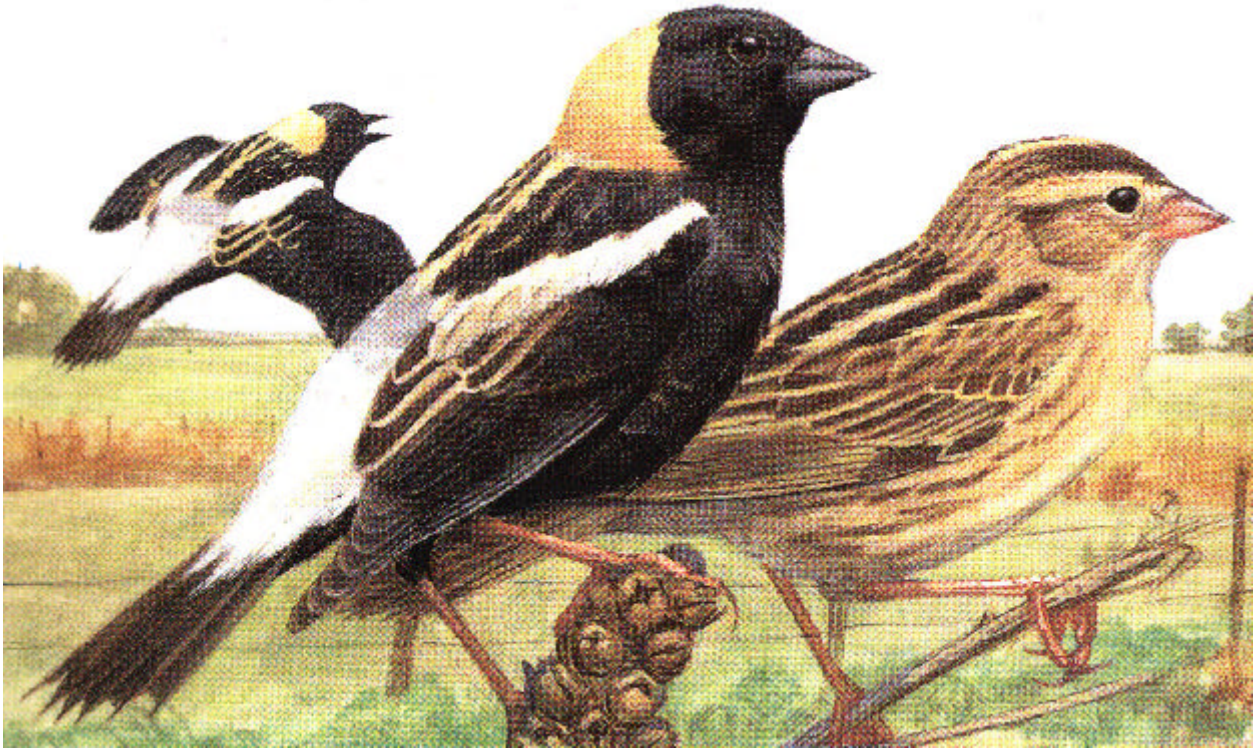
Partners in Flight
Bird Conservation Plan
for
The Dissected Till Plains
(Physiographic Area 32)



American Bird Conservancy

Partners in Flight

Bird Conservation Plan

for

The Dissected Till Plains
(Physiographic Area 32)

Version 1.0

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by

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Front cover illustration of Bobolinks from 'All the Birds of North America' by Jack Griggs, courtesy of HarperCollins publishers.

Table of Contents:

Executive Summary 1

Preface 2

Section 1: The planning unit

Background 3

Conservation issues 3

General conservation opportunities 8

Section 2: Avifaunal analysis

General characteristics 10

Priority species 10

Section 3: Habitats and objectives

Habitat-species suites 12

Grasslands 16

Ecology and conservation status 16

Bird habitat requirements 17

Population objectives and habitat strategies 23

Grassland conservation opportunities 28

Evaluation of assumptions - research, monitoring 29

Outreach 30

Savannas 30

Ecology and conservation status 30

Bird habitat requirements 32

Population objectives and habitat strategies 33

Evaluation of assumptions - research, monitoring 33

Savanna conservation opportunities 34

Outreach 34

Riparian forests 34

Ecology and conservation status 34

Bird habitat requirements 35

Population objectives and habitat strategies 37

Evaluation of assumptions - research, monitoring 38

Riparian forest conservation opportunities 38

Outreach 38

The Big Rivers 38

Literature cited: 39

Appendix 1. The Partners in Flight Prioritization Scheme and criteria for the development of priority species lists 50

Appendix 2. Statements and assumptions associated with grassland Bird Conservation Areas 53

Figure 1. A “Bird Conservation Area” 56

Partners In Flight

Dissected Till Plains Bird Conservation Plan

(Physiographic Area 32)

Executive Summary:

The Dissected Till Plains occupy much of Iowa, eastern Nebraska, northwestern Missouri, and small parts of northwestern Illinois, southern Minnesota and northeastern Kansas. (See attached mapset at end of document or at: http://www.cast.uark.edu/edu/pif/main/maincont.htm. The physiographic area is characterized by moderately dissected, glaciated, flat-to-rolling terrain that slopes gently toward the Missouri and Mississippi River valleys. There is a well-developed, dendritic drainage network of rivers and streams that meander across relatively broad valleys; natural lakes and ponds are rare or non-existent (McNab and Avers 1994). An estimated 60% of the physiographic area was covered by tallgrass prairie at the time of the original land survey, with burr and white oak savannas interspersed and in transition zones between prairies and forested areas. White oak-shagbark hickory forest occurred in the ravines and on slopes of the more dissected areas; bottomland hardwood forest occurred along the larger rivers. Today, very little natural vegetation exists in the Dissected Till Plains. Forest covers less than 4% of the area, and native grasslands less than 3%. Almost 70% of the physiographic area is planted to corn and soybeans, and nearly 20% is in pasture or hay fields which are concentrated primarily in the southern portion of the region. (See attached mapset at end of document or at: http://www.cast.uark.edu/edu/pif/main/maincont.htm). Loss of habitat is the primary reason for the decline of high-priority grassland, savanna-woodland and riparian forest birds throughout the planning unit. Conservation strategies thought able to improve the status of priority species' populations emphasize enhancement and restoration of those habitats at both patch and landscape scales.

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, United States 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 full and functional avifaunal communities.

The foundation of PIF's bird conservation strategy 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 general habitat requirements of priority species at the site-level, but also seek to identify the quantity and quality of habitat required by birds at the landscape scale. Needed conservation actions are recommended and opportunities to accomplish them are suggested. 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. Most species have suffered habitat habitat loss in non-breeding areas, and some are exposed directly 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 the necessary 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 Dissected Till Plains occupy much of Iowa, eastern Nebraska, northwestern Missouri, and small parts of northwestern Illinois, southern Minnesota and northeastern Kansas. (See attached mapset at end of document or at: http://www.cast.uark.edu/edu/pif/main/maincont.htm). The physiographic area is characterized by moderately dissected, glaciated, flat-to-rolling terrain that slopes gently toward the Missouri and Mississippi River valleys. Relief ranges from 7-60 meters (20-165 ft.), with elevations of 216-540 meters (600-1,500 ft.) above sea level. There is a well-developed, dendritic drainage network of rivers and streams that meander across relatively broad valleys; natural lakes and ponds are rare or non-existent (McNab and Avers 1994).

An estimated 60% of the physiographic area was covered by tallgrass prairie at the time of the original land survey, with burr and white oak savannas interspersed and in transition zones between prairies and forested areas (Kuchler 1964). White oak-shagbark hickory forest occurred in the ravines and on slopes of the more dissected areas; bottomland hardwood forest occurred along the larger rivers. Fire and grazing by herds of bison and elk were important in creating and maintaining the landscape.

