Highly Erodible Land and Swampbuster Provisions of the 2002 Farm Act

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Abstract

The Farm Security and Rural Investment Act of 2002 continued provisions for the conservation of highly erodible land and wetlands that had been enacted by the omnibus farm acts of 1985, 1990, and 1996. The effects these provisions have on wildlife conservation are reviewed in light of recent data and reports published about those programs. Strong evidence supporting the conservation benefits of these programs includes the significant reduction in cropland soil-erosion rates of 1.3 billion tons per year and the significant reduction in wetland losses due to agriculture in recent periods. The latter is highlighted by net wetland gains on agricultural lands during the period 1997–2002. While these 2 provisions generally do not create wildlife habitat directly, they play a very substantial role in supporting the conservation gains made by other U.S. Department of Agriculture (USDA) conservation provisions. Additionally they provide strong motivation for producers to apply conservation systems on their highly erodible lands, to protect wetlands from conversion to cropland, and to apply for enrollment in the other USDA conservation programs, especially the Conservation Reserve and Wetlands Reserve programs.

Introduction

The Highly Erodible Land (HEL) and "Swampbuster" (or Wetlands Conservation) provisions of federal farm acts were both initiated with the Food Security Act of 1985 (FSA, 16 U.S.C. 3801 et seq.). Subsequent farm acts (in 1990 and 1996) retained those provisions essentially intact. The HEL provisions are also referred to as "Conservation Compliance" and "Sodbuster". The effects of these provisions on wildlife conservation were summarized for the period 1985–2000 (Brady 2000) as part of a comprehensive review of Farm Bill contributions to wildlife conservation (Heard et al. 2000). This paper updates this information to include the Farm Security and Rural Investment Act of 2002.

Wetland and cropland interspersed in South Dakota (D. Poggensee, USDA-NRCS).

The Food Security Act of 1985 introduced a new era of agricultural conservation provisions that required an environmental standard to be achieved on certain classes of land for producers to maintain eligibility for many farm program benefits. The greatest direct environmental effects of the HEL and Swampbuster provisions were the following:

- reduction of soil erosion and associated sediments from highly erodible cropland,
- reduction in the conversion of other HEL to cropland, and
- the reduction in the conversion of wetlands to cropland.

These provisions generally did not create wildlife habitat directly but collectively supported the conservation gains made by other USDA programs, especially the Conservation Reserve and the Wetlands Reserve programs. There were substantial habitat gains made by other programs that would not have been achieved without the interaction of these compliance provisions with those other USDA programs (Brady 2000). The report by Zinn (2004) provided an excellent description of this legislation.

The definition of HEL is based on soil, climate, and topographic properties that when combined into a standardized "erodibility index" results in a value ≥8 (Brady 2000). This index does not include the effect of management practices, but represents an index of potential erosion based upon natural conditions. The HEL provisions consist of 2 parts, Conservation Compliance and "Sodbuster." Conservation Compliance applies to land that has been in use as cropland and that meets the definition of highly erodible. Sodbuster applies to HEL that is newly converted to cropland from permanent native vegetative cover such as rangeland or forest. Under both parts of this provision, producers who annually till HEL for the production of commodity crops are required to follow an approved conservation plan that would allow no substantial increase in soil erosion (<*T*, the tolerable or maximum level that maintains productivity). Failure to do so would result in the loss of eligibility for certain farm program benefits. When site-specific management practices (e.g., conservation tillage, terraces, contour farming, crop rotations, etc.) are applied, it is often possible to produce commodity crops on HEL and maintain soil erosion rates specified for the major HEL soil type in the field. The authors of this legislation recognized that there were numerous farmers who had participated in and abided by the rules of the programs but would not be able to farm their land and receive a reasonable return under the HEL provision. Therefore, they offered the Conservation Reserve Program (CRP) as a means to adapt their operations to the new program environment.

The 2002 Farm Act continued the Conservation Compliance and Sodbuster provisions; however, the law added the requirement that the Secretary of Agriculture cannot delegate authority to make a compliance determination to a private party or entity.

The Swampbuster provision applies to wetlands that may be converted to produce commodity crops. Such a conversion would also result in the loss of certain farm program benefits. However, there is a provision for conditions when minimal effects can be documented by USDA. The 2002 Farm Act also added the requirement that the Secretary of Agriculture cannot delegate authority to make a wetland compliance determination to a private person or entity.

Program Effects

Highly Erodible Lands

Declines in acreages of both cropland and grazing lands have been observed during the last 20 years (Table 1). Concomitant to the implementation of the Conservation Provisions of the recent Farm Acts have been shifts in the kind and management of land used for crop production. These changes are the net result of increased awareness on the part of agricultural producers, successful delivery of technical assistance, and the conservation provisions of the recent Farm Acts. Because of the confounding effect of these independent forces, it is not possible to single out specific cause-and-effect relationships, but it is evident that the "carrot and stick" approach to farm program benefits of the recent Farm Acts got the immediate attention of the agricultural community, particularly those producing commodity crops on HEL.

Table 1. Total surface area of the 48 contiguous states by land cover/use and year. Margins of error defining the 95% confidence intervals are in parentheses. The total surface area of the contiguous United States is 1,937.7 million acres (NRCS 2004).

	Major land cover/use (millions of acres)								
Year	Crop	Conservation Reserve Program	Pasture	Range	Forest	Other	Developed	Water	Federal
1982	419.6 (± 1.2)	0.0 (± 0.0)	131.0 (± 0.7)	415.5 (± 1.9)	403.0 (± 1.5)	48.0 (± 0.7)	72.8 (± 0.4)	48.6 (± 0.1)	399.1 (± 0.0)
1992	381.2 (± 1.1)	34.0 (± 0.1)	125.1 (± 0.7)	406.6 (± 1.7)	404.0 (± 1.4)	49.3 (± 0.7)	86.5 (± 0.5)	49.4 (± 0.1)	401.5 (± 0.0)
2002	368.4 (± 1.2)	31.6 (± 0.2)	117.3 (± 0.9)	405.3 (± 1.8)	404.9 (± 1.5)	50.6 (± 0.8)	107.3 (± 0.7)	50.4 (± 0.1)	401.9 (± 0.0)

Evidence of the positive effect of linking land stewardship with farm program benefits can be observed from reviewing results from the National Resources Inventory (NRI; NRCS 2003, 2004) and as reported by Flather et al. (1999). Soil erosion on all cropland declined from 3.1 billion tons per year in 1982 to 1.8 billion tons per year in 2001 (Figure 1), a net reduction of 1.3 billion tons/year or 42%. Sheet and rill erosion (i.e., rainfall induced) dropped by almost 41% during this period, while wind erosion dropped by 43%. Erosion rates per acre also declined. Sheet and rill erosion rates dropped from 4.0 to 2.7 tons per acre per year, and wind erosion rates dropped from 3.3 to 2.1 tons per acre per year (Table 2). Likewise cropland acreage eroding at excessive rates (>T, the tolerable or presumably the sustainable limit) dropped 39% from 170 million acres in 1982 to 103.8 million acres in 2001 (NRCS 2003).

Table 2. Soil erosion on cropland in the United States by year (NRCS 2003). Margins of error defining the 95% confidence interval are in parentheses.

	Sheet and rill erosion		Wind erosion	
Year	Millions of tons/year	Tons/acre/year	Millions of tons/year	Tons/acre/year
1982	1,680.1 (± 13.8)	4.0 (± 0.1)	1,389.2 (± 22.0)	3.3 (± 0.1)
1987	1,486.4 (± 12.8)	3.7 (± 0.1)	1,307.9 (± 22.0)	3.2 (± 0.1)
1992	1,182.0 (± 10.9)	3.1 (± 0.1)	919.6 (± 20.4)	2.4 (± 0.1)
1997	1,048.5 (± 9.3)	2.8 (± 0.1)	812.6 (± 18.2)	2.2 (± 0.1)
2001	997.2 (± 13.7)	2.7 (± 0.1)	789.8 (± 28.5)	2.1 (± 0.2)

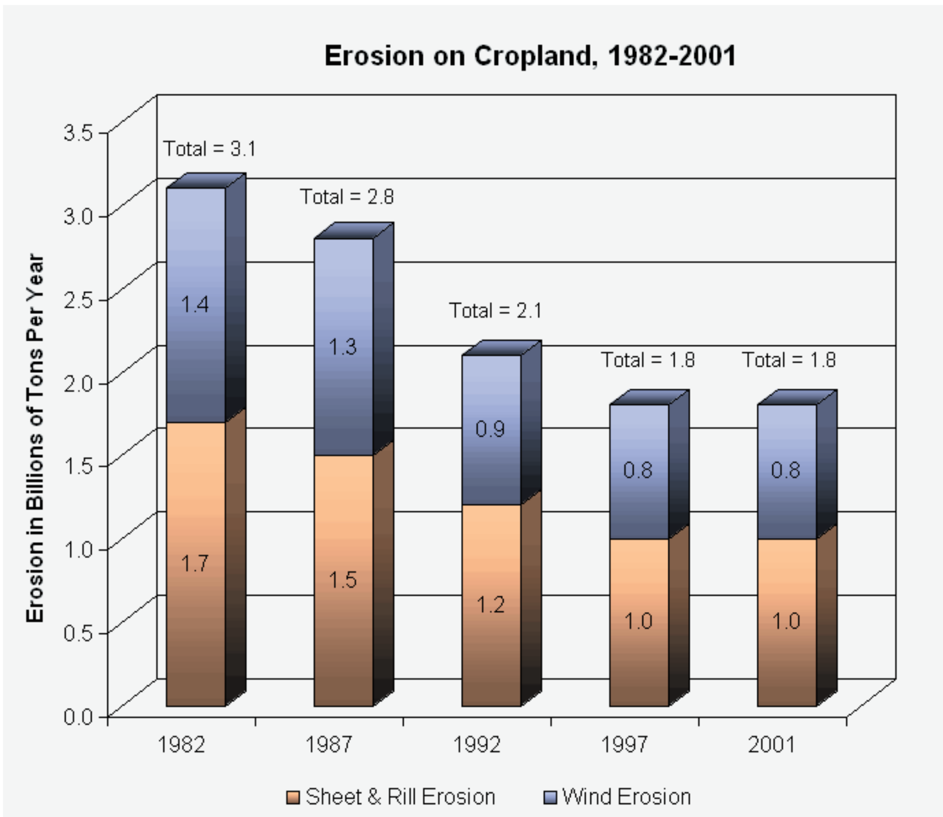


Figure 1. Sheet and rill– and wind-erosion rates on cropland from 1982 to 2001 (NRCS 2003).

