Partners in Flight
Bird Conservation Plan
for
The Osage Plains
(Physiographic Area 33)

American Bird Conservancy

Partners in Flight

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for

The Osage Plains
(Physiographic Area 33)

Version 1.0

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by

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Front cover illustration from 'All the Birds of North America'
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Executive Summary:

The Osage Plains physiographic area is comprised of the Flint Hills, Osage Plains, and Cross Timbers subregions. Historically, fire, drought, and bison herbivory were dominant ecological forces and had great influences on the vegetation from local to landscape scales.

The Osage Plains and Flint Hills were dominated historically by tallgrass prairie with scattered groves of oak (*Quercus marilandica*) in the uplands and along drainages. A variety of wetland types, including wet prairie, marshes and northern floodplain forests occurred along larger rivers. Today, much of the land in the Osage Plains is planted to corn and soybeans, or has been converted to non-native grasses for pasture and hay. Large expanses of tallgrass prairie remain in the Flint Hills where relief is greater than in the Osage Plains subregion and the land less suitable for cropping. The area now is managed almost exclusively for beef production with annual burns and intensive grazing practices that provide little of the habitat structure required to support many priority bird species. Many of the larger drainages in both the Osage Plains and Flint Hills have been impounded.

Bluestem prairies and oak-dominated savannas and woodlands characterize the natural vegetation in the Cross Timbers. Much of the area has been converted to agriculture, although expanses of oak forest and woodland are still scattered throughout the eastern portion of the subregion. Fire suppression, overgrazing and the spread of exotic plants are the factors most negatively affecting priority bird habitat.

Conservation strategies for birds can be compatible with a healthy farm and ranch economy, although economic incentives may have to be employed to encourage

management for species whose habitat needs depend on burn intervals or grazing regimes other than those that produce the greatest financial gain. Outreach to private landowners is needed, but the bird conservation community also must reach out to conservation professionals that work directly with those landowners so that the needs of priority birds are understood by all.

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 with the North American Waterfowl Management Plan, United States Shorebird Conservation Plan, and North American Colonial Waterbird Conservation Plan under the umbrella of the North American Bird Conservation Initiative 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 loss in non-breeding areas, and some are exposed directly to toxicants and persecution (Basili and Temple 1999; 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 Osage Plains physiographic area is comprised of several ecological subregions. Historically, fire, drought, and bison herbivory were dominant ecological forces and had great influences on the vegetation from local to landscape scales.

The Osage Plains and Flint Hills occupy the northeastern portion of the physiographic area and were dominated historically by tallgrass prairie with scattered groves of oak in the uplands. Oak savanna and woodlands were present where moisture was adequate and fire barriers were present, such as along rivers or north facing slopes. Upland prairie graded into wet bottomland prairie associated with sloughs, marshes, savanna and northern floodplain forests along major drainages (see sections 251E and 251F in McNab and Avers 1994). Today, much of the land in the Osage Plains is planted to corn and soybeans, or has been converted to non-native grasses for pasture and hay (see mapset attached at end of document or: <http://www.cast.uark.edu/pif/main/maincont.htm>). Large expanses of tallgrass prairie remain in the Flint Hills where relief is greater than in the Osage Plains and the land less suitable for cropping. The area now is managed almost exclusively for beef production. Many of the larger drainages in both the Osage Plains and Flint Hills have been impounded.

The northwestern portion of the physiographic area is part of the South-Central Great Plains (section 332E of McNab and Avers 1994). Dissected plains, terraces, and ridgetops are interspersed with both narrow and wide valleys and bottomlands. Grasslands of bluestem-gramma and sandsage-bluestem prairie are the predominant natural vegetation, but much of the area has been converted to wheat and other small grain crops. Large rivers, streams, ponds, and reservoirs are distributed throughout.

The Redbed Plains (section 311A) and Cross Timbers (section 255A) comprise the southern portion of the physiographic area and are part of the Great Plains Steppe and Shrub and Prairie Parkland provinces of McNab and Avers (1994). Bluestem prairies and oak-dominated savannas and woodlands characterize the natural vegetation. There is a low-to-moderate density of streams and slow-flowing rivers. Much of the area has been converted to agriculture, although large tracts of ancient oak woodlands persist in the eastern portion of the subregion (Stahle et al. 1996, Therrell and Stahle 1998, Stahle et. al 2000). These two areas will be referred to collectively as the Cross Timbers for the remainder of this document.

Conservation issues:

In general, the size of a bird population is determined by the amount and quality of habitat available to individuals for cover, nesting, and foraging, and the ability of individuals in the population to produce offspring that also can survive to reproduce. The density and reproductive success of a species in any given habitat type often is associated with the structure of the vegetation at the local scale and its extent and juxtaposition with other habitat types at the landscape scale (Cody 1968; Wiens 1969; James 1971; reviewed by Fitzgerald in press). Factors that can have large scale effects on important bird habitats native to the Osage Plains include conversion of native habitat to cropland, choices in livestock grazing regimes on private lands, changes in fire frequency, and low density urban sprawl (Engle and Bidwell 2000).

Conversion to cropland...

Although some species of grassland birds will nest in cropland, grassed waterways, pastures, hayfields and roadsides adjacent to agricultural lands, species diversity in those 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, Bergin et al. 1997). While alfalfa and grass hayfields are attractive nesting habitat to some species of grassland birds, nests and nestlings can suffer exceptionally high rates of mortality when mowing occurs during the breeding season (Frawley and Best 1991). The overall effect can be so great that too few young are produced to replace the population over time, and both local, regional, and global populations can decline as a result (Bollinger et al. 1990, Herkert 1997). Nests of Short-eared Owl in Kansas wheat and alfalfa fields, for example, often are destroyed by farming operations (Thompson and Ely 1989). Habitats that attract species to areas where they suffer extremely low rates of reproductive success are known as “ecological traps” (Gates and Gysel 1978).

Livestock grazing...

Partners in Flight recognizes the important role the livestock and ranching community can play in the conservation of landbirds, and emphasizes the need for that livelihood to remain economically viable in the Osage Plains. However, there are a variety of grazing management strategies in use in the region, and each can have different effects on bird communities. While bird species such as Upland Sandpiper may utilize the expanses of relatively uniform and short grass cover that results from the annual burns and intensive-early stocking practiced over much of the Flint Hills,
reproductive success has not been adequately studied in this habitat and it may be far less than in grasslands with a greater variety of cover heights. Furthermore, the needs of priority species that require a variety of grassland heights (eg. Greater Prairie-Chicken) or tall, dense vegetation with a lot of litter (eg. Henslow’s Sparrow) will go unmet. How uniformly cattle graze pastures in season-long stocking regimes also could affect the densities and

distributions of birds by affecting the uniformity of grass height and cover in the pasture. There are numerous unanswered questions regarding the effects of grazing practices on bird reproduction. (See the grasslands section of this document for more information on the habitat needs of priority grassland species).

Changes in fire frequency....

Many bird species associated with native habitats such as open grasslands, grass-shrublands, open woodlands and riparian forests are declining in the Osage Plains. Native habitats of the Osage Plains physiographic area evolved with episodic fires and bison herbivory. Today, however, areas such as the Flint Hills are burned every spring, resulting in a grassland landscape with little of the structural heterogeneity the prairie had historically. The effects are compounded when annual burns are combined with intensive grazing. Species that require the taller grass and increased litter layer of less frequently disturbed prairie, such as Henslow's Sparrow and Greater Prairie-Chicken, suffer as a result (see the grasslands section of this document for more discussion).