Conservation issues:

Today, very little potential natural vegetation exists in the Dissected Till Plains. Forest covers less than 4% of the area, and native grasslands less than 3%. Almost 70% of the

physiographic area is planted to corn and soybeans, and nearly 20% is in pasture or hay fields which are concentrated primarily in the southern portion of the region. (See attached mapset at end of document or at: http://www.cast.uark.edu/edu/pif/main/maincont.htm).

Although some species of grassland birds will nest in cropland, grassed waterways, pastures, hayfields and roadsides adjacent to agricultural lands, species diversity in these altered habitats typically is very low and 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). In addition, many grass hayfields have been replaced by alfalfa monocultures within recent decades (Warner 1994). While alfalfa is attractive nesting habitat to some species of grassland birds (Frawley and Best 1991), nests and nestlings can suffer exceptionally high rates of mortality when mowing occurs during the breeding season. The overall effect can be so great that too few young are produced to replace the population over time (Bollinger et al. 1990, Herkert 1997a). 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.

Although many species of grassland birds still are relatively abundant in the Dissected Till Plains, populations of some passerines (eg. Grasshopper Sparrow, Dickcissel, and Bobolink) have declined significantly over the past 30 years (Table 1; Sauer et al. 1997). Declines of these species within an eight-state region of the Midwest that includes Missouri, Illinois and Iowa were highly correlated with declines in the combined regional acreage of pasture and hayfields during the same time period, suggesting that loss of habitat explains a significant portion of the downward trend in grassland bird populations (Herkert et al. 1996). In addition, species such as the Bobolink and Grasshopper Sparrow were found to occur less frequently in patches of grassland habitat smaller than 50 and 30 ha (125 and 75 acres), respectively, in highly fragmented lanscapes in Illinois (Herkert 1994a), indicating that a reduction in the availability of habitat patches in a certain size

range can also contribute to population declines. However, in less-fragmented landscapes where a high proportion of grassland exists in the matrix surrounding the patches, the same species may be less area-sensitive (Herkert et al. 1996; Sample and Mossman 1997). Loss of habitat acreage, fragmentation patterns and patch sizes, therefore, all must be taken into account when developing habitat conservation strategies for grassland birds in the Dissected Till Plains. Finally, the structure of the vegetation within a patch also plays a role in determining what species are attracted to a site, where patch-size and landscape conditions are adequate. For example, Henslow's Sparrow, another area-sensitive species (Herkert 1994b), seeks fairly dense grass cover and a deep litter layer characteristic of relatively undisturbed prairies. Little habitat for Henslow's Sparrow exists in landscapes dominated by cropfields, annually mowed hayfields, or heavily grazed pastures.

While some species of grassland birds remain fairly common even despite significant long-term declines, the Greater Prairie-Chicken, which was once abundant in the physiographic area, is now extirpated in the Illinois portion of the Dissected Till Plains and threatened with extirpation in Missouri and Iowa. Greater Prairie-Chickens probably now number less than 500 individuals and occur only in a few small, scattered populations in the southern part of the physiographic area (Westmeier and Gough and Missouri Dept. of Conservation, unpublished data). Prairie-chickens are prairie specialists that range over large areas during their annual cycle, require large patches of grasslands within their home range that vary in height and structure (Drobney and Sparrowe 1977), and whose populations appear to be more stable where grassland landscapes are relatively unfragmented (Ryan et al. 1998). As with Henslow's Sparrow, few, if any, places in the physiographic area currently meet their needs.

Historically, fires on the open prairies burned into forests at varying distances, creating habitat in a transition zone between prairie and forest referred to today as Savannas and Oak-woodlands. These habitats are characterized by more widely-spaced canopy trees than are found in forests and an understory comprised largely of grasses and forbs

characteristic of 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 savanna-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, very little high quality savanna remains in the Midwestern United States (Nuzzo 1985).

Prior to European settlement, less than 40% of the Dissected Till Plains was forested. Forests occurred in areas with steep slopes and along river drainages where fire and bison had less direct effects on vegetation structure than in the prairies and savannas they bordered (Kuchler 1964; McNab and Avers 1994). Physiographic areas to the north and west of the Dissected Till Plains were extensively dominated by grassland ecosystems, and the Dissected Till Plains marks the northern or western edge of the breeding range of eastern forest bird species such as Cerulean Warbler, Kentucky Warbler, and Louisiana Waterthrush (National Geographic Society 1987; Price et al. 1995). Few extensive tracts of forest remain in the physiographic area today, however (see attached mapset at end of document or view maps at: <http://www.cast.uark.edu/edu/pif/main/maincont.htm>), and the Dissected Till Plains typically supports less than 1% of the range-wide breeding populations of upland forest birds (J. Sauer, unpublished data). Because research in other parts of the Midwest indicates that forest birds nesting in fragmented landscapes can suffer extremely high rates of brood parasitism and nest predation (Robinson et al. 1995, Donovan et al. 1995, Brawn and Robinson 1996), it has been estimated that tracts of forest in the range of 10,000-25,000 ha (25,000-62,500 acres) are needed to support self-sustaining populations (Robinson 1996, Thompson et al. 1996). Few opportunities currently exist in the physiographic area for conservation efforts at that scale in upland

areas. On the other hand, some species associated with riparian forests may have less stringent area requirements (Robinson et al. 1999), and forest bird conservation efforts could be associated with restoration of bottomland hardwoods in formerly wooded river floodplains.

Historically, wetlands in the Dissected Till Plains were associated with riparian areas along streams and rivers; natural lakes and ponds were not characteristic of the physiographic area (Prior 1991). Flood events and other aspects of rivers' natural hydrologic cycles created a diversity of wetland habitats in the floodplains, such as wet meadows, marshes, shrub swamps, oxbow lakes and sloughs and bottomland hardwood forests (Army Corps of Engineers 1981, Schroeder 1981). In the western part of the region, rivers such as the Missouri and Platte were relatively shallow and meandered widely. Marshes and wet prairies were more common than forests on the western floodplains. Forested areas were either absent or occurred in narrow belts on the western sides of rivers, but were somewhat more extensive in floodplains on the eastern sides. (This pattern resulted from southward draining rivers acting as firebreaks to eastward moving fires.) Farther east in the Dissected Till Plains, wooded valleys and bottomland hardwood forests were the dominant riparian habitats on both east and west sides of the rivers (Dinsmore et al. 1984).

Today, much of this habitat has been lost through impoundment or channelization; three of Iowa's largest reservoirs (Coralville, Red Rock, and Rathbun) are in this region (Prior 1991). Remaining wetlands often are silted-in from erosion of agricultural lands (McNab and Avers 1994). Habitat changes in the Missouri River floodplain between the years 1879 and 1967 were measured in five areas along a total of 114 kilometers (71 miles) of river. Habitat losses incuded 24,920 hectares (65,300 acres) of islands and sandbars from the former river channel; lost from the adjacent meander belt were 77,960 hectares (194,900 acres) of timber and 45,640 hectares (114,100 acres) of sandbars, wetlands and other habitat types (Army Corps of Engineers 1981). Floodplain forest coverage along the river's length in Missouri declined from 76% in 1826 to 13% in 1972, while the acreage

under cultivation increased from 18% to 83% in the same time period (Bragg and Tatschl 1977). A loss of 9,768 hectares (24,419 acres) of island-bar area occurred along the Missouri River between Rulo, NE and its mouth during the period from 1879-1972 (Funk and Robinson 1974). Similarly, a loss of 6,000 hectares (15,000 acres) of marsh and 50,360 hectares (125,900 acres) of natural habitat within the first and second floodplains was attributed to channelization and stabilization of the Missouri between Sioux City, IA and Omaha, NE (U.S. Fish and Wildlife Service 1963). While data such as these are unavailable for most of the other rivers in the region, it can be assumed that similar losses of habitat have occurred in other channelized or impounded systems.