Highly erodible cropland represents about 27% of the total cropland and is interspersed throughout that part of the country where cropland is a dominant land use (Figures 2–3). Erosion rates also declined substantially on HEL cropland. Only one-third of the HEL cropland exhibited erosion rates <*T* in 1982, but by 2001 nearly 46% of it met that goal (Table 3). Highly erodible cropland acreage declined from 123.9 million acres in 1982 to 101.1 million acres in 2001, most of which was eroding at excessive rates. Management of the non–highly erodible majority of cropland improved also as the proportion of cropland exhibiting tolerable erosion rates grew from 71% to 82% of the acreage from 1982 to 2001 (Table 3). These improvements stem from improved technology applied on the land (e.g., conservation tillage systems), technical assistance, and the conservation provisions of USDA Farm Acts since 1985, including the removal of 34 million acres of eroding cropland that was enrolled in the CRP. The CRP removed eroding cropland from cultivation and protected it with perennial vegetation for 10–15-year contracts, beginning in 1986. Conservation tillage in various forms has been applied extensively on both

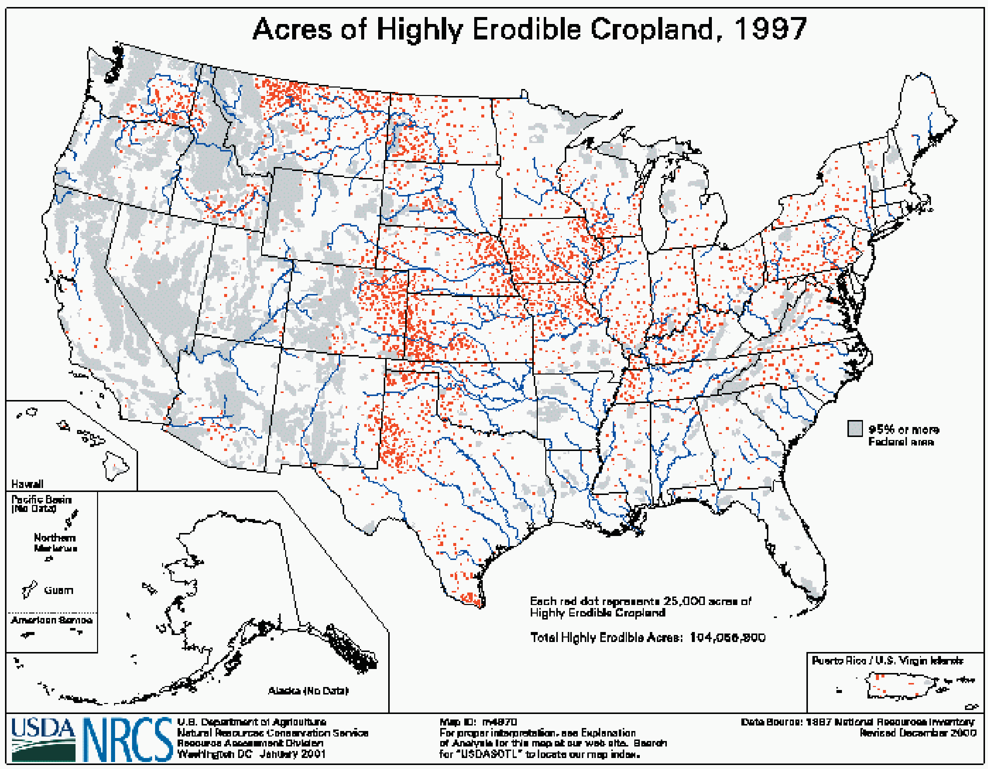


Figure 2. Distribution of highly erodible cropland in 1997 (NRCS 2000). Dots are aggregated by and placed randomly within 8-digit hydrologic units. Each red dot represents 25,000 acres.

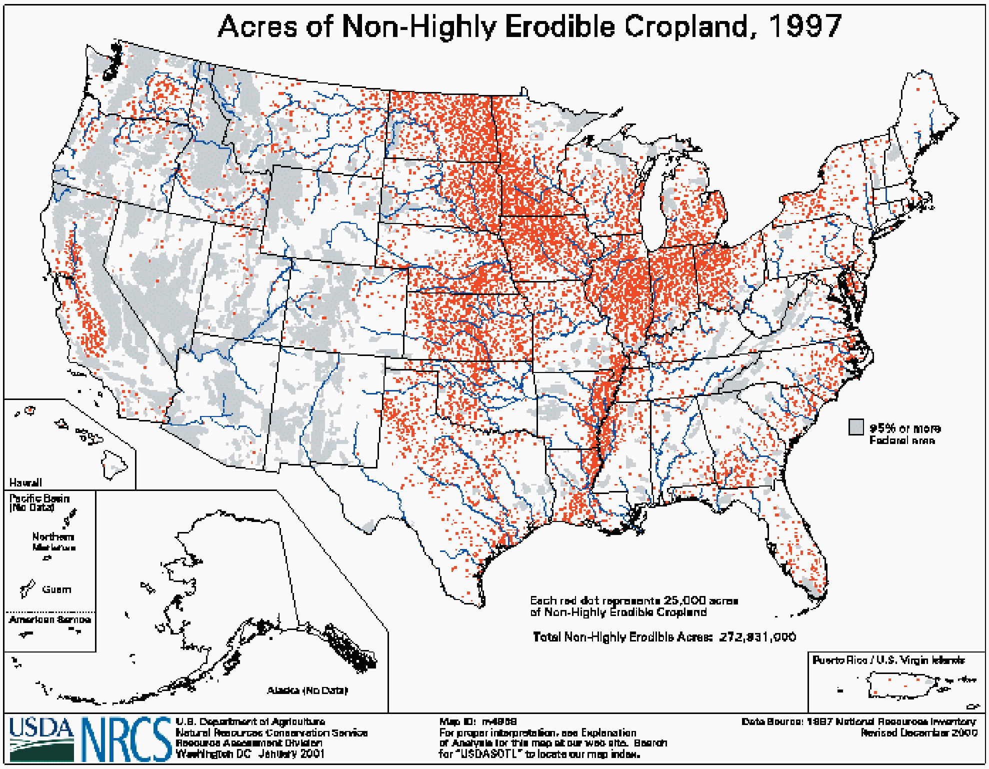
Cropland (millions of acres)

	Highly erodible				Non–highly erodible				All cropland	
Year	$<T$	$>T$	$<T$ (%)	Total	$<T$	$>T$	$<T$ (%)	Total	HEL (%)	$<T$ (%)
1982	41.0 (± 1.7)	82.9 (± 1.9)	33.1	123.9 (± 2.5)	209.5 (± 3.4)	87.1 (± 2.0)	70.6	296.6 (± 3.9)	29.5	59.6
1987	38.1 (± 1.6)	78.0 (± 1.9)	32.8	116.1 (± 2.6)	209.2 (± 3.4)	80.8 (± 1.9)	72.1	290.0 (± 3.9)	28.6	60.9
1992	41.6 (± 1.8)	63.1 (± 1.8)	39.7	104.7 (± 2.5)	221.0 (± 3.6)	56.0 (± 1.6)	79.8	277.0 (± 3.9)	27.4	68.8
1997	45.9 (± 1.8)	57.2 (± 1.6)	44.5	103.1 (± 2.5)	222.8 (± 3.6)	50.4 (± 1.5)	81.6	273.2 (± 3.9)	27.4	71.4
2001	46.0 (± 1.8)	55.1 (± 1.7)	45.5	101.1 (± 2.5)	219.9 (± 3.6)	48.7 (± 1.5)	81.9	268.6 (± 3.9)	27.3	71.9

Table 3. Highly erodible (HEL) and non–highly erodible cropland eroding at less than and greater than *T*, by year (NRCS 2003). *T* represents the maximum soil loss limit determined to be sustainable. Margins of error defining the 95% confidence interval are in parentheses.

HEL and non-HEL cropland to reduce erosion, conserve soil moisture and nutrients, and reduce trips across the field with large equipment. Modern applications of both conservation tillage and conventional tillage on croplands generally utilize chemical pesticides to control weeds, diseases, and insects. The biggest difference in these 2 systems is the frequency and timing of disturbances in the field and the retention of crop residues on

Figure 3. Distribution of non-highly erodible cropland in 1997 (NRCS 2000). Dots are aggregated by and placed randomly within 8-digit hydrologic units. Each red dot represents 25,000 acres.



Divided slope farming to reduce soil erosion in Washington. (T. McCabe, USDA-NRCS)