Native habitats of the western Cross Timbers, conversely, have suffered from fire suppression rather than over burning, resulting in the invasion of species such as Eastern Red Cedar (*Juniperus virginiana*) and Ashe Juniper (*J. ashei;* Engle et al. 1996, Engle and Bidwell 2000, Oklahoma Cooperative Extension Service circular E-947). The effects of fire on the restoration of shrubland and savanna-woodland bird communities in the Cross Timbers has yet to be evaluated. In the only definitive work along those lines to date was done by Brawn (1998) in Illinois, who found that species that are dependent on savannas and savanna-like habitats, such as the Red-headed Woodpecker, were significantly more abundant at savannas managed with fire than in closed canopy forests (Brawn 1998). The Endangered Black-capped Vireo is known to require a high density of woody thickets (primarily oak) with juniper cover less than 10%, conditions also created and maintained largely by periodic fire (Grzybowski et al. 1994).

Woody plants were naturally occurring components of the riparian vegetation of the Great Plains prior to Euro-American settlement, but generally occupied disjunct sites along drainages. Patches of deciduous woody plants along stream courses have become continuous stands in the absence of fire (see Engle and Bidwell 2000). While this might benefit birds more closely associated with eastern deciduous forests (such as Louisiana Waterthrush and Prothonotary Warbler), species that prefer more open riparian woodlands, such as Eastern Wood-Pewee, Orchard Oriole, and Baltimore Oriole, may have declined as a result.

Low-density urban sprawl....

The conversion of large ranches and traditional farms to ranchettes and rural residential developments threatens open expanses of rangeland that many grassland birds and other prairie-associated wildlife need to persist (Huntsinger and Hopkinson 1996, Engle and Bidwell 2000). The costs and risks of rangeland management, especially the use of prescribed fire, increase when range and urban areas intermix. Habitat fragmentation, conversion of native grasslands to introduced plant species typically used in landscaping, frequent mowing, fire suppression, and human disturbance all lower the attractiveness of rural developments to grassland birds. Non-native predators, especially domestic cats, also are introduced into native habitats when suburbs are interjected into rangeland, potentially increasing predation rates on bird eggs, nestlings, fledglings and adults.

General conservation opportunities:

The Osage Plains physiographic area, and especially the Flint Hills subregion, supports the largest remaining tracts of tallgrass prairie in North America. Given that the vast majority of land in the Osage Plains physiographic area is in private ownership, working with ranchers and other private landowners to maintain healthy rangeland and a variety of native habitat types is perhaps the most important contribution the Partners in Flight community can make to bird conservation in the Osage Plains. Because the vegetation evolved with fire and grazing, active management is needed to maintain and restore most native plant communities. However, management practices that promote a greater diversity of grassland age classes are more compatible with the needs of high priority

grassland birds than are complete and frequent burns over large areas. Economic incentives that help to compensate landowners for financial losses resulting from changes in management to benefit birds should be offered to landowners willing to participate in bird conservation. Working with local, county and regional planners to discourage urban sprawl also could help to keep native landscapes intact. Efforts by land trusts and other private not-for-profit groups that work toward conserving large blocks of native vegetation should be supported and encouraged.

Section 2: Avifaunal analysis

General characteristics:

Approximately 134 species of birds breed in the Osage Plains physiographic area. Roughly 27% are grassland or grass-shrubland birds, 12% are wetland associated, 26% are forest or woodland species, and many of the remainder use a variety of habitat types. Species that appear to be increasing (PIF population trend scores of 1 or 2; see Carter et al. 2000) and declining (PIF population trend scores of 4 or 5) are arranged by habitat type in Table 1. Trends are based on data from the Breeding Bird Survey, 1996-1999.

Table 1. Breeding bird species that appear to be increasing and declining in the Osage Plains physiographic area, arranged by habitat type.

Grasslands:	
Increasing	Declining
Cattle Egret	Northern Harrier*
Ring-necked Pheasant	Swainson's Hawk*
	Greater Prairie-Chicken*
	Horned Lark
	Grasshopper Sparrow*
	Eastern Meadowlark*

Grass-shrublands:	
Increasing	Declining
Bewick's Wren	Western Kingbird
Blue-gray Gnatcatcher	Eastern Kingbird
	Scissor-tailed Flycatcher*
	Loggerhead Shrike*
	Bell's Vireo*
	Brown Thrasher*
	Lark Sparrow*

Savanna-woodlands:	
Increasing	Declining
Wild Turkey	Red-headed Woodpecker*
Eastern Bluebird	Northern Flicker
Indigo Bunting	Western Kingbird
Carolina Chickadee	Eastern Kingbird
Tufted Titmouse	Scissor-tailed Flycatcher*
White-breasted Nuthatch	Loggerhead Shrike*
Carolina Wren	Brown Thrasher*

Riparian woodlands:	
Increasing	Declining
Red-shouldered Hawk	Green Heron
Eastern Phoebe	Black-billed Cuckoo
White-eyed Vireo	Yellow-billed Cuckoo*
Cliff Swallow	Red-headed Woodpecker*
Blue-gray Gnatcatcher	Hairy Woodpecker
Indigo Bunting	Eastern Wood-Pewee*
Ruby-throated Hummingbird	Bell's Vireo (willow thickets)*
	Yellow-breasted Chat
	Orchard Oriole*
	Baltimore Oriole*
	Black-capped Chickadee
	Bullock's Oriole

Wetlands:	
Increasing	Declining
Great Egret	
Mallard	
Common Yellowthroat	
Red-winged Blackbird	

Urban-suburban-farmsteads and fragmented habitat mosaics:	
Increasing	Declining
Black Vulture	American Kestral
Turkey Vulture	Mourning Dove
Canada Goose	Black-capped Chickadee
Red-tailed Hawk	Northern Mockingbird
Rock Dove	Brown Thrasher*
Ruby-throated Hummingbird	Eastern Meadowlark*
Eastern Phoebe	Brown-headed Cowbird
American Crow	House Sparrow
Purple Martin	
Carolina Chickadee	
Tufted Titmouse	
White-breasted Nuthatch	
Carolina Wren	
Eastern Bluebird	
Cedar Waxwing	
Red-winged Blackbird	
Great-tailed Grackle	
House Finch	

* indicates a PIF species of conservation priority.

Most of the species that are increasing in grasslands, shrub-lands, savannas and riparian forests are species that also are tolerant of fragmentation, and that can be found in urban-suburban areas and around farmsteads. Few species exhibiting declines share those affinities, but instead are species that breed in habitats native to the Osage Plains physiographic area (see Background section of this plan). Many of the species showing declines are Partners in Flight species of conservation priority (see the Priority species section below), emphasizing the importance of maintaining and restoring grasslands, shrublands, savannas and riparian woodlands throughout the planning unit.

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 across its range, 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. Population increases or declines in areas with large percentages of a species' global population have a greater impact on global abundance than if similar rates of increase or decline occur where there are fewer individuals. Therefore, conservation efforts for species in areas where they are relatively abundant can be more efficient than those directed toward areas where the species is relatively rare. 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 they should be monitored and their needs considered in long-range planning.

There are thirty-nine species designated as species of conservation priority for the Osage Plains physiographic area (Table 2). Eleven have greater than 10% of their global population breeding in the planning unit. Populations of six of those (Greater Prairie-Chicken, Northern Bobwhite, Yellow-billed Cuckoo, Scissor-tailed Flycatcher, Bell's Vireo, and Eastern Meadowlark) declined significantly in the physiographic area between 1966 and 1996.