The portion of the Mississippi River that overlaps the Dissected Till Plains includes parts of both the upper and lower floodplain reaches. Both spring and fall floods characterized the river's hydrologic cycle prior to impoundment in the late 1800's (Theiling 1996). Prairie and forested wetlands covered much of the floodplain (Finiels 1797). Presettlement floodplain forests were much more diverse than they are today, although the degree of change varies with proximity to a navigation dam. Annual water-level patterns of the river are most similar to the natural or predam hydrologic pattern immediately below each dam, and as a result, forest composition is also more typical of pre-dam communites. Only the most flood-tolerant species, such as willow (*Salix spp.*) and silver maple (*Acer saccharinum*), remain above dams where floodplains are continually inundated (Yin and Nelson 1996). Recent research in the Cache River floodplain in Illinois indicates that some of the less common forest bird species, including the high-priority Cerulean Warbler, forage selectively with regards to tree species (Gabbe 1999), and implies that shifts in forest tree species composition can alter the attractiveness of floodplain forests to bird species of conservation concern.

General conservation opportunities:

Opportunities for implementing PIF's grassland bird conservation objectives are greatest in the portion of the physiographic area that encompasses northern Missouri and southern

Iowa, where the landscape already has a large percentage of grassland cover. Within this region, a focus area for U.S. Department of Agriculture landowner incentive programs has been outlined and two PIF Bird Conservation Areas (BCAs) designated (see population objectives and habitat strategies section of this document for a desciption of the BCA model). Within these areas, there is an opportunity for applied management and a subsequent evaluation of its affects on population responses by high-priority species in open grasslands. The Kellerton Bird Conservation Area is in Ringold County, Iowa and the Dunn Ranch Bird Conservation Area in Harrison County, Missouri. Although many more grassland focal areas are needed to stabilize or increases grassland bird populations throughout the physiographic area as a whole, it is important that this area receive priority so that habitat strategies recommended by PIF can be evaluated and modified if necessary.

Savanna-woodland restoration efforts can be targeted toward private landowners with small- to- moderate-sized woodlots that may have been savanna in the past. Heritage data, geographic information systems and landtype analyses all can help to identify areas within the physiographic area where savanna habitats would have been found in the past and have the most potential for restoration.

Bottomland hardwood and wetland restoration also has potential in the Dissected Till Plains. Widespread flooding in recent years, and the subsequent financial burden to farmers in flood-prone river basins, have resulted in large acreages of river floodplains being transferred from private ownership to public land-managing agencies. The needs of PIF priority species should be brought to the table as management plans, especially for larger tracts, are developed. Restoration plans should seek to meet habitat structural requirements and area requirements of those species, as well as consider landscape-scale recommendations that could serve to reduce brood parasitism and nest predation rates.

Section 2: Avifaunal analysis

General characteristics:

One hundred and thirteen species of birds have been recorded by the Breeding Bird Survey in the Dissected Till Plains physiographic area (Sauer et al. 1997). Of those, approximately 20% are associated primarily with grassland or grass-shrub habitats, 6% with savannas, 29% with forests, and 27% with wetlands. The remaining 18% utilize a variety of habitats that typically include those markedly altered by humans (e.g. agricultural lands, farmsteads and urban areas). Of the 30 species showing significant population declines (p=or <1.0) during the 30 year period 1966-1996, 40% are associated with grassland or grass-shrub habitats, and 20% are associated with savannas or woodlands. Of the 22 species showing significant population increases, 27% are associated with wetlands, and 36% nest readily in urban-suburban environments.

Priority Species:

Species are considered of conservation priority for PIF physiographic area Bird Conservation Plans if they meet one of six criteria (see Appendix 1). These criteria variously emphasize the species' vulnerability to extinction range-wide, its 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 do not warrant immediate conservation action, 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 need more immediate conservation attention.

The priority species for the Dissected Till Plains are given in Table 1.

Table 1. Partners in Flight Priority Species for Physiographic Area 32: The Dissected Till Plains.

Species	Criteria	Total Score	RS	AI	PT local	PT global	BBS Trend	% Pop-B
Greater Prairie-Chicken	1b	27	b	2	3	3	na	2
Black Rail	1b	26	b	3	3	4	na	na
Henslow's Sparrow	1b	25	b	2	3	4	-1.9	4
Piping Plover	1b	25	b	2	3	5	na	na
Cerulean Warbler	1b	25	b	2	3	5	na	<1
Dickcissel	1b	25	b	5	5	5	-3.3**	17
Red-headed Woodpecker	1b	24	b	5	5	5	-3.8**	19
Bell's Vireo	1b	23	b	2	3	5	-2.6	3
Prothonotary Warbler	1b	22	b	2	3	5	na	na
Field Sparrow	1b	22	b	4	5	5	-1.9*	5
Bobolink	1b	21	b	2	5	5	-5.0**	2
Northern Bobwhite	2a	21	b	4	5	5	-2.6**	8
Brown Thrasher	2a	21	b	5	5	5	-2.2**	12
Grasshopper Sparrow	2a	20	b	3	5	5	-4.2*	7
Baltimore Oriole	2a	21	b	5	4	3	-1.0	11
Chimney Swift	2a	20	b	4	4	5	-1.1	5
Loggerhead Shrike	2a	20	b	3	5	5	-8.6**	3
Orchard Oriole	2a	20	b	3	5	5	-5.5*	3
Eastern Phoebe	2a	19	b	3	5	1	-4.9*	2
Eastern Kingbird	2a	19	b	5	5	3	-2.3**	6
Short-eared Owl	3a	20	b	3	3	5	na	na
Least Tern	3b	16	b	2	3	4	na	na
Greater Prairie-Chicken	1b	27	w	2		3		
Red-headed Woodpecker	1b	23	w	5		5		
Harris Sparrow	1b	24	w	3		5		
Short-eared Owl	1b	23	w	4		5		
Northern Bobwhite	2a	21	w	4		5		
Northern Harrier	2a	20	w	4		4		
Long-eared Owl	2a	20	w	5		5		

Species	Criteria	Total Score	RS	AI	PT local	PT global	BBS Trend	% Pop-B
Bald Eagle	2a	20	w	5		3		
American Tree Sparrow	2a	20	w	5		5		

Criteria: the criteria by which the species qualified for inclusion as a priority species in Table 1. (see appendix 1).
Total score: the sum of the seven variables that are used to rank species in the Partners in Flight species prioritization process. (see appendix 1).
RS: residency status. b = species breeds in the physiographic area; w = species winters in the hysiographic area.
AI: area of importance score, a measure of intraspecific relative abundance among physiographic areas. (see appendix 1).
PT local: the species' population trend score for the physiographic area (see appendix 1).
PT global: the species' population trend score rangewide (see appendix 1).
BBS trend: population trend as measured by the North American Breeding Bird Survery (Sauer et al. 1997). * = PT significant at 0.10; ** = PT significant at 0.05; na = not available.
%pop - B: percentage of the species' breeding population that occurs in the planning unit during breeding season. (See appendix 2).

Section 3: Habitats and objectives

Habitat-species suites:

Priority species for the Dissected Till Plains are grouped by suites into habitat types in Table 2.

The open grassland species suite is characterized by species that are poorly monitored and whose population trends are unknown, or whose populations have declined significantly during the last 30 years. Although most species in the suite have fairly large breeding or wintering distributions, the Dissected Till Plains has relatively large percentages of the global population of Dickcissels and Grasshopper Sparrows and is an important wintering area for Northern Harriers and Short-eared Owls (Table 2). Threats to their global wintering habitat or local breeding habitat are relatively high, and indicative of the need for conservation attention. Although the Greater Prairie-Chicken was once both abundant and widespread in the Dissected Till Plains, it is the species in the grassland suite most immediately threatened with extirpation in the physiographic area.

Table 2: Priority species by habitat type in the Dissected Till Plains physiographic area.