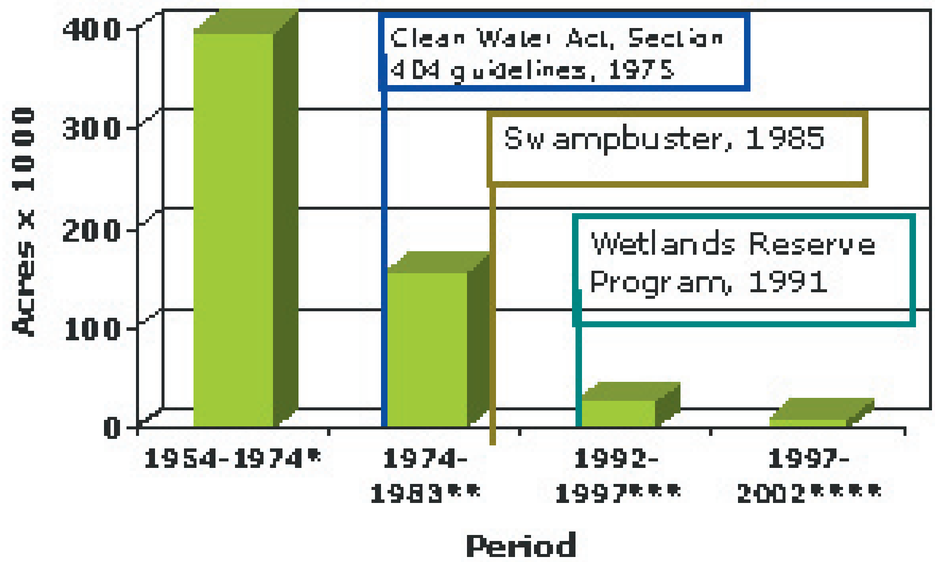
the surface. While croplands and haylands are generally unsuitable for grassland nesting birds (Johnson 2000), there is evidence that conservation tillage is better than conventional tillage for some birds. Wildlife benefits from conservation tillage over conventional tillage have been summarized previously (Brady 2000). However, a recent addition to the literature (Martin and Forsyth 2003) adds support for the concept that minimum tillage appears to confer benefits in productivity to birds that nest in farmland over conventionally tilled cropland. Martin and Forsyth (2003) studied songbird productivity in prairie farmlands under conventional versus minimum tillage regimes in southern Alberta, Canada. They found that Savannah sparrows (*Passerculus sandwichensis*) in spring cereal and winter wheat and chestnut-collared longspurs (*Calcarius ornatus*) in summer fallow tended to prefer minimum tillage. McCown's longspurs (*Calcarius mccownii*) and horned larks (*Eremophila alpestris*) occurred more frequently on conventional- than on minimum-till spring cereal plots in at least 1 of the 2 years. For Savannah sparrows, minimum-till spring cereal and winter wheat were more productive than conventional-till habitat. Summer fallow of either tillage regime did not appear to be as productive as minimum-till cereal fields for this species. Chestnut-collared longspurs occurred predominantly in minimum-till summer fallow and spring cereal habitat and showed almost no productivity in conventionally managed plots. McCown's longspurs tended to have higher productivity in minimum-till plots. These represent comparisons between different tillage techniques on cropland, not between cropland and native grasslands. While some doubt about the effectiveness and enforcement of the HEL provisions has been expressed (GAO 2003), it is clear from the preceding discussion and data that these provisions made a substantial difference in reducing cropland erosion. The reduction of 1.3 billion tons per year of eroding cropland soils has effects both on- and off-site. On-site, fertility and soil quality are retained, and the long-term sustainability of the productive soil resource base is protected. Off-site, there are substantially less sediment and attached pollutants moving into wetlands and water bodies, thereby improving water quality, extending the lifespan of reservoirs, and reducing sediment damage, maintenance, and dredging costs. The net effect on aquatic habitat has not been quantified, but it can be inferred from the previous discussion that substantial improvement in aquatic habitat quality is also expected.

The national estimates presented above indicate that resource-management decisions are moving favorably towards more sustainable use of those HEL croplands. However "sodbusting" still continues in some forms, although not necessarily on HEL. Concurrent advances in technology have made it possible to produce row crops on lands previously thought to be unsuitable for that use. Higgins et al. (2002) reported that development of drought-resistant, genetically modified soybeans has been responsible for the conversion of native grasslands and extended the western expansion of soybeans into 48 counties in South Dakota that previously had been considered too dry to grow soybeans. Land area devoted to soybean production now exceeds land area used for corn production in South Dakota. Since 1987 in eastern South Dakota alone, about 68,000 ha (~168,000 acres) of native rangeland have been converted to cropland in the 21 counties most heavily impacted by the western expansion of soybeans (Higgins et al. 2002:46). They express concern that while the current westward expansion of cropland has obvious impacts on prairie ecology, it also has the direct effect of moving wetland drainage interest into formerly secure (i.e., rangeland) habitats (Higgins et al. 2002:48).

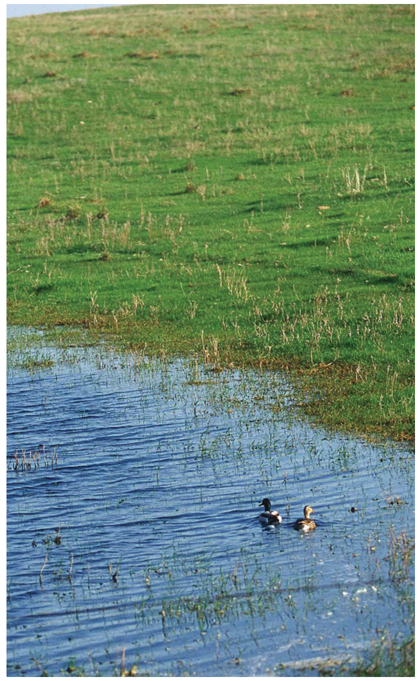
Swampbuster

Wetland losses due to agriculture have been declining in recent decades because of many factors, including Swampbuster, greater public awareness of wetland values, economic factors, and other federal, state, and local laws (Brady and Flather 1994, Flather et al. 1999, NRCS 2000, NRCS 2004; Figure 4). Recent studies reveal that the annual rate of wetland loss has continued to decline. Gross wetland losses from 1992 to 1997 were 506,000 (±43,600) acres (NRCS 2000), but declined by 44% to 281,600 (±79,000) acres during the subsequent period 1997–2002 (NRCS 2004). Gross wetland losses due to agriculture declined by 62% between the intervals 1992–1997 and 1997–2002. Swampbuster's effect has been significant since agriculture's role in gross wetland loss during the 1992–1997 period had declined to about 26% (NRCS 2000), then to about 18% during 1997–2002 (NRCS 2004). The synergistic effect of Swampbuster's deterrence of wetland losses and the gains derived from other wetland conservation programs, especially the Wetlands Reserve Program (WRP), resulted in a net wetland gain on agricultural lands of 131,400 (±70,000) acres from 1997 to 2002 (NRCS 2004). Most recent estimates for the 2001–2003 interval indicate a net wetland gain of 66,000 acres per year on agricultural lands (NRCS 2005), representing a major reversal of patterns observed prior to Swampbuster nearly 20 years ago. While Swampbuster's main impact has been to reduce agriculturally induced wetland conversions, it has also served to motivate landowners to submit bids for the CRP and for the WRP.

Figure 4. Average annual wetland loss due to agriculture, 1954–2002, and significant federal legislation (*Frayer et al. 1983, **Dahl and Johnson 1991, ***NRCS 2000, ****NRCS 2004).



The direct effect of Swampbuster is to reduce the rate of wetland loss, but it also has both synergistic and indirect benefits to wildlife. Reynolds (2005) studied the CRP and duck production in the Prairie Pothole Region (PPR) of the U.S. His results suggest that CRP cover planted around wetlands and the curtailment of disturbance associated with tilling and planting crops has improved the function of wetlands relative to breeding duck use. There were about 230,000 acres of small, shallow (temporary and seasonal) wetlands in CRP fields in the PPR. They attracted 492,000 duck pairs annually during the years 2000–2003, which was 210,000 more pairs per year than in the absence of the CRP. These small, shallow wetlands in the PPR are critical to brood survival by providing security from predators (Krapu et al. 2000) and food requirements for developing ducklings. Swampbuster has been effective in reducing wetland loss, but some question the need to protect small, shallow wetlands that interfere with tilling and planting. Reynolds (*this volume*) found that the types of wetlands in all land uses that showed the highest use by breeding ducks were temporary and seasonal classes (see Figure 2 in Reynolds [*this volume*]) that averaged only 0.6 and 1.46 acres in area, respectively. He also found that 63% of all dabbling ducks in the area depend on temporary and seasonal wetlands that were less than 1 acre in area and the majority of those wetlands occurred in crop fields. Reynolds (*this volume*) concluded: "Swampbuster provisions of the Farm Bill must be continued to protect wetlands habitat critical to breeding waterfowl and broods".



Mallard ducks in a prairie pothole in South Dakota. (D. Poggensee, USDA-NRCS)

Conclusions

Reduced erosion rates of 1.3 billion tons/year and net wetland gains on agricultural lands provide clear evidence that recent USDA farm program provisions are providing significant conservation benefits. The combined effect of these documented erosion reductions and greatly reduced wetland conversions in association with the Conservation Reserve Program (Farrand and Ryan, *this volume*; Johnson, *this volume*; Reynolds, *this volume*), Continuous Conservation Reserve Program (Clark and Reeder, *this volume*), the Conservation Reserve Enhancement Program (Allen, *this volume*), the Wildlife Habitat Incentives Program (Gray et al., *this volume*), the Wetlands Reserve Program (Rewa, *this volume*), Environmental Quality Incentives Program (Berkland and Rewa, *this volume*), and the Grassland Reserve Program (Wood and Williams, *this volume*) have very large synergistic benefits to the conservation of habitats for wildlife. While conservation tillage is not a panacea for wildlife management on highly erodible croplands, it does represent one additional increment improving cropland habitats over conventional tillage systems. Although the HEL and Swampbuster provisions generally do not create additional wildlife habitat, they collectively support the conservation gains obtained in the other programs and motivate producers to apply for enrollment in those programs. The net effect of the interaction of all these Farm Act Provisions results in substantial wildlife habitat improvements under existing patterns of land use that otherwise would not be possible if the various provisions were implemented independently of one another.

Acknowledgments

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Grassland Bird Use of Conservation Reserve Program Fields in the Great Plains

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Abstract

An enormous area in the Great Plains is currently enrolled in the Conservation Reserve Program (CRP): 19.5 million acres (nearly 8 million ha) in Montana, North Dakota, South Dakota, Wyoming, Nebraska, Colorado, Kansas, Oklahoma, and Texas. This change in land use from cropland to grassland since 1985 has markedly influenced grassland bird populations. Many, but certainly not all, grassland species do well in CRP fields. The responses by birds to the program differ not only by species but also by region, year, the vegetation composition in a field, and whether or not a field has been hayed or grazed. The large scale and extent of the program has allowed researchers to address important conservation questions, such as the effect of the size of habitat patch and the influence of landscape features on bird use. However, most studies on nongame bird use of CRP in or near the Great Plains have been short-lived; 83% lasted only 1–3 years. Further, attention to the topic seems to have waned in recent years; the number of active studies peaked in the early 1990s and dramatically declined after 1995. Because breeding-bird use of CRP fields varies dramatically in response both to vegetational succession and to climatic variation, long-term studies are important. What was learned about CRP in its early stages may no longer be applicable. Finally, although the CRP provisions of the Farm Bill have been beneficial to many grassland birds, it is critical that gains in grassland habitat produced by the program not be offset by losses of native prairie.