Sixteen priority species are on the PIF National Watch List, indicating that they warrant conservation attention in each physiographic area where they occur in manageable numbers. Populations of most of these species appear to have declined in the Osage Plains or trends are unknown due to rare appearances on Breeding Bird Survey routes. The Black-capped Vireo is federally endangered.

The Osage Plains priority species are grouped by habitat type in Table 3. Several of the Watch List species that have exhibited population declines are associated with open grasslands (Greater Prairie-Chicken and Grasshopper Sparrow), shrublands (Bell's Vireo and Black-capped Vireo), savanna/woodlands (Red-headed Woodpecker) and riparian forests (Prothonotary Warbler). Each of these habitats also hosts several other priority species that have declined in the planning unit, emphasizing the need for conservation and restoration of these habitat types in the Osage Plains.

Table 2. Partners in Flight Priority Species for Physiographic Area 33: The Osage Plains.

Species	Criteria*	Total Score	RS	AI	PT local	PT global	BBS Trend	% Pop.-B
Greater Prairie-Chicken[WL]	1a	29	b	3	4	3	-7.3**	8.9
Black-capped Vireo[WL]	1a	28	b	2	3	5	na	na
Henslow's Sparrow[WL]	1a	28	b	5	3	4	16.4	49.1
Black Rail[WL]	1b	26	b	3	3	4	na	na
Scissor-tailed Flycatcher	1b	26	b	5	5	3	-2.3**	24.9
Bell's Vireo[WL]	1b	26	b	3	5	5	-6.6**	11.0
Painted Bunting[WL]	1b	22	b	4	2	5	0.1	18.9
Swainson's Hawk	1b	22	b	2	5	1	-3.5**	1.2
Yellow-billed Cuckoo	1b	22	b	5	5	5	-1.2**	17.3
Brown Thrasher	1b	22	b	5	5	5	-2.3**	6.2
Dickcissel[WL]	1b	22	b	5	2	5	0.4	27.2
Red-headed Woodpecker[WL]	2a	21	b	3	5	5	-3.6**	4.8
Loggerhead Shrike	2a	20	b	3	5	5	-4.6**	8.0
Orchard Oriole	2a	20	b	3	5	5	-12.3**	1.7
Baltimore Oriole	2a	20	b	3	5	3	-3.6**	4.3
E. Wood-Pewee	2a	20	b	3	5	5	-1.6*	4.6
Grasshopper Sparrow	2a	19	b	4	5	4	-1.8	7.5
Lark Sparrow	2a	19	b	3	5	5	-4.2**	6.4
Eastern Meadowlark	2a	19	b	5	5	5	-1.9**	21.8
Mississippi Kite	2b	21	b	3	3	3	-3.3	15.6
Northern Bobwhite	2b	19	b	5	2	5	-0.9**	18.8
Upland Sandpiper	2b	19	b	3	2	2	0.4	9.5
Common Poorwill	2b	19	b	3	3	3	5.7	10.7
Field Sparrow	2b	19	b	5	2	5	-0.9	13.8
Short-eared Owl[WL]	3a	19	b	3	2	5	-0.9	8.9
Chuck-will's-widow[WL]	3a	19	b	3	2	5	-0.9	8.9
Prothonotary Warbler[WL]	3a	21	b	2	3	5	6.4	1.4

Species	Criteria*	Total Score	RS	AI	PT local	PT global	BBS Trend	% Pop.-B
Greater Prairie Chicken[WL]	1a	29	w	4		3		
Smith's Longspur[WL]	1a	28	w	5		3		
McCown's Longspur[WL]	1b	27	w	3		3		
Harris Sparrow[WL]	1b	26	w	5		5		
Sprague's Pipit[WL]	1b	24	w	2		5		
Northern Bobwhite	1b	22	w	5		5		
Red-headed Woodpecker[WL]	1b	22	w	3		5		
Loggerhead Shrike	1b	22	w	5		5		
Lark Bunting[WL]	1b	22	w	3		5		
Chestnut-collared Longspur	1b	22	w	3		3		
Canvasback	2a	21	w	4		4		
Northern Harrier	2a	21	w	5		4		
Field Sparrow	2a	21	w	4		5		
Brown Thrasher	2a	20	w	3		5		
Lark Sparrow	2a	20	w	4		5		
Spotted Towhee	2a	19	w	3		5		
Eastern Meadowlark	2a	19	w	5		5		
Rusty Blackbird	2a	19	w	3		5		
[1]Species of local interest:								
Kentucky Warbler		21	b	2	3	3	-1.1	1.0
Louisiana Waterthrush		21	b	2	3	3	8.4	3.1

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. This is derived from BBS data. Although relative abundance data derived from BBS are fairly robust (John Sauer, Patuxent Wildlife research Center, pers. comm.) information on species that aren't well sampled may be unreliable.

Table 3: Priority species by habitat type and geographic area in the Osage Plains.

Species	AI	PT	OP/FH	MG	CT/RBP	Comments
Open grasslands:						
Greater Prairie-Chicken[WL]	3	4	x	x		
Henslow's Sparrow[WL]	5	3	x	x		
Swainson's Hawk	2	5		x	x	
Dickcissel[WL]	5	2	x	x	x	
Grasshopper Sparrow[WL]	4	4	x	x	x	
Eastern Meadowlark	5	5	x	x	x	
Smith's Longspur[WL]			x	x	x	
McCown's Longspur[WL]				x	x	
Sprague's Pipit[WL]			x	x	x	
Lark Bunting[WL]				x	x	western part of cross timbers
Chestnut-collared Longspur				x	x	
Northern Harrier			x	x	x	
Grass/shrub:						
Black-capped Vireo[WL]	2	3			x	
Scissor-tailed Flycatcher	5	5	x	x	x	
Bell's Vireo[WL]	3	5	x	x	x	
Painted Bunting[WL]	4	2	x	x	x	
Brown Thrasher	5	5	x	x	x	
Field Sparrow	5	2	x	x	x	
Loggerhead Shrike	3	5	x	x	x	
Orchard Oriole	3	5	x	x	x	
Common Poorwill	3	3	x	x	x*	rare in western part of cross timbers

Species	AI	PT	OP/FH	MG	CT/RBP	Comments
Lark Sparrow	3	5	x	x	x	
Northern Bobwhite	5	2	x	x	x	
Harris's Sparrow[WL]			x	x	x	
Spotted Towhee			x	x	x	
Savanna/Woodlands:						
Mississippi Kite	3	3		x	x	
Brown Thrasher	5	5	x	x	x	
Field Sparrow	5	2	x	x	x	
Red-headed Woodpecker[WL]	3	5	x	x	x	
Orchard Oriole	3	5	x	x	x	
Baltimore Oriole	3	5	x	x	x	
E. Wood-Pewee	3	5	x		x	
Common Poorwill	3	3	x		x	western part of cross timbers
Chuck-will's-widow[WL]	3	2	x	x	x	
Northern Bobwhite	5	2	x	x	x	
Yellow-billed Cuckoo	5	5	x	x	x	
Harris's Sparrow[WL]			x	x	x	
Loggerhead Shrike			x	x	x	
Spotted Towhee			x	x	x	western part of cross timbers
Riparian woodlands:						
Bell's Vireo[WL]	3	5	x	x	x	occurs primarily in shrubby willow thickets
Mississippi Kite	3	3		x	x	
Red-headed Woodpecker[WL]	3	5	x	x	x	

Species	AI	PT	OP/FH	MG	CT/RBP	Comments
Brown Thrasher	5	5	x	X	x	
Orchard Oriole	3	5	x	x	x	
Baltimore Oriole	3	5	x	x	x	
E. Wood-Pewee	3	5	x		x	
Northern Bobwhite	5	2	x			
Chuck-will's-widow[WL]	3	2	x	x	x	
Yellow-billed Cuckoo	5	5	x	x	x	
Rusty Blackbird			x		x	eastern part of sub-region
Spotted Towhee			x	x	x	
Prothonotary Warbler[WL]	2	3	x	x	x	
Kentucky Warbler	2	3	x		x	eastern part of cross timbers
Louisiana Waterthrush	2	3	x		x	eastern part of cross timbers
Wetlands:						
Black Rail[WL]	3	3	?	?		secretive; status unknown
Canvasback			x	x	x	

AI = area importance. See appendix 1 and carter et al. 2000.