Species	Habitat[1]	RS	BD/ND	%Pop-B (AI)	TN (global)	TB (local)	PT (global)	PTB (local)
Greater Prairie-Chicken	GR	b, w	5/5	(2)	4	4	3	3
Henslow's Sparrow	GR	b	3	4		4	4	3
Dickcissel	GR	b	2	17		4	5	5
Bobolink	GR	b	2	2		4	5	5
Grasshopper Sparrow	GR	b	1	7		4	5	5
Northern Harrier	GR	w	1/1	(4)	3	4	4	3
Short-eared Owl	GR	b, w	1/1	(4)	4	4	5	3
Harris' Sparrow	GR-SH	w	4	(3)	3		5	
Bell's Vireo	GR-SH	b	3	3		4	5	3
Field Sparrow	GR-SH	b	2	5		4	5	5
Northern Bobwhite	GR-SH	b, w	2/2	8	3	3	5	5
Brown Thrasher	GR-SH	b	1	12		3	5	5
Long-eared Owl	GR-SH	w	1	(5)	3		5	
Loggerhead Shrike	GR-SH	b	1	3		4	5	5
American Tree Sparrow	GR-SH	w	2	(5)	2		5	
Orchard Oriole	GR-SH	b	2	3		4	5	5
Eastern Kingbird	GR-SH	b	1	6		2	3	5
Red-headed Woodpecker	SA	b, w	2	19	3	4	5	5
Field Sparrow	SA	b	2	5		4	5	5
Northern Bobwhite	SA	b, w	2/2	8	3	3	5	5
Brown Thrasher	SA	b	1	12		3	5	5
Baltimore Oriole	SA	b	2	11		3	3	4
Eastern Kingbird	SA	b	1	6		2	3	5
Cerulean Warbler	RF	b	4	<1		4	5	3
Red-headed Woodpecker	RF	b, w	2	19	3	4	5	5

Species	Habitat[1]	RS	BD/ND	%Pop-B (AI)	TN (global)	TB (local)	PT (global)	PTB (local)
Prothonotary Warbler	RF	b		na		4	5	3
Baltimore Oriole	RF	b	2	11		3	3	4
Bald Eagle	RF	w	2	(5)	3	4	3	
Long-eared Owl	RF	w	1	(5)	3		5	
Chimney Swift	RF-U	b	1	5		3	5	4
Eastern Kingbird	RF	b	1	6		2	3	5
Eastern Phoebe	RF	b	1	2		3	1	5
Black Rail	WM	b	4	(3)		4	4	3
Cerulean Warbler	BR	b	4	<1		4	5	3
Piping Plover	BR	b	4	(2)		4	5	3
Bald Eagle	BR	w	2	(5)	3	4	3	
Least Tern	BR	b	1	(2)		4	4	3

[1]Habitat codes: GR = grassland; GR-SH = grassy areas w/ scattered shrubs or trees; SA = savanna; RF = riparian forest; U = urban/suburban; WM = wet meadows; BR = big rivers;

RS: Residency Status. B = breeding species; w = wintering species.

BD/ND: BD = breeding distribution score; ND = non-breeding distribution. (see appendix 1)

%Pop-B (AI): %Pop-B = percentage of the species population estimated to breed in the physiographic area; (AI) is the Area Importance score (see appendix 1). AI is given if percentage of population estimates are not available.

TN (global): threats to the species in the non-breeding season across its range (see appendix 1). Threat scores for wintering species have not been assigned on a pysiographic area scale.

TB (local): threats to the species' breeding population in the physiographic area (see appendix 1).

PT (global): the species' population trend rangewide.

PTB (local): the species population trend in the physiographic area.

Many of the species in the grass-shrub habitat suite also are widely distributed but have relatively high area importance scores and large percentages of their populations breeding in the Dissected Till Plains. With the exception of Bell's Vireo, whose populations are poorly monitored and trend unknown, all have exhibited significant global or local population declines during the thirty-year period from 1966-1996. Threats to their breeding

or wintering habitat in the Dissected Till Plains may not be as severe as those facing species of open grasslands, but the species and habitat type warrant widespread conservation action.

As with grassland suites, many of the priority savanna-woodland species are widely distributed but have relatively large percentages of their populations breeding in the Dissected Till Plains and have declined significantly during the past 30 years. While species such as the Brown Thrasher, Northern Bobwhite and Field Sparrow are present in savannas, they respond more to the grass-shrub component of the understory and are found in grass-shrub habitats as well as savanna-woodlands. The Red-headed Woodpecker, however, is strictly associated with the woodland structure. Although open-canopied bottomland forests and even urban parks provide habitat for this species, both of those habitat types also are limited in the physiographic area. The Red-headed Woodpecker would benefit from a widespread effort to restore degraded savanna-woodland throughout the physiographic area.

All of the species in the riparian forest suite are declining either globally or locally. Threats breeding scores are relatively high for both Cerulean Warbler and Red-headed Woodpecker. Over 10% of the global population of Red-headed Woodpeckers and Orchard Orioles breed in the physiographic area and it is an important wintering area for Long-eared Owls and Bald Eagles.

Very little is known about the ecology and distribution of the secretive Black Rail, the only high-priority species in the wet meadows habitat-type. Although the species was not recorded during either the Iowa (Jackson et al. 1996) or Missouri (Jacobs and Wilson 1997) Breeding Bird Atlas efforts, Dinsmore et al. (1984) suggested that the Black Rail could be an undiscovered but regular breeding species in Iowa.

Two of the species in the Big Rivers species suite, Piping Plover and the interior subspecies of Least Tern, are listed under the Endangered Species Act. The Cerulean Warbler, a neotropical migrant, has faced severe loss and degradation of habitat

throughout both its breeding and wintering range (Robbins et al. 1992). Although Cerulean Warbler populations in the Dissected Till Plains are relatively small and scattered (Dinsmore et al. 1984, Jackson et al. 1996, Jacobs and Wilson 1997), it is crucial to preserve and restore habitat for the species wherever opportunities exist. Both the Mississippi and Missouri Rivers provide important wintering habitat for relatively large numbers of Bald Eagles, where they feed on fish and roost in large trees in the river's floodplains (James D. Wilson, pers. comm.).

Grasslands:

Ecology and conservation status:

An estimated 60% of the land surface of the Dissected Till Plains was tallgrass prairie at the time of the original land survey. Fire and grazing by herds of bison and elk played an important role in creating and maintaining the grasslands, but are no longer dominant ecological forces (McNab and Avers 1994). Today, almost 70% of the physiographic area is planted in corn and soybeans. Native grassland now covers less than 3% of the land surface, although surrogate grasslands such as pasture and hayfields occupy approximately 19% of the area. While surrogate grasslands provide habitat for some species of grassland birds, the vegetation structure of heavily grazed pastures is not attractive to any PIF species of conservation priority (Johnson et. al. 1999). Although hayfields are particularly attractive to Bobolinks, 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 some priority species (Herkert 1997b, Herkert 1998) but there is no assurance that the program will continue to be offered in the long-term. Therefore, protection, restoration and improvement of existing grassland structure is needed to conserve high-priority grassland avifauna. (See the Conservation Issues section of this document for more information).

Bird habitat requirements:

Priority species utilizing open grasslands and grass-shrub habitats in the Dissected Till Plains have been grouped into the following species suites. Information about each species' general habitat requirements and its response to management techniques such as mowing, grazing and burning is based, when available, upon research in the tallgrass prairie region of the Midwest.

Large tracts of open, treeless grasslands: Greater Prairie-Chicken/Short-eared Owl/Northern Harrier

This suite is characterized by species that have large area requirements, but tolerate or require a variety of habitats within their home ranges. For example, home ranges of Greater Prairie-Chicken flocks may be greater than 800 hectares (2,000 acres) during certain times of year (Robel et al. 1970), Short-eared Owls maintain winter feeding territories of up to 8.8 square kilometers (5.5 square miles, Short et al. 1962), and the cruising area of individual Northern Harriers has been identified as approximately 0.8 square kilometers (0.5 square mile, Hamerstrom 1986).

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 - 1996). However an average of 50% of the total male attendance among all sites was on those 35 “traditional” leks, even though they 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).