Introduction

Grasslands are among the nation's most threatened ecosystems (Samson and Knopf 1994, Noss et al. 1995). Their declines have been dramatic, with losses of native grasslands reaching 99.9% for tallgrass prairie in many states, and 70–80% for mixed-grass prairies. Grassland communities and the wildlife that depend on them have suffered from these declines, as well as from

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fragmentation of remaining patches, invasion by exotic species, planting of woody vegetation, and disruption of disturbance processes (Johnson 1996).

The Conservation Reserve Program (CRP) was established under the Farm Bill to encourage agricultural producers to plant highly erodible croplands to grasses. The result has been a vast conversion of cropland to perennial grassland (Johnson et al. 1993). The Great Plains has been a priority area for the CRP because of its plentiful winds and highly erodible soils. As of September 2003, the enrollment in CRP in Montana, North Dakota, South Dakota, Wyoming, Nebraska, Colorado, Kansas, Oklahoma, and Texas totaled 19.5 million acres (nearly 8 million ha). The majority of those lands were planted with introduced or native grasses, the former typically mixed with legumes. Grasslands established under the program offer the potential to mitigate some of the detrimental effects to fish and wildlife associated with the loss of native grassland. Johnson (2000) summarized research findings related to bird responses to CRP. This paper updates the information summarized in Johnson (2000) with new research conducted since that report.

Male lark bunting. (G. Kramer, USDA-NRCS)

Status of Grassland Birds

Johnson (2000) discussed the effects of grassland conversion to croplands. The historical prairies were reported to have rich abundances of wildlife (Dinsmore 1994). Surveys of bird populations over the past 35 years have documented the decline of more prairie bird species than in any other guild of birds (Peterjohn and Sauer 1999). As examples, declines during 1966–1979 were 3.4% per year for lark buntings (*Calamospiza melanocorys*), 4.3% per year for grasshopper sparrows (*Ammodramus savannarum*), and 5.5% for dickcissels (*Spiza americana*) (Sauer et al. 2004). Those numbers appear small, but they translate to declines of 34–52% for that short period of time. Projected for, say, 40 years, those trends would leave only 10–25% of the populations remaining.

Declines of grassland birds associated with the loss of prairies are due to a number of causes. Reduction in availability of habitat through conversion of prairies to croplands or other land uses is a primary cause. While some birds have been found to nest in croplands (e.g., horned lark [*Eremophila alpestris*], vesper sparrow [*Pooecetes gramineus*]) and in hayfields (e.g., waterfowl and vesper sparrow), their nests have high rates of failure because of the frequency of agricultural operations (Rodenhouse and Best 1983, Bollinger et al. 1990, Frawley and Best 1991, Dale et al. 1997, McMaster et al. 2005), producing conditions that can lead to population "sinks" (sensu Pulliam 1988). An additional cause of decline in many areas is the habitat fragmentation resulting from the high levels of habitat loss, producing patches that lack sufficient size to support many bird species (Johnson 2001), or that have reduced reproductive rates due to edge effects that can increase the densities of predators (Clark and Reeder, *this volume*) or the brood parasite brown-headed cowbirds (*Molothrus ater*) (Koford et al. 2000). These influences are discussed in more detail below.

The value of grasslands to many bird species (e.g., Sprague's pipit [*Anthus spragueii*] and Baird's sparrow [*Ammodramus bairdii*]) has been found to be reduced by the invasion or planting of woody vegetation (Johnson 2000), even though areas supporting woody vegetation may contain more bird species than those without (Arnold and Higgins 1986). This increase in species tends to be due to the presence of edge or generalist species, such as brown thrasher (*Toxostoma rufum*), gray catbird (*Dumetella carolinensis*), song sparrow *(Melospiza melodia*), American robin (*Turdus migratorius*), and common grackle (*Quiscalus quiscula*). Woody vegetation has been found to influence grassland birds in several ways. First, the presence of trees and shrubs reduces the total area of grassland and fragments it. Second, it precludes some species from using the remaining grassland areas (Wiens 1969, Whitmore 1981, Kahl et al. 1985, Bollinger and Gavin 2004). Third, woody plants provide perches for raptors, other avian predators, and brown-headed cowbirds, as well as travel lanes for mammalian predators (Winter et al. 2000), which can result in reduced nest success near trees and shrubs (Johnson and Temple 1990, Bollinger and Gavin 2004). Fourth, species attracted to the woody vegetation may forage in nearby grasslands and potentially compete with prairie species.

CRP as Habitat for Grassland Birds

Evaluations of bird use of CRP fields in the Great Plains, summarized by Johnson (2000), have demonstrated that many species of birds utilize CRP, including lark bunting, western meadowlark (*Sturnella neglecta*), horned lark, Savannah sparrow (*Passerculus sandwichensis*), clay-colored sparrow (*Spizella pallida*), bobolink (*Dolichonyx oryzivorus*), common yellowthroat (*Geothlypis trichas*), sedge wren (*Cistothorus platensis*), and grasshopper sparrow, with different species occurring at different densities in different locations (Johnson and Schwartz 1993a,b; Hanowski 1995, Johnson and Igl 1995, Delisle and Savidge 1997, Horn 2000). Table 1 lists the primary species reported to occur in CRP in these studies.

Species	Great Plains Roughlands Johnson and Schwartz 1993a	Missouri Coteau Johnson and Schwartz 1993a	Drift Prairie Johnson and Schwartz 1993a	Black Prairie Johnson and Schwartz 1993a	Minnesota Hanowski 1995	Nebraska Delisle and Savidge 1997	North Dakota Horn 2000
Lark bunting	1	1					
Grasshopper sparrow	2	2	1.5	6	11	2	11
Red-winged blackbird	5	3	1.5	1	2	4	8
Western meadowlark	4	6	10	9.5	15	9	12
Horned lark	3	5	11				
Savannah sparrow	7	8	4	5	4		5
Brown-headed cowbird	6	4	8	9.5	11	3	1
Clay-colored sparrow	10.5	10	3	7	3		2
Bobolink	8	11	5.5	3	1	7	7
Common yellowthroat		12	5.5	4	8	5	6
Sedge wren			8	2	5	6	3
Chestnut-collared longspur	9	7					
Dickcissel		13	8	8		1	
Baird's sparrow	10.5	9	12				
American goldfinch[a]					6		9
Brewer's blackbird[b]					7		
Common grackle					9		
Tree swallow[c]					10		
Vesper sparrow					13		
Song sparrow					14		10
Mourning dove					16	9	
Northern bobwhite						9	
Ring-necked pheasant						11	
Le Conte's sparrow							4

a Carduelis tristis b Euphagus cyanocephalus c Tachycineta bicolor.

Table 1. Reported densities of breeding birds (by ranking) in Conservation Reserve Program fields in the northern Great Plains.

Johnson (2000) also reported that, in general, CRP fields supported larger populations of grassland birds than croplands, citing studies by Kimmel et al. (1992), Johnson and Igl (1995), and Wachob (1997). Johnson (2000) did note that the species composition of birds using CRP fields can vary dramatically from one year to the next, depending on climatic variation, succession of vegetation communities within CRP fields, and fluctuations in the numbers and distributions of birds. Johnson et al. (1997) surveyed breeding birds annually in several hundred CRP fields in 4 northern Great Plains states during 1990–1996. Ecological succession had taken place in these grasslands during that time as the plantings matured. In addition, the region experienced drought conditions early in the study but received above-average precipitation in the latter years. Bird populations responded to these changes in a variety of ways (Table 2). Many species had similar densities in 1990–1991 and 1995–1996, but several species increased in number fairly steadily throughout that period. They included common yellowthroat, bobolink, and clay-colored sparrow, all of which favor tall or dense vegetation. After the drought ended in mid-1993, several species increased, including northern harrier (*Circus cyaneus*), Wilson's phalarope

(*Phalaropus tricolor*), and Savannah sparrow, and some populations mushroomed, such as sedge wren and Le Conte's sparrow (*Ammodramus leconteii*) (Igl and Johnson 1999). Horned larks, chestnut-collared longspurs (*Calcarius ornatus*), and lark buntings typically declined in number (Table 2). These latter species prefer sparser, more open vegetation.

Table 2. Average density of breeding birds in CRP fields in the northern Great Plains during 1990–1991 versus 1995–1996 (Johnson et al. 1997). Several species increased dramatically, while others declined.

Species	Average density (pairs/100 ha)	
	1990–1991	1995–1996
Savannah sparrow	6	20
Clay-colored sparrow	5	12
Bobolink	5	9
Common yellowthroat	4	6
Sedge wren	3	11
Le Conte's sparrow	0	16
Lark bunting	21	4
Horned lark	7	1
Chestnut-collared longspur	2	0

Delisle and Savidge (1997) noted that grasshopper sparrow densities declined with time in CRP fields (1991–1994), a change they attributed to a buildup of litter and dead vegetation. Winter et al. (2005) noted that responses of densities and nesting successes of grassland birds to vegetation parameters varied by regions, years, and species.

Conservation Reserve Program fields have been found to support higher reproductive rates of grassland birds than croplands. Johnson (2000) noted work conducted by Berthelsen and Smith (1995), Clawson and Rotella (1998), and Koford (1999) that supported this relationship. However, because of the difficulty of finding nests (Winter et al. 2003), reproductive success has not been well studied in CRP fields in the Great Plains. Winter et al. (2005) emphasized the variability in nesting success that can occur due to the factors mentioned above for densities, and suggested that more research is needed before the relationships of many factors to nesting success will be understood. Further, some studies on nesting success in CRP fields have used artificial nests for their research focus, and extrapolation of the results of these studies to actual nests must be viewed with some caution (e.g., Major and Kendal 1996, Davison and Bollinger 2000).

Effects of Patch Size and Landscape Features on Bird Use

As identified above, and discussed by Johnson (2000, 2001) and Johnson and Winter (1999), habitat fragmentation can affect bird use of CRP. Habitat-fragmentation effects involve the size, shape, and distribution of patches as well as surrounding landscape conditions. Some patches may be too small to be used by certain species, or birds that do use smaller patches may suffer more from competition, brood parasitism, or predation than birds in larger patches, resulting in lower nesting success. Smaller patches have a relatively greater proportion of their area near an edge, so edge effects (Faaborg et al. 1993, Clawson and Rotella 1998, Winter and Faaborg 1999, Winter et al. 2000) may be more pronounced, causing lower densities or reduced nesting success. Distribution of patches may also have an effect on bird use, as isolation from other grassland patches can affect occupancy by birds. Finally, arrangement of patches and presence of other vegetation types in the surrounding landscape can provide habitat conditions favorable to competing species, which in turn can reduce densities or nesting success of grassland birds.