PT = population trend. See appendix 1 and carter et al. 2000.

OP/FH - Osage Plains and Flint Hills

MG - Southern Great Plains (central KS and north-central portion of OK)

CT/RBP - Cross timbers of Oklahoma and Texas, including the Redbed Plains.

Section 3: Habitats and objectives

Grasslands:

Ecology and conservation status:

Prior to European settlement, the Osage Plains/Flint Hills sub-region was dominated by tallgrass prairie (McNab and Avers 1994). Prairies were frequently disturbed by fire and the grazing of elk and bison. Estimates of pre-settlement fire frequency in the prairie range from every 5-10 years (Wright and Bailey 1982), every 6 years (Rowe 1969) and two to five times every 10 years (Hulbert 1973). Fires were ignited both by lightning (Komarek 1968, Higgins 1984) and native Americans (Gleason 1913, Sauer 1950, Pyne 1983). Fire, in conjunction with topography and climate, has been shown to modify plant species richness and composition on the prairie, with the number of forb, grass and woody species increasing during postfire succession. Warm-season grass cover peaks the year following a burn, then decreases until an equilibrium is reached after approximately 3 years. Species richness of annual plants increases during postfire succession, although it decreases again with time since burning; cover of forbs and woody vegetation increases over time (Gibson 1988, Collins and Gibson 1990). Forbs are more common in areas burned in winter or early spring (Hulbert and Wilson 1983, Hulbert 1986). Tallgrass prairie unburned for 10 or more years begins to convert to woodlands (Abrams and Gibson 1991). Sites in the Flint Hills of Kansas that are burned every four years show cyclic fluctuations in plant community composition thought to closely typify pre-settlement prairie communities (Gibson 1988, Abrams and Gibson 1991).

Grazing by bison also affects plant species community composition and structure on tallgrass prairies. Grazing reduces the dominance of matrix species such as warm-season grasses and increases space for interstitial species such as forbs and annuals, thus increasing plant species richness (Collins 1987, Collins and Gibson 1990). Soil temperatures are warmer and water and light are more available to forbs in grazed patches, enhancing plant growth and biomass production (Fahnestock and Knapp 1994). Bison are attracted to recently burned areas and preferentially graze them over unburned prairie, but grazing in prairie that has not been recently burned does occur. In unburned

prairie, particular patches were found to be grazed repeatedly from year to year, resulting in a mosaic of grazed and ungrazed patches at the landscape scale (Vinton et al. 1993).

The structure and composition of prairie vegetation varied both temporally and spatially across the Osage Plains, and was dependent upon interactions among climate, topography, fire and herbivory. Thus, grassland birds evolved in an ever-changing mosaic of habitat conditions. Species such as the Greater Prairie-Chicken that require large expanses of grassland comprised of patches with different structural characteristics for display sites, nesting, feeding, and brood and roost cover were able to find sufficient kinds and amounts of habitat required to complete their lifecycles (see the "species suites" section for references). Grassland bird species with smaller area requirements but that prefer grassland patches at different intervals following disturbance (eg. Grasshopper Sparrows, Henslow's Sparrows) also were able to find suitable sites within the greater prairie landscape.

In many counties within the Flint Hills area of the Osage Plains, 50-75% of the land remains in native grassland (see mapset attached at end of document or: <http://www.cast.uark.edu/pif/main/maincont.htm>). Over 90% of the land is in private ownership, devoted to beef production, and managed primarily with a combination of annual spring burns and intensive early stocking.

Annual springs burns result in more rapid growth of warm-season grasses in the early part of the growing season, more uniform grass cover, and reduction of forb cover and species richness (Kucera and Ehrenreich 1962, Hulbert 1986, Abrams and Hulbert 1987, Collins and Gibson 1990). Intensive early stocking involves doubling the number of cattle that would represent moderate stocking rates under season-long grazing regimes, and grazing those cattle only from Mid-April to Mid-July or August. Stocking at high densities forces cattle to be less selective and grazing is distributed more evenly across the pasture as a result (Oklahoma State University extension facts F-2875). The popularity of annual spring burns in combination with intensive early stocking has resulted in short, uniform grass cover across large spatial scales throughout the Flint Hills during late spring and early summer. Although this provides habitat for grassland birds like Upland Sandpiper and Killdeer, those species requiring dense, tall grasslands with a well developed litter layer (Henslow's Sparrow), preferring grasses of moderate height with a larger forb component

(Dickcissel and Eastern Meadowlark), or requiring large tracts of grassland habitats with patches of varying height and structure (Greater Prairie-Chicken) have suffered widespread habitat degradation (see Johnson and Igl 2000). The reduction of forb and annual plant species diversity may result in a loss insect diversity and abundance (Evans 1988). Burning and grazing seem to have little effect on clutch size, fledgling weights, or fledgling rates from successful nests (Zimmerman 1997, Rohrbaugh et al. 1999), however the number of nesting attempts and successful nests may be dramatically impacted by burning and grazing practices.

Variation in season-long grazing regimes also has the potential to influence the attractiveness of pastures to birds, thereby affecting the relative abundance of individual species and, in turn, the overall composition of the bird community. Rotating cattle among pastures during the growing season can result in more homogeneous cover than season-long grazing without deferments (Oklahoma State University extension facts F-2875) favoring species requiring more homogeneous cover than those that prefer variation in grass height. Trampling of nests and young birds also may be greater when cattle are rotated among pastures at relatively high densities, although the degree to which reproductive success is affected has not been determined in the Osage Plains physiographic area. A variety of grazing regimes within a given landscape may provide the breadth in grassland structure required to meet the needs of all of the priority species in the grassland species suite, but data on bird-habitat relationships in grazed rangeland are needed to test that assumption and to determine the most beneficial mosaic of grazing and fire management practices.

With the exception of the Flint Hills, little native prairie remains throughout the Osage Plains sub-region. The majority of the land is in corn, milo, soybeans, wheat, sorghum, non-native pasture, hay and other crops. In areas where much of the prairie has been plowed for agricultural or developed for urban uses, grassland birds are left only with habitats such as parks, hayfields, non-native pastures, roadsides, small grain fields and land enrolled in the USDA's Conservation Reserve Program (CRP). Many of these habitats are monotypic in their vegetative structure, resulting in a low grassland bird species diversity. Harvest of hay and row crops during the breeding season also can result in high nest failure rates and significantly reduce the density of birds attempting to renest (Bollinger et al. 1990, Frawley

and Best 1991). Much of the native prairie in the mixed-grass sub-region of the planning unit has been plowed and the land is now cultivated for wheat and small grain crops, although there appear to be relatively large prairie-dominated landscapes scattered throughout.