Management for prairie-chickens in Wisconsin and Illinois has been shown to be successful in providing habitat for Short-eared Owls and Northern Harriers as well (Hamerstrom 1986, Herkert 1999). Short-eared Owls use the medium- to- tall grasslands for breeding and winter foraging that prairie chickens use for nesting and roosting (Short and Drew 1962, Voous 1988). Disturbance regimes used to keep grasslands from succeeding to woody vegetation are credited with maintaining habitat for the microtine rodents that the owls and harriers prey upon (Hamerstrom 1986, Colvin and Spaulding 1983). Local occurrence of owls is unpredictable, however, as populations fluctuate yearly due to variation in small mammal populations (Johnson et al. 1999). Both Short-eared Owls and Northern Harriers have nested at two grassland sanctuary complexes in southeastern Illinois that also are occupied by remnant flocks of Greater Prairie-Chickens; harriers preferred fields that had not been disturbed by management in the 12 months prior to the breeding season, while the owls were more likely to nest in areas that had been disturbed within the year (Herkert 1999).

Moderate -sized, open grasslands:

Henslow’s Sparrow/Dickcissel/Bobolink/Grasshopper Sparrow

Both the structure of the vegetation and the size of a given tract of grassland can affect the attractiveness of a site to 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, Grasshopper Sparrows and Bobolinks have been shown to be relatively large in fragmented landscapes in Illinois (56, 50 and 30 ha, respectively; Herkert 1994a), management for these species should focus first upon tracts of grassland as large or larger than those sizes. However, ongoing research suggests that area requirements could be mitigated with an increase in the percentage of grass cover in a landscape surrounding a site (Herkert et al. 1996; Sample and Mossman 1997), but the threshold amount of cover needed has not been determined. In the largely grass-covered landscapes of northern Missouri, McCoy (1996) did not document area sensitivity but found that landscape-level factors influenced relative abundance and species richness of grassland birds nesting in CRP fields. Therefore, landscape conditions, patch size and the structure of the vegetation should all be considered when developing managements plans for the species in this suite.

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

Table 3. Microhabitat associations and responses to management of the species suite. (From Johnson et al. 1998 unless noted).

Species	Grass cover	Forb cover	Litter cover	Native/ tame[a]	Use mowed[b]	Use grazed[c]	Use burned[d]	Area sens[e]
Henslow's Sparrow	danse	light to moderate	thick	both	not if done annually	light	yes	55 ha
Dickcissel	dense	heavy	thick	both	not if done annually	light	yes	RS
Bobolink	dense	light	thick	both	yes	light	yes	50 ha
Grasshopper Sparrow	sparse to moderate	light to moderate	light to moderate	both	yes	light to moderate	yes	30 ha

[a]Native/ tame:[c] refers to a whether a species shows a preference for nesting in native grass, non-native or "tame" grass, or uses both with no obvious preference. Different mixtures of tame or native grasses can result in differences in vegetation structure, which can influence the composition of the bird community at a site.

[B]Use mowed: refers to whether the species utilizes mown areas as breeding habitat. Species with a "yes" are those that will utilize the site the first breeding season after mowing; "not if done annually" refers to those species that typically don't recolonize the site until at least 2 years after the disturbance. (Mowing should never be done during the breeding season to avoid nest destruction.)

[C]Use grazed: refers to whether the species will nest in areas that have been grazed. "No" means the species avoids grazed areas; "light" means the species will tolerate light grazing; "not clear" means the effect has not been determined.

[D]Use burned: refers to whether the species will nest in areas that have been burned. "Yes" means the species is attracted to sites that have been burned prior to the breeding season, although it may be 2 or more years after the disturbance before the site is recolonized. Relative densities of birds in the years following the burn can vary depending upon the habitat preferences of the species of birds present, the characteristics of the site and climate in a given year.

[E]Areas sens.: refers to the size a grassland tract had to be before there was a 50% probability of of the species occurrence. Estimates are from Herkert 1994, based upon data from prairie tracts in fragmented landscapes in Illinois. RS indicates that reproductive success increases with patch size (Winter 1998).

Grasslands with a shrubby component:

Bell's Vireo/Field Sparrow/Northern Bobwhite/Loggerhead Shrike/Brown Thrasher/Eastern Kingbird/Orchard Oriole/Long-eared Owl/American Tree Sparrow/Harris' Sparrow

All 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, so 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 Orchard Oriole are most abundant where scattered patches of shrubs are embedded in a grassland matrix. Although there were few consistent indications of area sensitivity, Brown Thrashers were at least twice as abundant in fields greater than 15 ha (38 acres) than in smaller fields, Northern Bobwhites and Orchard Orioles 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). Management that maintains grass cover without destroying all existing woody vegetation should favor species in this suite.

Three of the species in this suite are winter residents only. The Long-eared Owl is an opportunist that feeds upon a variety of small mammals in open habitats. It roosts in dense, woody vegetation of riparian woodlands or isolated tree groves adjacent to foraging areas (Marks et al. 1994). Harris' Sparrows and American Tree Sparrows also utilize woody edge vegetation during winter, with the former especially frequenting thick shrubbery along creeks and wood edges. Both sparrows feed on seeds and other plant material during winter (Nice 1929, Naugler 1993, Norment and Shackleton 1993).

General habitat and substrate descriptions for priority grass-shrub species in the Dissected Till Plains are given in Table 4.

Table 4. General habitat and substrate descriptions for priority grass-shrub species in the Dissected Till Plains.

Species	General habitat	Nesting substrate	Foraging substrate	MAR
Bell's Vireo[1]	grasslands with scattered shrubs and small trees, especially wet areas	shrub or small tree, generally <2m	at low heights in the interior of woody vegetation	> 50 ha
Field Sparrow[2]	grasslands with low-medium shrub density (15-35% shrub cover)	or ground or in woody vegetation generally < 1m	on ground or in shrubs	
Northern Bobwhite[3]	brushy areas	ground	ground or low vegetation	> 15 ha
Loggerhead Shrike[4]	relatively short grassland with scattered trees or shrubs	typically in isolated shrubs or trees, especially thorny species	in short grass but typically search for prey from elevated perch	
Brown Thrasher[6]	moderate -to-dense shrub cover	in woody vegetation, usually within 1-3m of ground	in woody vegetation, usually within 3m of ground	more abundant in fields > 15 ha

Species	General habitat	Nesting substrate	Foraging substrate	MAR
Eastern Kingbird[7]	grasslands with scattered trees or shrubs	typically in trees with an abundance of secondary and tertiary branches; most nests 2-8m above ground	most prey captures begin from perch 1-4m above ground	
Orchard Oriole	grasslands with scattered trees or shrubs, especially in wet areas	in canopies of trees at varying heights	typically from 0.6 - 10.7 m above ground	> 15 ha
Harris' Sparrow	brushy ravines dominated by deciduous trees and shrubs	winter resident only	forages in grass and forbs	
American Tree Sparrow	dense grasslands and weedy fields	winter resident only	feeds upon seeds of grasses and forbs	
Long-eared Owl	utilizes dense vegetation for roosting and open areas for foraging	winter resident only	forages in open habitats	

[1]Bell's Vireo information from Hamel 1992.

[2]Field Sparrow information from Johnson et al. 1998.

[3]Northern Bobwhite information from Hamel 1992.

[4]Loggerhead Shrike information from Johnson et al. 1998.

[6]Brown Thrasher information from Hamel 1992.

[7]Eastern Kingbird information from Murphy 1996.

[8]Orchard Oriole information from Scharf and Kren 1996.

[9]Harris Sparrow information from Norment and Shackleton 1993.

[10]American Tree Sparrow information from Naugler 1993.

[11]Long-eared Owl information from Marks et al. 1994.

MAR = minimum area requirements; from Robinson, et al. 1999.