These features have been found to operate among several species of grassland birds, in several regions, and in different types of grasslands (e.g., Herkert et al. 2003, Winter et al. 2005). In CRP fields specifically, Johnson and Igl (2001) related the occurrence of species and their densities to the patch size of each field. They conducted 699 fixed-radius point counts of 15 bird species in 303 CRP fields in 9 counties in 4 northern Great Plains states (Figure 1). They found that northern harriers, sedge wrens, clay-colored sparrows, grasshopper sparrows, Baird's sparrows, Le Conte's sparrows, and bobolinks favored larger grassland patches in 1 or more counties. In contrast, 2 edge species, mourning doves (*Zenaida macroura*) and brown-headed cowbirds, tended to prefer smaller grassland patches. Horn (2000) reported that bobolinks, grasshopper sparrows, and red-winged blackbirds (*Agelaius phoeniceus*) were more common in larger CRP fields, while brown-headed cowbirds preferred smaller fields. Wachob (1997) investigated sharp-tailed grouse (*Tympanuchus phasianellus*) and found that it favored larger CRP patches for nesting but not for brood-rearing. He also reported that leks were more common closer to CRP fields and in areas with extensive CRP grassland within 0.6 mile (1 km).

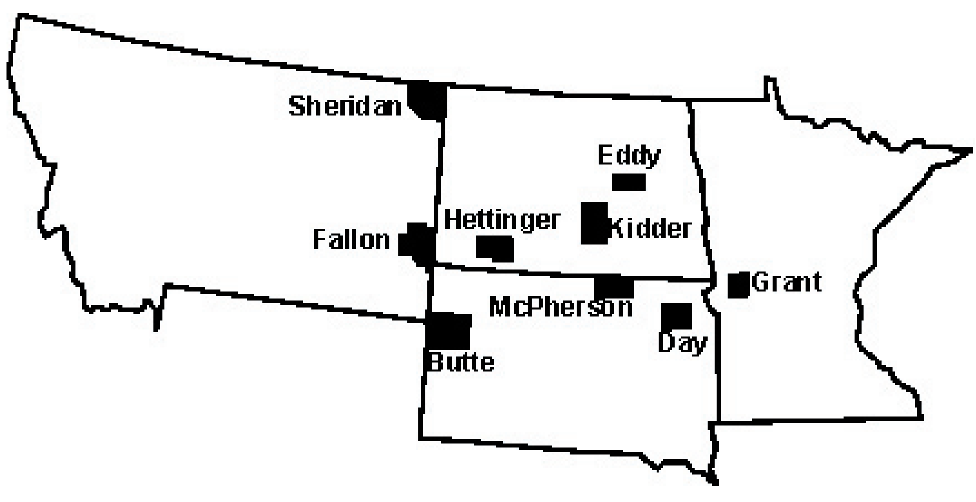


Figure 1. Counties containing study areas used in the Northern Prairie Wildlife Research Center long-term study of breeding-bird use of Conservation Reserve Program fields. Fallon (Montana), Butte (South Dakota), and Hettinger (North Dakota) counties are in the Great Plains Roughland geologic landform; Sheridan (Montana), Kidder (North Dakota), and McPherson (South Dakota) counties are in the Missouri Coteau; Eddy (North Dakota) and Day (South Dakota) counties are in the Drift Prairie; and Grant County (Minnesota) is in the Black Prairie.

Effects of Haying of CRP

In many counties, in certain years, CRP fields have been released for haying or, less frequently, grazing, due either to drought or to excessive precipitation, often in combination with landowner and political pressure. Johnson et al. (1998) assessed densities of breeding birds in hayed versus idled CRP, the year after the disturbance occurred. Because the authors used the same fields in all years, they had essentially a before-and-after, treatment-and-control design. They had data from nearly 300 fields that had been hayed and more than 2,600 fields that had been left idle in a year. A few species responded positively the year following haying; these were horned lark, chestnut-collared longspur, and lark bunting, all of which favor short and sparse vegetation. Many more species, in contrast, had reduced densities the year following haying, including vesper sparrow, sedge wren, common yellowthroat, bobolink, clay-colored sparrow, dickcissel, and Le Conte's sparrow.

Horn and Koford (2000) reported fewer sedge wrens and, possibly, clay-colored sparrows, Le Conte's sparrows, red-winged blackbirds, common yellowthroats, and grasshopper sparrows in mowed than in uncut CRP fields in the year after mowing. Savannah sparrows showed the opposite tendency, being more common in mowed CRP.

McCoy et al. (2001) noted that mowing of cool-season CRP plantings in Missouri in late summer and early fall permitted sufficient regrowth to provide habitat for wintering birds. In contrast, the value of mowed warm-season planting was reduced for at least 2 years. McMaster et al. (2005) investigated bird use of croplands converted to hayfields in Saskatchewan. They found nests of 26 species using the hayfields, and also found high levels of nest success compared to other related studies, but they noted that haying of the fields they investigated was delayed in the years of their study because of high precipitation. They acknowledged that mowing earlier in the season could have significantly reduced nesting success.

Use of CRP Habitat During the Nonbreeding Season

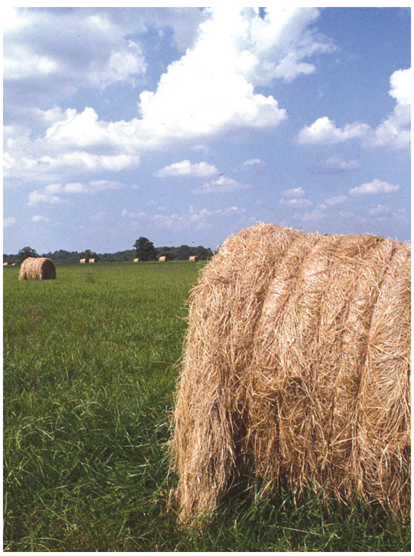
Johnson (2000) summarized studies of bird use of CRP during the nonbreeding season. King and Savidge (1995), Delisle and Savidge (1997), and Best et al. (1998) investigated winter use of CRP fields. Species noted to utilize CRP during this season included American tree sparrow (*Spizella arborea*), ring-necked pheasant (*Phasianus colchicus*), meadowlark, northern bobwhite (*Colinus virginianus*), dark-eyed junco (*Junco hyemalis*), red-winged blackbird, and horned lark. Johnson (2000) noted the lack of studies that have investigated nonbreeding-season bird use of CRP. No new information has been identified relative to this subject since that report.

Research Needs and Status

As Johnson (2000) noted, much has been learned about CRP and its value to grassland birds, but a number of issues deserved further investigation, particularly landscape and patch-size effects (Johnson 2001, Johnson and Igl 2001). Johnson (2000) also noted that more information was needed about the influences of specific vegetation conditions on use of CRP by grassland birds.

Few studies have been conducted in the interim to address these questions. McCoy et al. (2001) reported greater use of CRP fields planted to cool-season species than to fields dominated by switchgrass (*Panicum virgatum*), a warm-season species. In CRP fields in eastern South Dakota, Eggebo (2001) observed higher densities of sedge wrens, Savannah sparrows, and bobolinks in cool-season than in warm-season plantings. The reverse pattern held for killdeer (*Charadrius vociferus*), mourning dove, song sparrow, and brown-headed cowbird, species less tightly dependent on grassland. Johnson and Schwartz (1993b) reported on the response of several species to differences in vegetation composition. More recent CRP guidelines have encouraged mixtures of more species in the plantings, which should develop into more diverse grasslands. A study recently concluded by the Northern Prairie Wildlife Research Center, with support from the U.S. Fish and Wildlife Service, is addressing some issues relating to planting mixtures in the northern Great Plains. Preliminary results indicate that plantings of either introduced or native grasses, along with legumes, support populations of breeding birds, although the species composition sometimes differs between the 2 types. Winter et al. (2005) emphasized the need for studies that included larger spatial and temporal scales to address many of the complexities of grassland bird abundances and nesting success.

Hay bales in Missouri CRP fields. (N. Klopfenstein, USDA-NRCS)



The effects of haying on the reproductive success of birds nesting in CRP fields, discussed above, also needs further study. While this need was noted by Johnson (2000), little remains known about the total immediate and long-term effects on reproduction during the year of mowing. In conventionally managed hayfields, mowing can be detrimental to birds that are still nesting, so the actual effect depends on the date of mowing (McMaster et al. 2005). Political and economic pressures continue to mount for earlier mowing dates, before the forage value of CRP vegetation diminishes, but earlier mowing is much more detrimental to breeding birds than is mowing after most of the nesting activities have been completed.

The advent of the Conservation Reserve Program, with the major changes it wrought on the Great Plains landscape, led to a large number of research studies. These projects, many of which were conducted by graduate students, sought to understand how CRP fields were used by birds. Other than the long-term study by Northern Prairie Wildlife Research Center (continuously from 1990 to the present), most of the studies on nongame bird use of CRP in or near the Great Plains were short-lived; 83% had durations of only 1 to 3 years.

Further, attention to the topic seems to have waned in recent years. The number of active studies (excluding those of Northern Prairie Wildlife Research Center) peaked in the early 1990s and has dramatically declined since 1995 (Figure 2). This pattern would pose no problem if the phenomenon under study were unchanging. But, as discussed by Igl and Johnson (1999) and Johnson (2000), breeding bird populations in CRP fields can vary dramatically in response both to vegetational succession and to climatic variation. What was learned about CRP in its early stages may no longer be applicable.