While species that are largely dependent upon open expanses of tallgrass prairie (eg. Greater Prairie-Chicken and Short-eared Owl) are not emphasized in the Cross Timbers sub-region, several grassland species that more readily inhabit smaller patches of grassland (i.e. Dickcissel, Grasshopper Sparrow, Eastern Meadowlark and the wintering longspurs) are. However, the juxtaposition of woody edges with grassland, the size of the grassland patch, and the amount of grassland versus woody cover in the surrounding landscape have been shown to influence density and/or nesting success of these ground-nesting grassland passerines, and must be taken into account when developing local management plans for these birds (Johnson and Temple 1990, Burger et al. 1994, Herkert 1994a and b, Herkert et al. in prep, Winter 1998, reviewed by Fitzgerald et al. in press). The affect of the interspersion of grass-shrublands and savanna-woodlands on the density and reproductive success of grassland nesting passerines has not been examined. Fire, or some other means of controlling woody vegetation, is critical to keeping grassland, grass-shrublands, and savanna from converting to woodland and closed canopy forest.

Bird habitat requirements:

Large, mosaic grassland landscape: Northern Harrier/Swainson's Hawk/Greater Prairie-Chicken/Short-eared Owl.

This suite is characterized by species that have large area requirements, but tolerate or prefer a variety of habitats within their home ranges. For example, home ranges of 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 and Drew 1962), and the cruising range of individual Northern Harriers has been identified as approximately 0.8 square kilometers (0.5 square mile, Hammerstrom 1986). Estimates of home range sizes of Swainson's Hawk have ranged from 6.2 to 27.3 km^2 (see Johnson and Igl 2000).

It is 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 (Horak 1985). Females mate with males on leks (or “booming grounds”) typically located on open, exposed sites with sparse vegetation. Nesting typically occurs within 0.8 kilometers (0.5 miles) of the lek site if there is adequate habitat (Drobney 1973). Warm-season grass cover at least 25-45 centimeters (10-18 inches) in height must be reserved for roosting and spring nesting cover with warm-season or “clump-type” grasses preferred (prairie-chickens should be able to easily walk through, see over, and hide in the grass cover). In Missouri, 56% of nests in mosaic habitat were on tracts greater than 64 hectares (160 acres); nest success in wheat, fallow fields, field edges, exotic grass, sweet clover and disced fields was lower than nest success in native prairie or mixed grass pastures (Jones 1988). Of 20 nests found during a Kansas study (Horak 1985) 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. In another study, nest success was highest when litter cover was less than 25% and forb cover was greater than 5% (McKee 1995), indicating that rotational controlled burns should be a regular part of the management for this species. Light-to-moderate grazing can also be a beneficial part of a management regime (Cristisen 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 has been shown to be successful in providing habitat for Short-eared Owls and Northern Harriers as well (Hamerstrom 1986, Herkert 1999). 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 and Igl 2000). Both Short-eared Owls and Northern Harriers have nested at two grassland complexes in southeastern Illinois that are managed for 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 previous year (Herkert 1999). Again, this indicates the importance of providing a mosaic of large patches of grassland with different structural characteristics within a larger grassland landscape.

Swainson’s Hawk is more closely associated with shortgrass and mixed-grass than tallgrass prairie. Its range overlap with Greater Prairie-Chicken is not great. However,

management that helps to enhance a prey base of insects and small mammals is likely to provide adequate foraging conditions for Swainson's Hawks as well as for Northern Harriers and Short-eared Owls. Swainson's Hawks appear more tolerant of fragmentation and the interspersion of agricultural and woody vegetation within grasslands than the other species in this suite, and require the presence of trees for nest sites (Johnson and Igl 2000).

Open grasslands: Grasshopper Sparrow/Henslow's Sparrow/Dickcissel/Eastern Meadowlark:

Species in this suite are among a set of "core" species that are dependent upon grass/forb vegetation and were found to breed on the Konza Prairie Research Natural Area in the Flint Hills of northeastern Kansas every year from 1981 through 1995 (Zimmerman 1997). Numbers of Dickcissels, Grasshopper Sparrows and Eastern Meadowlarks, which together comprised about 70% of the total individuals in the avian community, did not decrease as a result of annual or less frequent fires, but Henslow's Sparrows were absent on annually burned plots. Nest success was not significantly different for Grasshopper Sparrow or Dickcissel in annually burned or unburned prairie that had not been grazed, but nesting success of Eastern Meadowlark was much lower on annually burned plots. Grazing depressed the numbers of grass/forb dependent species on annually burned prairie. The probability for nest survival was significantly lower on plots that had been both burned and grazed than on ungrazed plots, especially for Dickcissel. Zimmerman suggested that the increase in nest predation was a result of the decrease in height and density of vegetation in prairie that was both burned and grazed.

Henslow's Sparrows in Illinois did not reach maximum breeding densities until 3 or more years after burning (Herkert 1994b, Herkert and Glass 1995) although other studies have shown birds will at least recolonize a site the second year following disturbance (see Pruit 1996). Data from the Flint Hills in Oklahoma, however, show that Henslow's Sparrow does not occur at all until the third growing season after a burn (Reinking et al. in press). Indeed, necessary components of Henslow's Sparrow breeding habitat are characteristic of grassland several years post-disturbance: tall, dense grass, a well developed litter layer, standing dead vegetation often used as song perches and little, if any, woody vegetation, although scattered shrubs are often present (Pruitt 1996). Both Zimmerman (1988) and

Herkert (1994b) recommend a 3-4 year burn cycle rotated among tracts 30 hectares (75 acre) or larger to provide adequate breeding habitat for Henslow's Sparrows. However, even longer rotations may maintain greater numbers of Henslow's Sparrows over time, but the effect of fire intervals on the population dynamics of birds over extended periods of time has not been investigated. Henslow's Sparrows also have been found to move from recently burned patches to those less recently disturbed within rotationally managed prairies, suggesting that the latter provide "refugia" to individuals at the local scale (Herkert and Glass 1995). Relatively high densities of Henslow's Sparrows also have been recorded on prairies in southwestern Missouri that are mowed approximately every two years in mid-to-late July (Swengel 1996). Reinking and colleagues (Reinking et al. in press) found that light grazed pastures (roughly one head of cattle per 2 ha) were suitable to Henslow's Sparrows in the Flint Hills of Oklahoma, but more research is needed to determine the maximum grazing intensity that the species will accept.

While Dickcissels consistently establish breeding territories on prairies and other grasslands each year, old fields with more heterogeneous vegetation and a greater coverage of forbs are their preferred habitat in the Flint Hills of Kansas (Zimmerman 1982). Although densities of both males and females are greater in old fields than in prairies, nest predation in old fields also is higher and productivity per female per nest was found to be about equal in the two habitats (Zimmerman 1982, 1984).

In Winter's study of grassland bird ecology in southwestern Missouri, Dickcissel densities were found to be similar in patches of various size (Winter 1998, Winter and Faaborg 1999). Vegetation variables explained variation in the density of Henslow's Sparrow, Grasshopper Sparrow, and Dickcissel better than fragment size, although Henslow's Sparrows did occur at significantly lower densities in smaller fragments. Densities of Eastern Meadowlarks were not affected by either fragment size or any of the vegetation variables analyzed. However, the smallest sites in Winter's study were 30 ha or greater, well above the 10 ha minimum area requirement suggested for the Eastern Meadowlark in Illinois (Herkert 1994a). The relationship between the density of birds and patch size may vary depending upon the landscape context in which the patch is embedded, with minimum area requirements decreasing as the amount of grassland in the surrounding landscape increases (Herkert et al. 1996; Winter 1998, Winter et al. 2000).