Population objectives and habitat strategies:

Population objectives:

Populations of every priority grassland or grass-shrub species whose trend is known (8 of 13 species) have declined significantly in the Dissected Till Plains from 1966-1996 (Sauer

et al. 1996). Each of these species also have moderate- to- high area of importance scores, indicating that a relatively large proportion of their global population breeds in the physiographic area (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. The population objective for each of is to stabilize or increase the populations of each of these species throughout the physiographic area.

Although Greater Prairie-Chickens have been nearly extirpated in both Missouri and Iowa, remnant populations exist. An area along the Missouri/Iowa border (see the General Conservation Opportunities section of this document) had been designated as a focal area for the conservation of this species, and includes two Bird Conservation Areas (see Habitat Strategies for grasslands, below) centered upon active prairie-chicken leks. The long-term objective is to provide enough high-quality habitat that a self-sustaining population recolonizes the entire focal corridor.

For those grassland or grass-shrub species whose population trends currently are unknown (Smith's Longspur, Henslow's Sparrow, Bell's Vireo, etc.), inventory and monitoring are encouraged to determine the status of each species.

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 the 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 leks and managed in tracts 65 ha or larger. Rotational 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 whose structure is 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 are will be used to further refine 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 Dissected Till Plains, our existing knowledge of habitat requirements of grassland-nesting birds provides a basis for these current management guidelines.

Habitat strategies for priority species in grass-shrub habitats:

Little is known about landscape factors affecting demographics of most of the species in this suite, so it is difficult to make recommendations at this time about the size and spatial

configuration of habitat tracts needed to support viable populations of these species. Several species appear to be moderately area sensitive, however, so conservation efforts should focus on tracts 15 ha (38 acres) or greater. Habitat efforts should be concentrated in areas where management for large, open grasslands is prohibitive as a result of topographic, edaphic or other factors.

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 conservation haying, 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.

The greatest specific opportunity for applied management and a subsequent evaluation of its affects on population responses by high-priority species in open grasslands lies in a focus area that encompasses the Kellerton Bird Conservation Area in Ringold County, Iowa and the Dunn Ranch Bird Conservation Area in Harrison County, Missouri. Although many more grassland focal areas will be needed to stabilize or increases grassland bird populations throughout the physiographic area as a whole, it is important that this area receive priority so that habitat strategies recommended by PIF can be evaluated and modified if necessary.

Evaluation of assumptions - research and monitoring:

The following actions are needed to further conservation of grassland birds in the Dissected Till Plains, and to help conservation efforts continue to evolve in a responsible and adaptive atmosphere:

1. Increase monitoring and inventory efforts for those species whose trends are unknown, with a special emphasis on Henslow's Sparrow. 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.

2. Determine the ability of grassland Bird Conservation Areas (BCAs) to support source populations of Greater Prairie-Chickens and other priority species of grassland birds, and continue to monitor populations to determine whether population objectives are being met.

3. Additional research also 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?
4. Determine the number of BCAs needed to stabilize or increase populations.

5. Additional research is needed on the effects of various management practices (i.e. burning, haying and grazing) on the density and reproductive success of grassland and grass-shrub birds breeding within managed areas in the region. More information especially 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?). Emphasis needs to be placed on those practices that not only improve bird habitat but maintain or improve economic conditions for landowners as well.

6. Determine the influence of landscape patterns on movements and densities of brood parasites and predators of grassland and grass-shrub priority species.

7. Investigate the dynamics of avian dispersal and colonization of sites.

8. Continue to develop Geographic Information Systems that can help to identify existing and potential grassland Bird Conservation Areas.

Outreach:

Private lands incentive and outreach programs will be key to the success of bird conservation in the Dissected Till Plains, where the vast majority of land is in private ownership. While meeting minimum area requirements of species such as Northern Bobwhite, Henslow's Sparrow, Bobolink, 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. Partnerships should continue to be encouraged to accomplish cooperative conservation ventures. Conservation successes should be recognized and celebrated whenever possible.

Savannas:

Ecology and conservation status:

Savannas and woodlands of the Prairie Peninsula derived both from trees invading prairie during periods of fire absence and from prairie invading woodland 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 fairly closed canopies. Savannas today generally are defined as areas with a well developed herbaceous ground layer 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). Many species of birds that were shown to have exclusive or important habitat associations with savanna/woodland habitats in Illinois (e.g. Northern Bobwhite, Black-billed Cuckoo, Bewick's Wren, Gray Catbird, Brown Thrasher, Northern Cardinal, Indigo Bunting, Eastern Towhee and Field Sparrow, 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) and numerous 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/wood 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 has 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/woodlands in the Dissected Till Plains include Red-headed Woodpecker, Eastern Kingbird, Baltimore Oriole, Northern Bobwhite, Field Sparrow, and Brown Thrasher. The savanna/woodland species suite requires the presence of large, decaying trees as well as a shrubby understory and herbaceous ground layer (Table 5). Some species that utilize grass-shrub habitats, such as Northern Bobwhite, Field Sparrow, and Brown Thrasher also can be associated with grassland habitats with shrubby vegetation interspersed.

Table 5. Habitat associations of PIF priority savanna/woodland species in the Dissected Till Plains.

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.
Eastern Kingbird			N	aerial insectivore.
Baltimore Oriole			N, F	
Northern Bobwhite	N, F	C		
Field Sparrow	N, F	N, F		
Brown Thrasher	F	N, F		

N = nest; F = forage; C = cover

Information on from Red-headed Woodpecker from Hamel 1992; Eastern Kingbird from Murphy 1996, Baltimore Oriole from Rising and Flood 1998, Northern Bobwhite from Hamel 1992; Field Sparrow from Johnson et al. 1998, Brown Thrasher from Hamel 1992.

Population objectives and habitat strategies:

With the exception of Baltimore Oriole, all of the priority species in the savanna/woodland suite declined significantly in the Dissected Till Plains at annual rates of 1.9-5.5% during a thirty-year period (1966-1996) of the Breeding Bird Survey, (Table 1; Sauer et al. 1997). Given the predominance of rowcrop agriculture in the Dissected Till Plains at present, it may not be feasible to expect populations of species in the savanna suite to return to levels characteristic of the physiographic area in the 1960s. However, conservation efforts should be made at least to stabilize populations at their current levels.

Recent work by Brawn (1998) in savanna/woodland habitats in Illinois 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. However, tract size had little effect. It is recommended that savanna restoration sites be identified based upon soils, floristic composition, topography and other indicators that can be used to determine those locations that likely were savanna/woodlands prior to European settlement. On sites greater than 100 ha (250 acres) “landscape burns” (i.e. fires that are allowed to burn the tract differentially with respect to aspect, slope, moisture gradients, etc.) should be employed to create 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.

Evaluation of assumptions - research and monitoring:

Very little is known about the effect of savanna-woodland restoration on bird populations, although several species known to be associated with those habitats are of moderate and high conservation priority. The definitive work to data was done by Brawn (1998) in Illinois. Efforts should be made to gather similar kinds of data from the Dissected Till Plains physiographic area,

so that habitat strategies to conserve savanna-woodland avifaunas evolve in an adaptive fashion and are most amenable to the planning unit in question.

Savanna conservation opportunities:

The bird conservation community should partner with agencies and organizations pursuing savanna restoration programs. Guidelines in the Habitat Strategies section of this document should be promoted, although their effects on savanna bird populations in the Dissected Till Plains should be monitored and management adapted where indicated.

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.

Riparian forests:

Ecology and conservation status:

Prior to European settlement, less than 40% of the Dissected Till Plains was forested. Forests occurred in areas with steep slopes and along river drainages where fire and bison had less direct effects on vegetation structure than in the prairies and savannas they bordered (Kuchler 1964; McNab and Avers 1994). Physiographic areas to the north and west of the Dissected Till Plains were extensively dominated by grassland ecosystems, and the Dissected Till Plains marks the northern or western edge of the breeding range of eastern forest bird species such as Cerulean Warbler, Kentucky Warbler, and Louisiana Waterthrush (National Geographic Society 1987; Price et al. 1995). Few extensive tracts of forest remain in the physiographic area today.