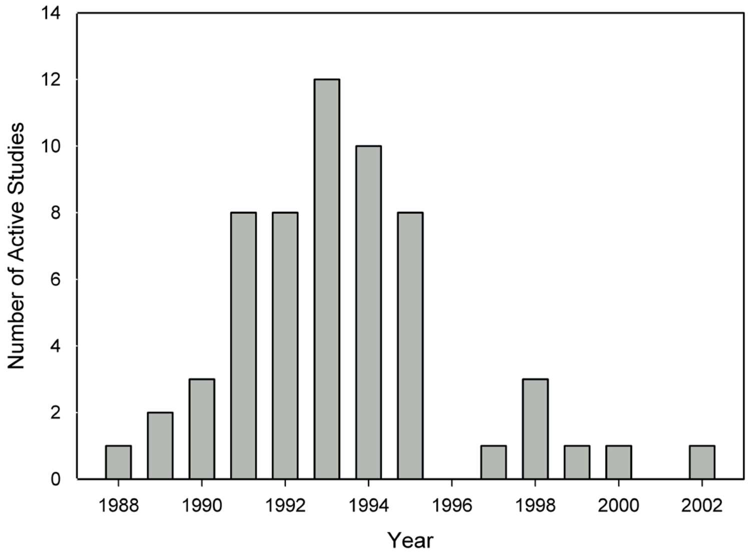


Figure 2. Number of studies involving bird use of Conservation Reserve Program fields in or near the Great Plains, by year, based on a review by the author of theses and published articles.

Conclusions

Conservation Reserve Program fields are clearly much more beneficial to a wide variety of breeding birds than are the cropland fields that they replaced. Tracts of untilled native prairie, however, are tremendously important to grassland birds; they support many species that rarely if ever use cropland or even CRP fields, such as burrowing owl (*Athene cunicularia*), Sprague's pipit, Baird's sparrow, and chestnut-collared longspur (D. H. Johnson and L. D. Igl, unpublished data). Likewise, Klute et al. (1997) found greater densities of several grassland species in grazed native prairie than in CRP fields in Kansas. Maintaining extant native prairie should be a high priority for the conservation of birds (as well as many other animal and plant species). It is critical that farm programs do not directly or indirectly encourage conversion of native prairie to cultivation while seeking to restore perennial grassland to existing areas of cropland.


Yellow-rumped warbler in a South Dakota prairie pothole. (D. Larson, USDA-NRCS)

As reported by Johnson (2000), evidence indicates that native grasslands are being lost at the same time as CRP is reestablishing grassland. Johnson (2000) reported on information compiled by C. Madsen (U.S. Fish and Wildlife Service , personal communication). In South Dakota, 1,776,383 acres (718,884 ha) were enrolled in CRP by 1995. However, during the period (1985–1995), 707,896 acres (286,478 ha) of grassland were converted to cropland. Recent summaries of U.S. Department of Agriculture data indicate that sodbusting continues. Analyses by Ducks Unlimited show that 74,470 acres (30,137 ha) in North Dakota and 191,813 acres (77,625 ha) in South Dakota were broken for crops during 2002–2004 (J. K. Ringelman, Ducks Unlimited, personal communication). Analysis of Landsat satellite imagery of selected counties in North Dakota and South Dakota during 1982–2002 conducted by Ducks Unlimited likewise shows conversion of native grassland continues at an appalling rate (S. Stephens, Ducks Unlimited, personal communication). Tillage of rangeland is being encouraged by new varieties of crops, many of them genetically modified, such as Roundup®-ready (use of trade names does not imply endorsement by the U.S. government) corn and soybeans.

Natural Resources Inventory data tell similar stories of losses of grassland. In North Dakota, rangeland diminished by 791,100 acres (320,000 ha) between 1982 and 1997; pastureland declined by 160,900 acres (65,100 ha) during the same period (USDA 2000). Those losses definitely offset many of the gains in wildlife habitat provided by the 2,802,300 acres (1,133,700 ha) enrolled in CRP in North Dakota by 1997. Similarly, losses of rangeland between 1982 and 1997 totaled 1,089,300 acres (440,800 ha) in South Dakota, 1,076,300 acres (435,600 ha) in Montana, and 506,500 acres (205,000 ha) in Nebraska. More recent Natural Resources Inventory results are not yet available by state, but nationwide values show a continuing decline in the area of land used for grazing (USDA 2004). These changes in land use undoubtedly have had a negative influence on the populations of many grassland bird species.

Although Conservation Reserve Program fields are much more beneficial to breeding birds in the northern Great Plains than in the croplands that they replaced, the continuing loss of native grasslands is a critical concern. Those native grasslands provide habitat for a wide variety of breeding birds, including many species that make little if any use of cropland or even CRP fields. Further, native rangeland often occurs in large patches and thus is less susceptible to many of the problems associated with fragmentation that were previously described. Conversion of cropland to CRP grasslands may be only temporary, but the conversion of native prairie to cropland is virtually permanent; prairie restoration is a costly process that does not fully restore the integrity of native prairie ecosystems. Recent Farm Bills have made positive contributions to wildlife habitat though the Conservation Reserve Program. Those contributions would be greatly enhanced if they also discouraged further cultivation of existing native grassland and fostered the preservation of these threatened ecosystems. A more balanced and comprehensive program is needed.

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The Conservation Reserve Program and Duck Production in the U.S. Prairie Pothole Region[1]

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Introduction

The Prairie Pothole Region (PPR) of North America has historically been considered the most important area of the continent for many species of waterfowl, particularly upland nesting ducks (Bellrose 1976). However, during the time since settlement of this area by Europeans, productivity by species such as mallard, gadwall, blue-winged teal, northern shoveler, and northern pintail has apparently declined. Beauchamp and others (1996) reported a system-wide decline in nest success of upland nesting duck species in the PPR between 1935 and 1992. Nest success has been identified as the single most important factor influencing population change of mallards breeding in the PPR (Hoekman and others 2002) and predation has been identified as the primary reason for nest failure of upland nesting duck species in the PPR of the U.S. (Klett and others 1988, Reynolds and others 2001). Declines in nest success in the PPR have coincided with the conversion of large areas of perennial grasslands to cropland that has presumably altered predator/prey relationships in ways unfavorable to upland nesting birds (Cowardin and others 1983). In 1985, Congress authorized the Conservation Reserve Program (CRP) as part of the Food Security Act (Public Law 99-198). Under this Act, landowners enroll cropland to be converted to perennial cover for a specified period (e.g., 10–15 years) in exchange for annual payments. The CRP has been part of all subsequent Farm Bills since the 1985 Act and resulted in approximately 4.7 million acres of cropland converted to undisturbed grass cover in the PPR of the Dakotas and northeast Montana during the period 1992–present. Conservationists have heralded the CRP as the most significant conservation program benefiting wildlife populations ever implemented by the U.S. Department of Agriculture (USDA). During the period 1992–1997, Reynolds and others (2001) conducted a study to assess the impact of CRP on duck productivity in the PPR of North Dakota, South

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Dakota, and northeast Montana. This paper presents results from that study and other data to demonstrate the benefits of CRP to waterfowl beyond 1997.

Wetlands in the prairie pothole region in South Dakota. (D. Poggensee, USDA-NRCS)

Impacts of CRP on Waterfowl in the PPR

Duck Production 1992–1997

For nesting cover to provide meaningful benefits to duck populations, certain criteria need to be met: (1) the cover must be characterized by nest success that is higher than other major cover types, (2) it should be more attractive to nesting hens than less secure competing cover, and (3) it should be accessible to a large number of nesting hens. In addition nest success should exceed 15–20% in order for productivity to balance annual mortality (Klett and others 1988). During the period 1992–1997, Reynolds and others (2001) studied use and success by five duck species (mallards, gadwall, blue-winged teal, northern shoveler, and northern pintail) nesting in CRP cover in the U.S. PPR. These investigators searched over 30,000 acres of CRP cover in the Dakotas and Northeast Montana and collected information on over 10,000 duck nests. Results from that study showed that nest success in CRP, averaged among years and species, was 23%, and was higher than any other major cover type used by ducks. They found that CRP cover was preferred over all other major cover types on the landscape by all duck species studied, and that 30% of all successful nests across the study area were initiated in CRP fields that accounted for 7% of the total land area. They also found that nest success in CRP fields was positively related to the percent of total perennial cover on the study sites and that nest success in other cover types was higher during the CRP period than that observed prior to the CRP. They concluded that CRP was having a positive impact on the entire landscape. Overall, these investigators estimated that duck productivity in the PPR increased by 30% compared to that expected in the absence of CRP and that an additional 12.4 million ducks (2.1 million per year) were produced in the U.S. PPR during the study period over what would have occurred in the absence of the CRP. This is equivalent to approximately 33% of the entire U.S. harvest of those species studied during the 6-year period.

Duck Production 1998–2002

Models developed from the 1992–1997 study can be used to estimate the impact of CRP on duck production beyond 1997 if certain information is available and/or assumptions made as follows: (1) estimates of duck breeding pair numbers and distribution are available annually, (2) the distribution of CRP since the 1996 Farm Bill is available in the digital/spatial database, and (3) nest success estimates were updated or assumed to be unchanged since the 1992–1997 period. The U.S. Fish and Wildlife Service continued to annually survey duck breeding populations since

1997 and therefore this critical component of evaluation exists. Because broad-scale temporal variation in nest success was not observed during the 1992–1997 period (Reynolds and others 2001), the assumption that nest success has remained similar in subsequent years seems to be reasonable. The most important change that has occurred since 1997 has been the amount and distribution of CRP throughout the PPR. There have been large shifts among counties and states in the region that will need to be incorporated into any serious attempt to quantify CRP benefits to waterfowl production beyond 1997. However, a rather crude examination can be made if we assume the current CRP is equivalent to that which was in place during1992–1997. Under those conditions, model projections predict that during the 1998–2003 period (period for which breeding populations have been summarized) an additional 13.3 million (2.2 million/year) puddle ducks have been produced as a result of the CRP. The slightly greater average annual incremental increase during the 1998–2002 period compared to the 1992–1997 period is due to the larger average breeding population size during the later period. This brings the total incremental increased production of ducks to 25.7 million for the period 1992–2003.