Several studies have shown that nesting success of grassland-nesting birds is lower when nests are placed in close proximity (e.g. within 50-60 m) of a woodland edge (Johnson and Temple 1990, Berger et al. 1994, Winter 1998, Winter et al. 2000). The effect appeared more pronounced in the Henslow's Sparrow than Dickcissel in a southwest Missouri study, even though Henslow's Sparrow nested more frequently in the core area of grasslands rather than near woody cover. Dickcissels also had lower nesting success close to woody edges, but the effect of fragment size on nesting success was more pronounced than the effect of proximity to edge. The frequency of brood parasitism of Dickcissel nests also was highest within 50 m of shrubby edge. In southwestern Missouri, fates of Dickcissel and Henslow's Sparrow nests were not related to distance to roads or edges bordered by crop fields (Winter 1998, Winter et al. 2000). In contrast, Delisle and Savidge (1996) used behavioral cues to examine reproductive success for Grasshopper Sparrows, and found no difference in reproductive success between territories within 100 m of edge and those in the interior. However, Grasshopper Sparrows appeared to avoid nesting within 50 m of edge habitat. Recent work in remnant prairies in eastern Kansas indicated that predation of Grasshopper Sparrow, Eastern Meadowlark and Dickcissel nests were not significantly greater within 100 m of either wooded or crop field edges than those found at greater distances from edges, but brood parasitism, especially of Dickcissels, was greater as proximity to woody edges increased (Jensen and Finck, in prep).

Between 1991 and 1998, six teams of researchers collectively found and monitored nearly 3,000 nests of Grasshopper Sparrows, Henslow's Sparrows, Dickcissels, and Eastern Meadowlarks in 39 prairie fragments located in 16 counties in 5 midwestern states (Illinois, Kansas, Missouri, North Dakota, and Oklahoma; Herkert et al. in prep). Data were pooled to represent nests from fragments in three size classes: <100, 100-1000, and >1000 ha. Daily nest predation tended to decline with increasing fragment area, but fragment isolation did not significantly influence predation rates within fragments. Differences in predation rates among fragment size classes were highly significant for Dickcissels and Eastern Meadowlarks, and marginally significant for Grasshopper Sparrows. Nest predation rates declined significantly with increasing fragment size for Dickcissels and Henslow's Sparrow, but reduced predation rates for Grasshopper Sparrows and Eastern Meadowlarks were most evident in prairies larger than 1,000 ha. The pattern of reduced nest predation rates was consistent across all study regions, with daily nest predation rates being lower in prairies larger than 1,000 ha in all states and for all species for which

there were data from both small and large prairies. Patterns of brood parasitism were not consistent among study regions, although it increased significantly for Eastern Meadowlarks with decreasing prairie size.

Wintering species of open grasslands: Northern Harrier/Smith's Longspur/McCown's Longspur/Sprague's Pipit/Lark Bunting/Chestnut-collared Longspur.

Northern Harriers in winter appear to feed primarily upon small mammals. Passerine birds also are taken, and the proportion of birds in the diet seems to be greater in the southern than northern proportion of their winter range (Macwhirter and Bildstein 1996). If prairie and other grasslands are managed in a way that they support an adequate habitat and prey base for breeding Swainson's Hawks and Short-eared Owls, it is likely that needs of wintering Northern Harriers will be met, as well.

Very little has been published on relative abundance, densities or habitat relationships of the wintering passerines in this suite. More information is needed to refine management recommendations for these species.

Population objectives and habitat strategies:

The population objective is to stabilize or increase the populations of each species in the grassland species suites throughout the physiographic area. Because the population trend of Henslow's Sparrow remains unknown, a specialized monitoring strategy may be needed to determine its status in the physiographic area.

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, Grasshopper Sparrow, and Eastern Meadowlark) 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, and therefore a variety of grassland patches with different disturbance histories should be available in the landscape to meet the needs of all species of concern. 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 may be as effective on both small and large patches, although this also needs to be investigated further.

2. Changes in 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 a 5 km radius 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. Scattered shrubs within prairies may be tolerable, and even useful to prairie-chicken broods in hot weather.

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 maximum.

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. Managers will have to assess which leks would be most suitable to focus upon first, given the facts that some leks are used less regularly than others, and that factors affecting which leks females choose to nest near are largely unknown. 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 along edges 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 in the species suite, 800 ha core areas are less relevant, because core size is based upon the home range of Greater Prairie-Chickens. However, grasslands 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 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 Osage Plains, our existing knowledge of habitat requirements of grassland-nesting birds provides a basis for these current management guidelines.

Evaluation of assumptions - research and monitoring:

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

1. Increase monitoring and inventory efforts for 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 its populations. Similarly, more intensive lek surveys are needed to better assess the status of Greater Prairie-Chicken populations throughout the physiographic area.

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. Although the inverse relationship between patch size and reproductive success appears to hold true for the priority grassland nesting passerines in this suite (Herkert et al. in press), more information is needed to assess whether the amount of grassland in the surrounding landscape, especially annual burned and heavily grazed prairie, influences density and nest success within patches under different management regimes. The affects on grassland birds of annual burns over large areas and early season grazing practices, such as occur in the Flint Hills, also need to be better evaluated. Since the potential natural vegetation of much of the Cross Timbers is essentially grass-shrubland and savanna-woodland, research is need to assess the affects of the juxtaposition of those habitat types on grassland bird populations in that sub-region.

4. Little is known about the dynamics of avian dispersal and colonization of sites. Much more research is needed to understand the movements of birds within and between years.

5. In intensively farmed areas natural prairie habitat is not extensive and may be absent. Research is needed to determine what management strategies would be most beneficial to grassland birds when applied to alternative habitats including former croplands enrolled in the Conservation Reserve Program, and roadsides. Several million acres are enrolled in CRP within the Osage Plains, and several hundred thousand acres are devoted to roadside vegetation within this same area.

6. Determine habitat requirements for grassland passerines wintering in the Osage Plains, and prepare management recommendations.

Grassland Conservation Opportunities:

In the Flint Hills of Kansas and Oklahoma, where much of the land is still in native grassland, annual spring burns are a common grassland management tool. However, annual burns and heavy grazing do not provide the habitat structure or later successional grasslands that support many of the PIF species of concern. In areas such as these, a combination of education and landowner incentives that promote longer fire-free intervals and reduced cattle stocking rates on range land will be an appropriate conservation tool. In the more fragmented areas of the Osage Plains subregion, the most promising core areas for grassland Bird Conservation Areas should be identified, and work initiated to bring habitat in the core and matrix up to a level that meets BCA conditions. Acquisitions, easements, economic incentives and other tools should be offered only to landowners willing to participate. In the Cross Timbers, conservationists should work with private landowners to restore grassland-shrubland-savanna complexes at a landscape scale. Again, landowners should be offered incentives and compensation for any economic loss that they may incur.

Outreach:

Work with private landowners is essential to the success of bird conservation in the Osage Plains physiographic area. Educational materials should be developed that help both landowners and private lands specialists to understand the needs of birds and how management practices affect priority species.

Grass-shrublands and savanna-woodlands:

Ecology and conservation status:

In the absence of fire, woody vegetation will invade prairies of the Osage Plains physiographic area (see grasslands section of this document). Coverage of woody and forb species increases with the length of the fire-free interval. Shrub habitats typically become established along stream margins where short-lived, early successional species such as honey locust (*Gleditsia triacanthos*), cottonwood (*Populus deltoides*), and willows

(*Salix spp.*) persist in low densities even on frequently burned prairies (Abrams and Gibson 1991). Shrub and brush species such as rough-leaved dogwood (*Cornus drummondii*) and buckbrush (*Symphoricarpos orbiculatus*) also are associated with these gallery forests, especially under more xeric conditions (Abrams 1986). Most trees and woody species exhibit highly clumped patterns along stream channels. Species like honey locust, whose large seed pods fall close to the parent tree, tend to form thickets, and others, such as American elm (*Ulmus americana*) increase in density after periodic fire because of basal sprouting from small trees (Abrams 1988, Briggs and Gibson 1992). The effects of annual burns and intensive grazing on fire tolerant trees and shrubs need investigation.