Today, much of the forested habitat along river drainages has been lost through impoundment or channelization (U.S. Fish and Wildlife Service 1963; Funk and Robinson 1974; Bragg and Tatschl 1977; U. S. Army Corps of Engineers 1981; Prior 1991). Remaining wetlands often are silted-in from erosion of agricultural lands (McNab and Avers 1994). In the larger river systems, such as the Upper Mississippi, both spring and fall floods characterized the river's hydrologic cycle prior to impoundment in the late 1800's (Theiling 1996). Prairie and forested wetlands covered much of the floodplain (Finiels 1797). Presettlement floodplain forests were much more diverse than they are today, although the degree of change varies with proximity to a navigation dam. Recent research in the Cache River floodplain in Illinois indicates that some of the less common forest bird species, including the high-priority Cerulean Warbler, forage selectively with regards to tree species (Gabbe 1999), and implies that shifts in forest tree species composition can alter the attractiveness of floodplain forests to bird species of conservation concern.

Although floodplains habitats have been altered by channelization and impoundment, existing floodplain forests have been found to host a larger number of species than other habitat types in Iowa (Best et al. 1995), bird abundances in floodplain forests can be twice as high as in floodplain compared to upland forests (Knutson et al.1996), and wide floodplains support more species than narrow floodplains (Knutson et al.1996; Robinson et al. 1999).

Bird habitat requirements:

The PIF priority species for riparian forest habitats are Bald Eagle, Long-eared Owl, Red-headed Woodpecker, Chimney Swift, Eastern Phoebe, Eastern Kingbird, Cerulean Warbler, Prothonotary Warbler, and Baltimore Oriole. Habitat requirements of the species suite are given in Table 6.

Table 6. Habitat requirements of priority riparian forest bird species in the Dissected Till Plains physiographic area.

Species	Nest substrate	General Habitat Requirements*	Diet
Bald Eagle	fork of tall tree	forested areas near rivers and large lakes	fish, small mammals, waterfowl
Long-eared Owl	winter resident only	Roosts in dense vegetation adjacent to open areas. Forages nocturnally in open areas.	Primarily rodents
Red-headed Woodpecker	Primary or secondary cavity, usually in barkless dead tree or dead stub of live tree.	Open woodlands with a grassy understory	Mostly insects, but some vertebrates, seeds and fruits
Chimney Swift	secondary cavities, including chimneys	varied	forages on the wing for aerial insects
Eastern Kingbird	usually at mid-height of tree	grassland and other open habitats with scattered trees and shrubs	primarily insects, some fruits
Eastern Phoebe	attach mud-based nests to bridges, cliffs, river banks	both riparian and suburban areas	insects, occasionally small fish and frogs, fruits
Prothonotary Warbler	secondary cavities, often in stumps over water	bottomland forests subject to flooding	insects and some aquatic invertebrates
Cerulean Warbler	high in tree canopy	extensive tracts of bottomland hardwood forest	primarily insectivorous
Baltimore Oriole	attach nests to drooping branches	open riparian woodland or other open areas with scattered trees	insects and invertebrates such as spiders and snails

* All habitat information from Ehrlich et al. (1988).

Population objectives and habitat strategies:

The most imperiled species in the riparian forest species suite is the Cerulean Warbler, largely as a result of extensive loss of mature, deciduous forest habitat throughout its breeding range during the last century (Robbins et al. 1992). The population objective for this species is to enhance or establish as many populations as possible in the Dissected Till Plains to bolster global populations and recover the species throughout its historical breeding range. Minimum area requirements for this species in the Middle Atlantic States have been estimated to be 700 ha (1750 acres), with maximum densities reached only when woodlands exceeded 3000 ha (7500 acres; Robbins et al. 1989). Ongoing research by Hamel in Tennessee supports this pattern. Hamel's data also indicate the species prefers the canopy of mature trees of relatively large diameter (Robbins et al. 1992; Hamel, unpublished data). Therefore, large tracts of mature floodplain forest need to be restored or established in the Dissected Till Plains wherever opportunity allows. While the Prothonotary Warbler is somewhat peripheral to the Dissected Till Plains, the restoration of mature tracts of floodplain forest should enhance habitat for this species as well.

The other priority species that have declined significantly in the planning unit include Red-headed Woodpecker, Eastern Kingbird and Eastern Phoebe (Table 1). The Red-headed Woodpecker and Eastern Kingbird, as well as the Baltimore Oriole, utilize habitats with grassy understories and a fairly open canopy. Conservation efforts to stabilize or increase the populations of these species in riparian zones should be focused in areas where savanna-like conditions are maintained within floodplains, either by fire during periodic droughts or flooding. Stream bank improvements and measures that enhance insect biodiversity in riparian areas may improve conditions for Eastern Phoebe, although specific conservation guidelines for this species have yet to be developed or tested. Denser woody vegetation near open areas should provide habitat for wintering Long-eared Owls. Red-headed Woodpeckers, Prothonotary Warblers and Chimney Swifts all require the presence of tree cavities for nesting; dead and dying trees should be left in floodplains to provide nesting substrates for these birds. Recent work in riparian Illinois indicates that both riparian bird species diversity and reproductive success are greatly enhanced where forested riparian corridors exceed 500m (550 yds.) in width (Robinson et al. 1999).

Evaluation of assumptions - research, monitoring:

Little research on the structural and habitat needs of riparian forests birds has been completed in the Dissected Till Plains. Data need to be gathered on bird community composition, and species densities and reproductive success as well as habitat structure and landscape conditions that affect those. Monitoring systems for riparian areas need to be developed and implemented.

Riparian forest conservation opportunities:

An increase in land acquisition of floodplains riddled by extensive flooding in the 1990s, an increased emphasis on the value of floodplain wetlands to migrating waterfowl by the Upper Mississippi/Great Lakes Joint Venture, and increased attention on the ability of healthy floodplain habitats to maintain and improve water quality, provide a wealth of opportunities for the Partners in Flight community to partner with other conservation initiatives to restore and enhance riparian and floodplain habitats. The structural needs and minimum area requirements of priority species must be communicated, however, so that riparian and floodplain conservation initiatives can meet the needs of those species.

Outreach:

Habitat needs of riparian forest birds, both at the patch and landscape scale, must be emphasized to land managers and conservation planners so that the needs of the species suite can be included in objectives of riparian conservation initiatives.

The Big Rivers, the Missouri and Mississippi:

Historically, the upper Mississippi and Missouri Rivers meandered widely across their floodplains. Associated patterns of sediment removal and deposition were integral to normal river function, and affected the spatial and temporal distribution of floodplain habitats such as emergent and shrub-scrub wetlands and riparian forests (U.S. Army Corps of Engineers 1994, Johnson 1992, Theiling 1996). These kinds of habitats still exist today in both North and South

Dakota in the deltas and riverine reaches of river created by the mainstem dams. However, the riverine sandbar habitat that was maintained by dynamics of water depth, velocity and sediment transport (U.S. Army Corps of Engineers 1993) has been negatively affected by flood control strategies and management of the rivers for navigation. As a result, species such as Least Tern and Piping Plover that depend upon sandbars for nesting habitat have suffered such precipitous population declines that both species currently are on the Federal Endangered Species list (Smith 1996). The existing floodplain and riparian forest is probably adequate to support nesting and wintering Bald Eagles, whose population declines resulted more from pesticide contamination than habitat loss. Since all the priority species in this suite are Federally listed and are subjects of active recovery efforts in place in the region, we will defer to the U. S. Fish and Wildlife Service recovery plans for recommendations about habitat requirements, population objectives and habitat strategies.

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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. A declining trend has the greatest effect 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. A species with high relative densities in the area are included if its population trend 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 Colorado Bird Observatory's homepage: http://www.rmbo.org/pif/pifdb.html

Appendix 2: Statements and assumptions associated with grassland Bird Conservation Areas.