Mallard ducks in a prairie pothole wetland. (D. Poggensee, USDA-NRCS)

Breeding Duck Pairs and Wetlands in CRP Fields

In addition to providing relatively secure nesting cover for upland nesting ducks, the CRP has the potential to impact the number of breeding ducks settling in the U.S. PPR. There is speculation that homing by adult and young females due to increased productivity from CRP has resulted in greater than expected densities of breeding duck pairs using much of the U.S. PPR. However, wetland habitat has also been positively affected by CRP cover. Wetlands that occur in grasslands tend to attract higher densities of ducks and are considered superior in biological function to those that occur in cropland (Kantrud and Newton 1996, Krapu and others 1997). I examined breeding duck data from over 2,400 wetland observations collected by the U.S. Fish and Wildlife Service (USFWS, Habitat and Population Evaluation Team, Bismarck, ND, unpublished data) for the period 2000–2003 to compare the density of 13 combined duck species using three classes (Cowardin and others 1979) of wetlands occurring in CRP fields (n = 466) and crop fields (n = 1957). Wetlands in both CRP and crop fields showed frequent use by breeding ducks, but greater densities were recorded for wetlands in CRP fields compared to those in crop fields (Figure 1). These results suggest that CRP cover planted around wetlands and the curtailment of disturbance associated with tilling and planting crops has improved the function of wetlands relative to breeding duck use. This impact is not trivial as evidenced by estimates from landscape samples that indicate there are about

230,000 acres of small-shallow (temporary and seasonal) wetlands in CRP fields throughout the PPR. These wetlands attracted 492,000 duck pairs annually during years 2000–2003, which was 210,000 more pairs per year than if they had been in cropland instead of the CRP.

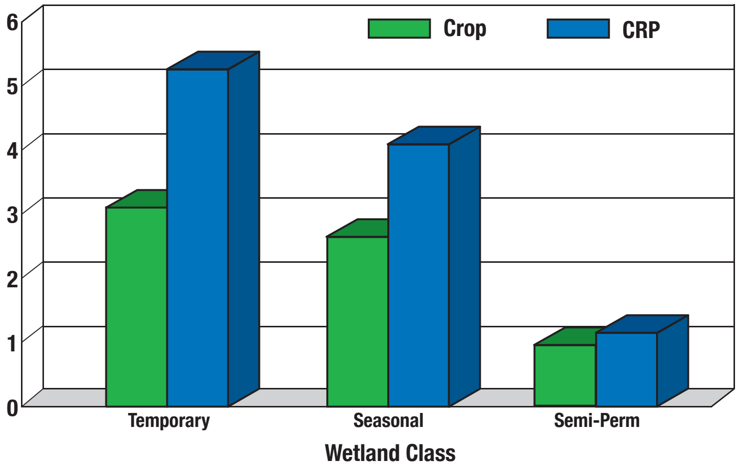

Figure 1. Duck pairs/wet acre (13 species combined) on wetlands occurring in crop fields versus those in CRP fields in the U.S. Prairie Pothole Region during spring 2000–2003.

Wetland Conservation

CRP cover provides benefit to duck production only when this cover occurs in proximity to wetlands that attract numerous breeding hens. Some nesting hens will travel as much as 2 miles or more from core wetlands to access suitable nesting cover (Derrickson 1975, Dwyer and others 1979, Cowardin and others 1985). Loss of wetlands due to drainage can have a significant effect by reducing the capability of an area to attract ducks. Tiner (1984) reported that over half of the original 7 million acres of pothole wetlands in the Dakotas have already been lost, mostly due to agriculture. In addition, small shallow wetlands in the PPR are critical to brood survival by providing security from predators (Krapu and others 2000) and food requirements for developing ducklings. Since 1985, all Farm Bills have included conservation compliance (Swampbuster) provisions that restrict wetlands from being drained and converted to cropland. Swampbuster has been effective in reducing wetland loss, but

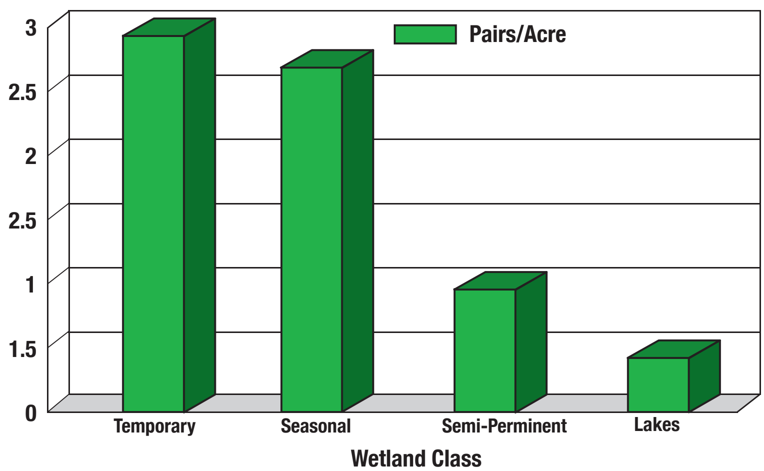

Figure 2. Duck pairs/wet acre (13 species combined) observed on four classes of wetlands in the U.S. Prairie Pothole Region during May 2000–2003.

some farm groups question the need to protect small-shallow wetlands that interfere with tilling and planting. I examined data collected by the U.S. Fish and Wildlife Service (USFWS, Habitat and Population Evaluation Team, Bismarck, ND, unpublished data) during the period 1987–2003 to determine which wetland types attracted the highest amount of use by breeding ducks in the U.S. PPR. The types of wetlands in all land uses that showed the highest use by breeding ducks were temporary and seasonal classes (Figure 2) that averaged only 0.60 and 1.46 acres in area, respectively. Further examination of this data revealed that 63% of all dabbling ducks in the area depend on temporary and seasonal wetlands that are less than 1 acre in area and the majority of these wetlands occur in crop fields.

Discussion

The PPR of the U.S. is the most important breeding area in the nation for many duck species. The PPR area of the Dakotas makes up about 7% of the traditional waterfowl survey area (Cowardin and Blohm 1992) that is considered the principal breeding range for ducks in North America (Reynolds 1987). During the period 1994–2002, 21% of all breeding ducks from the traditional continental survey area occurred in the PPR of the Dakotas (U.S. Fish and Wildlife Service Administrative Reports 1994–2002). The CRP has been popular with landowners in this area who have enrolled and maintained nearly 5 million acres of land in the program since 1992. Reynolds and others (2001) documented the importance of CRP to duck production and concluded the program has provided widespread landscape level affects. In addition, CRP cover appears to have improved the attractiveness of certain wetlands and increased the carrying capacity of breeding ducks in the region.

Notwithstanding the demonstrated benefits CRP has provided for waterfowl in the PPR, there is concern about the future continuation of these benefits. Nearly 2.5 million acres (>1/2 of the total) of CRP in the PPR is due to expire in 2007 and by 2010 only about 20% of the current CRP acres will remain in active contracts. The CRP will need to be reauthorized prior to contract expiration if benefits to waterfowl are to continue. However, even with reauthorization of the CRP, changes need to be made in the current Environmental Benefit Index (EBI) (used to determine which CRP contracts are accepted by USDA) if waterfowl are considered a conservation priority. The EBI has changed considerably since sign-ups in 1997–2000 when most of the CRP in the PPR was contracted. EBI criteria for earlier sign-ups included points for offers in the PPR National Conservation Priority Area, proximity to wetlands, proximity to protected areas such as National Wildlife Refuge System Waterfowl Production Areas, and upland to wetland ratios that allowed enrollment of entire fields with numerous pothole wetlands. The most recent sign-ups emphasized criteria such as riparian buffers, shelterbelts, grass waterways, contour grass strips, wetland buffers, and filter strips (USDA, Farm Service Agency 2004). While these later criteria may result in plantings that provide certain conservation benefits, they are unlikely to be compatible with the habitat needs of prairie ducks. Idle grass plantings with these configurations are similar to road rights-of-way and other fragmented habitats described by Cowardin and others (1988) that are attractive to nesting ducks, but have been characterized by low nest success due to excessive predation (Klett and others 1988, Reynolds and others 2001). Conversely, landscapes that have been shown to be associated with high duck productivity include large blocks (e.g., ≥32 ha) of CRP associated with other CRP or perennial grasslands in close proximity to wetland complexes that support moderate to high densities of breeding duck pairs. Whole field enrollments in CRP cover will be needed to meet the nesting habitat requirements of upland nesting ducks.

As a result of EBI changes in later sign-ups, only 12% (50,954 acres) of 428,470 acres of CRP offered from the Dakotas were accepted during the most recent general sign-up (signup 26) (USDA, Farm Services Agency news release (2004). This is in contrast to the national CRP acceptance rate of 48%. If waterfowl are intended to be a priority wildlife group for a future CRP, practices popular with landowners in the PPR will need to be emphasized (Table 1). Also, the USDA should consider using available biological data to maximize the waterfowl benefits from the program. The USFWS Habitat and Population Evaluation Teams in Bismarck, North Dakota, and Fergus Falls, Minnesota, have developed spatially explicit models and used Geographic Information System technology to create maps that can be used to target programs such as CRP to achieve the greatest waterfowl production results (e.g., Reynolds and others 1996). Maps developed from these models can be made available for the entire PPR.

Table 1. Percent distribution of Conservation Reserve Program (CRP) by practice category for states that make up the majority of the U.S. Prairie Pothole Region[a].

CRP practice	Percentage of total CRP in the north-central Plains
CP-1: Introduced grasses	16.5%
CP-2: Native grasses	12.6%
CP-4: Wildlife habitat	10.4%
CP-10: Established grasses	35.1%
CP-23: Wetland restoration	15.0%
All other practices combined	8.4%

[a] Includes North Dakota, South Dakota, Montana, and Minnesota.

Conclusions

In summary, the CRP has resulted in significantly increased duck productivity from the most important duck breeding area in North America. Ducks produced in the PPR migrate to virtually every state, province, and territory in North America, Mexico, and several countries in South America. Waterfowl hunters and observers nationwide have been the beneficiaries of the CRP. In order to maintain duck production levels in the PPR, at least 5 million acres of CRP will need to be targeted toward areas of moderate to high duck density. To maximize duck production and meet other migratory bird and upland bird population goals in the region, a total of 8 million acres of CRP cover is recommended (Wildlife Management Institute 2001). Finally, Swampbuster provisions of the Farm Bill must be continued to protect wetlands habitat critical to breeding waterfowl and broods. Waterfowl enthusiasts nationwide will be looking forward to continuing the benefits of these landmark conservation initiatives.