Prior to Euro-American settlement, the Cross Timbers region was likely a fire-maintained mosaic of grassland, glades, oak thickets, brushy savannas, and dense woodlands (Rice and Penfound 1959, Penfound 1962, Johnson and Risser 1975, Smeins 1994). In the western section of the Cross Timbers, periodic fires resulted in prolific sprouting which increased the density of oak stems, but also promoted a grassy understory (Dyksterhuis 1948, Harlan 1958, Axelrod 1985, Abrams 1992). Although oaks continue to dominate there, much of what was presettlement savanna has become closed canopy forests due to the combined effect of fire suppression and a reduction in combustible vegetation by grazing cattle. As a result, much grass-shrubland-savanna habitat has been lost, and restoration efforts will need to take into account site-specific disturbance histories to be effective (see Engle et al. 1996).

It is estimated, however, that as much as 42,000 ha (162 square miles) of ancient Cross Timbers forest still survive in eastern Oklahoma, and that those forests have been only marginally impacted by grazing or fire suppression (Stahle et al. 1996, Therrell and Stahle 1998, Stahle et al. 2000) Tree ring chronologies constructed from post oaks indicate that many of these trees are as old as 400 years of age. Ancient trees occupy sites with sapling, juvenile and mature trees, standing-dead snags, and fallen logs in various stage of decomposition, and are typical of ancient forests in general. Stahle and colleagues also suggest that forests in the eastern Cross Timbers may have remained largely unchanged since the post-glacial thermal maximum some 6,000 years ago. Little is known about the bird communities in these ancient forests.

Bird habitat requirements:

The Black-capped Vireo has the most stringent habitat requirements of any species in the grass-shrub-savanna suite, breeding only where shrubby oak thickets less than 3m in height occupy approximately 35-55% of an area with a grassy understory. Areas where juniper (*Juniperus sp.*) cover exceeds 10% are avoided (Grzybowski 1991, Grzybowski et al. 1994). These features are characteristic of sites that have undergone a period of severe disturbance, or where edaphic factors limit the growth of the woody vegetation. The largest Black-capped Vireo populations in the Wichita Mountains of Oklahoma were in areas that had been intensively burned (Grzybowski 1991). Other priority species associated with Black-capped Vireo habitat are: Painted Bunting, Brown Thrasher, Spotted Towhee, Mississippi Kite and Chuck-will's-Widow (M. Howery, unpublished data).

The other priority bird species in the grass-shrubland and savanna-woodland suites occupy a continuum of vegetation types that range from grasslands with only scattered shrubs and small trees (eg. Bell's Vireo and Field Sparrow), to grasslands with more moderate shrub cover (eg. Brown Thrasher and Northern Bobwhite), to savanna-woodlands with a grass and forb dominated understory (eg. Red-headed Woodpecker and Mississippi Kite, and Yellow-billed Cuckoo). This continuum is represented by the three species groups in Table 4, although the groupings are general and overlap between them may occur.

Table 4. General habitat associations of priority grass-shrub-savanna/woodland species in the Osage Plains.

Species*	Grass/forb layer < 1m	Shrub layer 1-3m	Trees > 3m	General habitat and other comments
Grasslands with scattered shrubs or trees:				
Scissor-tailed Flycatcher	F	N	N	utilzes a grassy matrix with isolated trees or shrubs. Flycatches and forages aerially over open areas

Species*	Grass/forb layer < 1m	Shrub layer 1-3m	Trees > 3m	General habitat and other comments
Loggerhead Shrike	F	N	N	utilzes a grassy matrix with isolated trees or shrubs. Forages from a perch for insects and small vertebrates
Bell's Vireo		N, F		low densities of shrubs, but especially riparian thickets greater than 16 ha (40 acres).
Lark Sparrow	N, F	nests often placed under shrubs		low to moderate shrub densities, but in relatively short grass
Field Sparrow	N, F	N, F		low to moderate shrub densities
Grasslands with moderate-to-dense shrub cover:				
Northern Bobwhite	N, F	C		low to moderate shrub densities
Common Poorwill	N			rocky, brushy ravines dominated by deciduous trees and shrubs. Nocturnal aerial forager
Brown Thrasher	F	N, F		low to moderate shrub densities
Spotted Towhee (winter priority)	F	C		moderate to dense shrub cover
Harris's Sparrow (winter priority)	F	C		brushy ravines dominated by deciduous trees and shrubs
Painted Bunting	F	N, F		moderate to dense shrub cover
Orchard Oriole	F	F	N, F	especially associated with wet or riparian areas
Grasslands with trees:				
Mississippi Kite			N	prefers forested areas with open foraging areas nearby. Aerial forager
Yellow-billed Cuckoo		F	N, F	prefers open woodland with well developed undergrowth

Species*	Grass/forb layer < 1m	Shrub layer 1-3m	Trees > 3m	General habitat and other comments
Chuck-will's-widow	N	C		Favors dry or mesic woodlands with open areas nearby for foraging. Nocturnal aerial forager
Red-headed Woodpecker			N	Prefers large, widely spaced trees with open, grassy understory. Nests in cavities. Utilizes a variety of foraging techniques to acquire insects and fruit
Eastern Wood-Pewee			N	Prefers open woodlands, where it flycatches from a perch in the canopy or sub-canopy
Baltimore Oriole			N, F	Prefers open, riparian woodlands

N = nest; F = forage; C = cover

* Species accounts used to categorize species are given below:

Scissor-tailed Flycatcher, Regosin1998.

Loggerhead Shrike, Johnson and Igl 2000.

Bell's Vireo, Hamel 1992.

Lark Sparrow, Johnson and Igl 2000, and Ehrlich 1988.

Field Sparrow, Johnson and Igl 2000.

Northern Bobwhite, Brennan 1999.

Common Poorwill, Ehrlich1988.

Brown Thrasher, Hamel 1992.

Spotted Towhee, Ehrlich 1988.

Harris Sparrow, Norment and Shackleton 1993.

Painted Bunting, The Nature Conservancy 1999, Ehrlich 1988.

Orchard Oriole, Scharf and Kren 1996.

Mississippi Kite, The Nature Conservancy 2000.

Yellow-billed Cuckoo, The Nature Conservancy 2000.

Chuck-Will's Widow, The Nature Conservancy 2000.

Red-headed Woodpecker, Smith et al. 2000.

Eastern Wood-Pewee, McCarty 1996.

Baltimore Oriole, Rising and Flood 1998.

Population objectives and habitat strategies:

Because the Black-capped Vireo is listed under the Endangered Species Act, we yield to recommended objectives developed by U. S. Fish and Wildlife Service biologists on the recovery team and others who work closely with this species. Populations of most of the other species in the suite either have declined significantly in the physiographic area or their trends are unknown (Table 2). The objectives for the physiographic area are to stabilize or increase declining populations and to determine the status of those whose trends are unknown.

