than do areas with smaller numbers of individuals.

3a. It is a PIF "Watch List" species with an AI = 3 or greater. (Watch List species are those with the highest PIF prioritization scores based upon the species' ranks across their entire range. Some Watch List species may already have met criteria 1 or 2).

3b. A species is federally listed as Threatened or Endangered.

Partners in Flight species prioritization scores for all species in the physiographic area can be found at the Rocky Mountain Bird Observatory's homepage: http://www.rmbo.org/pif/pifdb.html

Fig. 1. The figure on the right depicts a Bird Conservation Area consisting of an 800 hectare (2,000 acre) block of permanent grassland as a core within an approximately 4,000 hectare (10,000 acre) matrix. 25% of the matrix contains compatible grassland habitat, with 51% in tracts greater than 40 hectares (100 acres).