The following is a list of statements, assumptions, corollaries, and addenda associated with the development of grassland Bird Conservation Areas:

1. The nature of habitat objectives for a region is determined in part by the total percentage of area covered by “natural” high quality habitat (as defined by the needs of priority bird species). Objectives for regions in which the percentage of quality habitat falls below an imprecisely defined threshold should be phrased in terms of habitat blocks. Within blocks, objectives are phrased in terms of maintenance of “healthy” populations rather than numbers of individuals. A “healthy” population is difficult to define, but includes the concepts that: 1) there is a low probability of extirpation over time, and 2) birds breeding within the block are producing enough young to replace adult attrition (population growth rate greater than or equal to 1). Populations producing at or above this level are considered “source” populations. Populations producing below replacement levels are called “sinks”. Areas with sink populations sometimes appear to have stable populations because the birds present are colonizing from other areas with source populations.

2. It is suggested that a block must equal or exceed 800 ha (2000 acres) of high quality protected grassland (in a polygon in which edge is minimized) in order to support source breeding populations of high priority bird species. In areas where conservation of Greater Prairie-Chickens is not an issue, blocks may be as small as 300 ha (750 acres), but the total amount of habitat in the blocks still must equal or exceed 800 ha (2000 acres). A “protected grassland” is one on which appropriate management is assured for a long period of time, including private land under long-term easements or land under public or private conservation organization ownership. The original recommendation for a 800 ha (2000 acres) block is based on a model developed by Wisconsin Department of Natural Resources, in which sustained populations of priority grassland birds have been related to block size. The modification of block sizes of 300 ha (750 acres) is based upon preliminary results of a test of the BCA concept in the

Northern Tallgrass Prairie physiographic area and results of research in other grassland ecosystems in the Midwest. The assumption that large blocks of habitat in the Northern Mixed-grass prairie region will support source populations of non-game grassland birds is critical to all that follows, but is weakly supported and must be tested within the physiographic area.

3. Internal characteristics of identified quality blocks will vary, and no one block is presumed to be optimal for all breeding bird species. Any block should, nonetheless, consist almost entirely of quality habitat. Quality habitat can include native and/or restored prairie, old fields and non-native grasslands, appropriately grazed pasture, or properly managed CRP land (with the caveat that CRP land under short-term contracts does not enjoy the protection necessary to serve within a block designed for long-term conservation purposes). A block should contain a minimum of hostile habitat conditions (including woodlots, treed ditch and fencerows, and treed riparian habitat that provide habitat and perch sites for avian parasites and predators or early-mowed hayfields that serve as a sink for breeding grassland birds). This minimum is tentatively defined as no more than 1% of the total area of the block (this figure may be unrealistically low and should be evaluated as experience in establishing blocks is gained).

4. Internal characteristics of blocks will change over time in response to disturbance, succession, and management practices. The effects of various conditions and practices on priority birds, species suites, and their habitats must continue to be evaluated. It may be necessary to maintain a spatially shifting balance of habitat conditions over time to simultaneously and continuously provide habitat for all species of concern. Minimum necessary sizes for blocks should reflect these predicted needs.

5. Each block is embedded in a matrix that can have both positive and negative impacts on activities within the block. These impacts can include (but are not limited to): support of predators or parasites that have access to parts or all of the block; provision of additional foraging habitat for birds breeding within the block; additional breeding habitat that increases the functional size of populations within the block; habitat for birds dispersing from the block or as attractants to birds colonizing or re-colonizing the block. The distance from the edge of the block over which these

impacts can originate is not defined, but can range from zero to several miles. PIF has tentatively settled on a matrix with a width of one mile (the side of one section) beyond the edge of an identified block. For a square or near-square block of 800 ha (2000 acres), the total area of that block and its matrix would be approximately 4000 ha (10,000 acres). A block and its matrix make up a Bird Conservation Area (BCA, Figure 1).

6. Habitat in a matrix can be compatible, neutral, or hostile for bird populations within a block. Compatible habitat includes native or non-native grasslands, CRP land, pasture, old fields, and late-cut hayfields; neutral habitat includes most small-grain and some row crop agriculture; hostile habitat includes treed areas and early mowed hayfields (these designations must be more carefully considered). It is possible that the negative impacts of a matrix are more critical than the positive impacts. As a tentative step, it is recommended that a matrix include a minimum of 25% compatible habitat and a maximum of 5% hostile habitat. Of the 25% or more that is compatible, much should occur in patches of 100 hectares (250 acres) or greater (Fig. 1). The remainder should be neutral - an important point here is that it is implicit in this recommendation that many agricultural practices and a vibrant rural economy are desired features of these conservation recommendations.

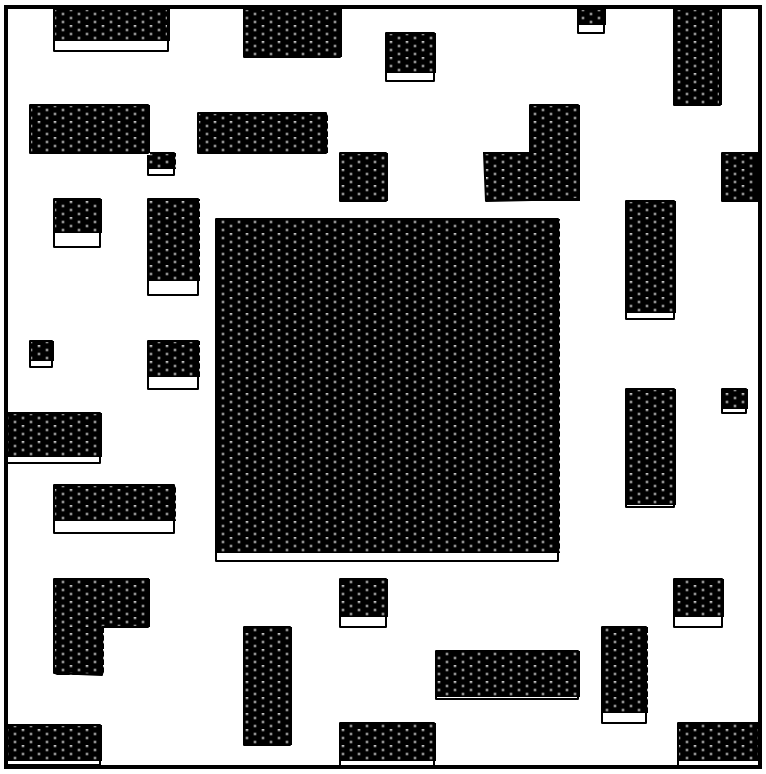
7. Within a BCA, the relationship between the effective size of a block and the nature of its matrix is flexible. It is possible, for example, that a moderate increase in the size of the block can mitigate for some unavoidable hostile conditions in the surrounding matrix.

8. The nature of habitat within landscapes but outside of BCAs (blocks and their associated matrices) may be important. It is tentatively recommended that it be at least 15% compatible (as much as possible arrayed in patches exceeding 100 acres in size), no more than 10% hostile, and the remainder neutral.

9. Bird Conservation Areas should, to the extent feasible, coincide with the conservation of other natural communities and native vegetation and/or be integrated with objectives set for other bird taxa, such as waterfowl or shorebirds.

10. The distribution of BCA's should reflect concerns regarding interpopulational distances, colonization potential, gene flow, and representation of species over the extent of their ranges.

11. For those priority species that are rare, habitat specialists, and/or sparsely distributed, the total number and distribution of individuals supported under these objectives should be evaluated for sufficiency.



12. The assumptions inherent in the above objectives should be tested in both the short-term and long-term. In the short-term, a range of the above conditions, incorporating varying combinations of the assumptions regarding block size, the nature of matrices, and geographic juxtaposition among them, should be identified. These different situations should be investigated for the presence of high priority bird species and species suites, the health of populations (productivity, survivorship, etc.), and their ability to support source populations.

13. Principles of adaptive management should apply, in that all recommendations are subject to change as more and better information becomes available.

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).