Historically, the “oak mottes” and shrubby vegetation along streams in the prairie and the grass-shrub-savanna/woodland of the Cross Timbers provided habitat for the species in this suite. Today, much of the Flint Hills is annually burned and heavily grazed, reducing habitat for species that use woody vegetation in a prairie matrix. Much of the Osage Plains subregion has been converted to crops, non-pastures and hayfields, also displacing areas of shrub-savanna. While fencerows, windbreaks, and shelterbelts, especially those greater than 4 ha (10 acres), will attract the species in this suite (Cable et al. 1992, Schroeder et al. 1992), those linear habitats fragment grassland habitats and may provide additional den sites and travel lanes for mammalian nest predators and perch sites for cowbirds. Restoration and/or protection of savannas and mottes at appropriate sites is preferable to increased and widespread plantings of fencerows, shelterbelts and windbreaks. Restoration of native vegetation and plant communities in the Cross Timbers, particularly at the landscape scale, is likely to benefit the bird community as well. Relationships between density or reproductive success of grass-shrub-savanna species and patch size or the quantity and dispersion of habitat types at the landscape scale have yet to be investigated, but we individual patches of shrubland should be at least 32 ha (80 acres) or greater to attract species like Bell’s Vireo, Painted Bunting, and Northern Bobwhite which appear to be somewhat area sensitive. We also suggest that shrublands comprise approximately 20% of forested landscapes and up to 50% of agricultural landscapes not intended to be managed for open grassland suites.

Evaluation of assumptions - research and monitoring:

In comparison to grassland and forest breeding birds, species and communities of birds that inhabit grass-shrub-savanna ecotones have been poorly studied. Very little is known about factors affecting densities and reproductive success, or how these species respond to native

habitat restoration efforts. Because many of these birds have a center of abundance in the Osage Plains, research there could provide valuable insights that could be used to make better recommendations for their conservation and recovery.

Grass-shrub-savanna conservation opportunities:

Although a number of federal cost-share and incentive programs have been designed and funded to encourage habitat establishment and management practices for conservation of grasslands and wetlands or to encourage tree plantings, comparable programs for restoration and management of natural shrub-savanna habitats have not been established. Existing programs such as the USFWS Partners For Wildlife Program and the USDA Grazing Lands Conservation Initiative could conceivably be broadened to incorporate practices that could serve to maintain or enhance grass-shrub-savanna habitats. These include reducing stocking rates in pastures, prescribed burning and selective cutting or control of trees and shrubs. USDA programs that promote non-selective attempts to eradicate all natural woody vegetation from pastures and rangelands, especially in the Cross Timbers, should begin to consider the needs of the priority birds and other wildlife dependent upon this habitat type. Conversely, allowing succession of trees to progress to closed canopy conditions also will greatly reduce the value of this habitat to this suite. We highlight the need for management that maintains the structure typical of native grass-shrub and savanna-woodland communities, and encourage that these communities be promoted and maintained across landscapes that encompass several sections or more of land.

Given that patch sizes needed to attract and support shrub-savanna priority species appear to be relatively small, we also suggest that private lands and other outreach specialists promote management for shrubland birds with non-agricultural rural landownwers who do not actively farm or graze their lands. Landowners not directly dependent upon their land for income may be more amenable to managing their properties for early successional wildlife than those who actively ranch or farm. Public conservation lands managed for deer also may provide suitable habitat for these species where the emphasis is on maintaining relatively large tracts of early successional habitat within forested matrices, and where grazing by horses or cattle is discouraged.

Large tracts and expanses of ancient Cross Timbers forest persist in eastern Oklahoma, and efforts are underway to get at least one area, the Frank Tract, recognized as a Biosphere Reserve (Stahle et al. 1996). The PIF community should work with Dr. Stahle and others to preserve this tract and as much of the ancient forests and associated grass-shrub and glade communities as possible.

Outreach:

Work with private landowners is essential to the success of bird conservation (for both grassland birds and birds that rely on shrub and savanna-woodland habitats) in the Osage Plains physiographic area. Educational materials should be developed that helps private landowners, private lands specialists, and other agency biologists to understand the needs of birds and how management practices affect priority species from the patch to the landscape scale. Areas managed for priority birds should be promoted as demonstration areas. The importance of periodic fire as a management tool, and the response of both plant and bird communities to fire, should be more thoroughly researched and shared with landowners that might be interested in supporting grass-shrub-savanna habitats on their land.

Riparian Zones and Wetland Complexes:

Ecology and conservation status:

Historically, there were extensive wetland complexes in the Osage Plains physiographic area in flood plains of major rivers (Thompson and Ely 1989, McNab and Avers 1994), with flooded areas up to 5 km (3 miles) in width recorded in the Osage River Valley in Missouri (Tixier 1940). Narrow strips of timber extended along drainageways into upland prairies (Schroeder 1982). Today, much of this riparian and wetland habitat has been impounded or drained and converted to agricultural land. In areas where riparian zones are still intact, expansion of woody vegetation has occurred in the absence of fire, resulting in an increase of riparian woodlands at the expense of grassland-woodland mosaics (Reichman 1987, Engle and Bidwell 2000).

Bird habitat requirements:

Most of the species in the riparian forest suite also are included in the grass-shrubland-savanna suite, emphasizing the need for a more open-canopied woodland with both grasses and shrubs in the understory (see table 4). Baltimore Orioles are found most frequently in narrow, riparian woodlands (M. Howery, unpublished data). Species in the riparian suite most closely associated with true bottomland forests, such as Prothonotary Warbler, Kentucky Warbler, Louisiana Waterthrush, and Rusty Blackbird, occur only in appreciable numbers in the eastern part of the physiographic area.

The Black Rail is a very secretive and understudied species of wet meadows (Thompson and Ely 1989). Its status in the physiographic area needs to be better determined. Wintering Canvasback utilize the deeper water of impoundments (Thompson and Ely 1989), habitat that is not immediately threatened in the physiographic area.

Population objectives and habitat strategies:

Many of the species associated with riparian and wetland habitats have declined significantly in the physiographic area. These declines need to be curtailed and, preferably, reversed. However, restoration, management and other factors that can affect densities and reproductive success of riparian and wetland birds have not been evaluated to date. Until that sort of information is available, conservation efforts along rivers and other riparian corridors should seek to develop extensive and contiguous tracts of habitat that mimic presettlement conditions and seek to restore natural communities, especially in areas that would enhance habitat for threatened, endangered or declining populations of other animals and plants. Scattered smaller tracts are potentially useful to migrant birds, but the dispersion of those areas should be considered so that “stepping stones” of habitat exist throughout the physiographic area.

Evaluation of assumptions - research and monitoring:

Surveys are needed to determine the status of the PIF priority species in wetland and riparian areas throughout the Osage Plains physiographic area. Data on species-habitat relationships,

and how densities and reproductive success are affected by changes in habitat types at both the local and landscape scale, also are needed.

Riparian and wetland conservation opportunities:

The largest remaining wetland/riparian complexes are publically owned. The PIF community should encourage and work with land managing agencies to improve management of the areas for PIF priority wetland species. The USDA Wetland Reserve Program and riparian buffer program, and USFWS Partners for Wildlife program should be utilized wherever possible to enhance wetland and riparian habitats. Financial incentive will be needed to restore wetland habitats on private lands, especially where landowners derive their income directly from farming or ranching activities.

Outreach:

We suggest that the PIF community work with other partners and programs whose work focuses upon wetland recovery. Education of both private lands specialists and other agency biologists as well as the general public about the habitat needs of priority wetland and riparian birds should be encouraged.

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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. 2000). 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 is 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 is included if its population trend is unknown or declining.

2b. Its total PIF score is 19-21, and the percentage of the global population breeding in the physiographic area is greater than 10%. 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.