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Impact of the Conservation Reserve Program on Wildlife Conservation in the Midwest

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Abstract

Evidence that the Conservation Reserve Program (CRP) created habitat used by grassland birds in the Midwest is unquestionable. Evidence also is accumulating that suggests CRP is used by a variety of other terrestrial wildlife species. Reproductive and population-level benefits have been demonstrated for some, but not all, avian species; evidence for other terrestrial wildlife is lacking. Wildlife response to CRP is a multiscale phenomenon dependent upon vegetation structure and composition within the planting, practice-level factors such as size and shape, and its landscape context, as well as temporal factors. Thus, the benefits of CRP and the impacts of recent programmatic changes are location- and species-specific. Overall, CRP habitat in the Midwest likely contributes to the population stability and growth of many, but not all, grassland wildlife species.

Introduction

Since its inception in 1985, the Conservation Reserve Program has influenced wildlife conservation in the United States. With each reauthorization of farm policy legislation (in 1990, 1996, 2002), CRP has expanded in terms of acreage and the emphasis given to providing wildlife habitat. The 2002 Farm Bill added additional practices (e.g., CP29 wildlife habitat buffer) and management options for landowners, including managed haying and grazing, managed harvesting of biomass, and installation of wind turbines on CRP fields (USDA 2003). These changes will affect the potential of CRP to provide wildlife habitat.

As of January 2005, nearly 7.7 million acres were enrolled in the CRP in 8 midwestern states (Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, Ohio, and Wisconsin). The majority of these acres (80%) were enrolled through the competitive general signup, and 4.4 million acres (58%) are whole fields planted to grass. Although new land is expected to be brought into the CRP between 2003 and 2007, many new contracts are likely to be focused on forests, wetlands, and linear buffers, thereby altering the benefits for some species (Riley 2004). Many of the existing contracts are set to expire between 2007 and 2009. Contracts on 34% of existing acreage in the Midwest will expire by the end of 2007, with another 30% expiring over the following 2 years (USDA 2005). The future of these acres and the wildlife benefits they provide is uncertain.

Ryan (2000) reviewed existing knowledge on avian response to grassland CRP plantings (CP1, CP2, CP10) in the Midwest. We build upon that knowledge by emphasizing recently published information on birds (since 1999), as well as presenting available information on other terrestrial wildlife (i.e., mammals, reptiles, amphibians, and invertebrates). Discussion is focused on whole field grass plantings in the tallgrass prairie region (states mentioned above), but studies undertaken outside the Midwest are reviewed when the species of concern occur there.

Wildlife and the CRP in the Midwest

Among the intended objectives of the CRP was an increase in total habitat available for wildlife, especially grassland birds. The implicit assumption underlying this objective was that availability of grasslands was limiting populations of many species of birds. By establishing new grass plantings, it was expected that birds would occupy those fields and successfully reproduce, thereby augmenting their populations. The decline of grassland bird populations over the last half of the 20th century has been well documented by the efforts of the Breeding Bird Survey (BBS) (Sauer et al. 1996). Unfortunately, no other continent-wide survey exists to maintain data on other vertebrate groups. Still, it was widely assumed that the establishment of CRP plantings would positively affect grassland wildlife populations (e.g., Berner 1988). However, wildlife response to changes in land use is species-specific, depending on life-history requirements. Also, wildlife habitat selection and use is a multiscale phenomenon (e.g., Best et al. 2001, Gehring and Swihart 2004). Response to implementation of a particular CRP practice is dependent upon vegetation structure and composition within the planting, practice-level factors (e.g., size, shape), and its landscape context, as well as temporal factors (e.g., succession).

Ryan (2000) identified 6 levels of evidence of a positive impact on conservation of wildlife in the Midwest, from weakest to strongest, that should be investigated:

1) Evidence of use (occupancy) of CRP fields;
2) Evidence of high abundance in CRP relative to alternative vegetation types, especially cropfields that were replaced by CRP;
3) Evidence of nesting in CRP and comparison with alternative vegetation types;
4) Evidence of high reproductive success relative to alternative vegetation types;
5) Evidence of reproductive success and survival in CRP fields sufficient for positive population growth (i.e., $\lambda > 1.0$); and
6) Evidence of positive population growth (or reduced decline) after initiation of the CRP.

Evidence of Wildlife Use of CRP Fields

Birds

There is overwhelming evidence that CRP plantings were used by a variety of bird species. In their review of the literature, Ryan et al. (1998) listed 92 species of birds, including 53 songbirds (Order Passeriformes), that had been observed using CRP plantings in the central U.S. Recent research has added only 1 species to that list; Evrard (2000) noted 3 rough-legged hawks (*Buteo lagopus*) hunting CRP fields in Wisconsin. In the most extensive study of songbird use of CRP in the Midwest, Best et al. (1997) observed over 60 species of birds using CRP habitats during the breeding season. Similarly, Best et al. (1998) recorded over 40 bird species using CRP grasslands as winter-feeding or roosting habitat. Interestingly, the total number of bird species observed in CRP plantings by Best et al. (1997, 1998) did not differ markedly from the number of species they observed in nearby row-crop fields.

Pheasant in a CRP field in Iowa. (USDA-NRCS)

Several studies have investigated the impact of field-level (e.g., age, field size) and within-field (e.g., planting mix) factors on avian use of CRP. Eggebo et al. (2003) observed more crowing ring-necked pheasants (*Phasianus colchicus*) in old cool-season CRP fields than in any other age or cover type in South Dakota. Horn et al. (2002) found field size to be an important factor influencing the occurrence and/or abundance of grassland songbirds in switchgrass (*Panicum virgatum*) plantings in Iowa. Swanson et al. (1999) evaluated avian use of CRP (CP1, CP2, and CP10) fields in Ohio as a function of vegetation, physical, and disturbance characteristics. Age and field size were not related to species richness, but the grassland area of the field plus surrounding areas was related to use by several grassland-dependent species. All species were more abundant in CRP fields contiguous with other grassland.

In Missouri, species richness, abundance, and nesting success of grassland birds during the breeding season and total bird use in the winter did not differ between introduced grasses with legumes (CP1) and native grasses (CP2) (McCoy et al. 2001). In contrast, Morris (2000) observed grassland birds using CP2 fields, but not CP1, in winter in southern Wisconsin. Hull et al. (1996) examined the relationship between avian abundance and forb abundance in native-grass CRP fields in Northeast Kansas. The expected significant relationship was not found, but no field had >24% forbs, which the authors surmised was too low to produce a response. Murray and Best (2003) found that species richness did not differ between harvest treatments in Iowa switchgrass fields; species preferring taller vegetation were replaced by species preferring shorter vegetation in the harvested treatments. The abundances of 16 of 18 species did not differ with treatment. Sedge wrens (*Cistothorus platensis*) were more abundant in non-harvested than totally harvested fields, while grasshopper sparrow (*Ammodramus savannarum)* abundances differed in all treatments (total > strip > non-harvested). Svedarsky et al. (2000) noted the potential of CRP to provide greater prairie-chicken (*Tympanuchus cupido pinnatus*) habitat if it was managed to maintain grass vigor and reduce woody invasion and litter buildup.

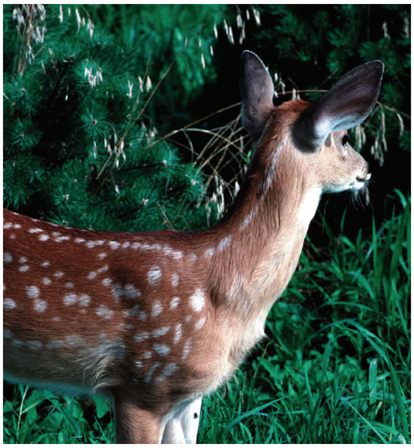
Recent studies also have examined the effect of a CRP field's landscape context on avian use. Merrill et al. (1999) compared landscapes (1.6-km radius) surrounding greater prairie-chicken leks to random non-lek points and found greater amounts of CRP in the landscape for leks. Toepfer (1988) documented nesting in Minnesota CRP, but success was lower in CRP than in native grasslands (J. Toepfer, unpublished data [in Merrill et al. 1999]). The shape of grassland and woodland patches was significant but had low predictive power for comparisons between temporary and traditional leks. Merrill et al. (1999) believed CRP might be important, especially near temporary lek sites. Svedarsky et al. (2000) recommended that 30% of the grassland surrounding greater prairie-chicken leks be managed to provide spring nesting cover and be in close proximity to brood cover to maintain populations.

Best et al. (2001) investigated the effect of landscape context, including proportion in CRP, on avian use of row-crop fields in Iowa. Some species showed a strong response to landscape composition (including dickcissel [*Spiza americana*] and indigo bunting [*Passerina cyanea*]), while others did not (e.g., American robin [*Turdus migratorius*], American goldfinch [*Carduelis tristis*], and killdeer [*Charadrius vociferus*]). Seven species differed significantly between landscapes—for these the lowest numbers in crop fields occurred in areas of intensive agriculture. Species with different habitat affinities (grass or wood) showed similar aversion to row crop. Grassland birds occurred more often in landscapes with more grass (block or strip). Generalists, crop specialists, and aerial foragers were not affected by landscape composition.

In contrast to these studies, Hughes et al. (2000) found that mourning dove (*Zenaida macroura*) daily survival rate was influenced by vegetation structure within the field, but not field edge or landscape (800-m) factors. Landscape effects were thought to be lacking due to the generalist nature of doves. For ring-necked pheasants in northwestern Kansas, the amount of CRP in areas where home ranges were located had no detectable effect on size of home ranges (Applegate et al. 2002). Females tended to have smaller home ranges (average of 127 ha) in high-density (25%) CRP sites than in low-density (8% to 11%) CRP sites (average 155 ha), but males showed the reverse trend. Horn et al. (2002) also found no effect of landscape on the relations between avian occurrence, abundance, and field size. They noted that the literature is contradictory concerning landscape effects on area sensitivity. Horn et al. (2002) reported that the amount of woodland cover, ranges in field sizes among landscapes, and amounts of shrub and forb cover within CRP fields may have confounded any relationship with landscape composition.

Mammals

Information on mammalian use of CRP fields is scarce. The majority of available evidence comes from surveys of small mammals, either to assess wildlife habitat quality or estimate the potential to contribute to crop depredation. Eight species of small mammals were captured on CRP fields planted to exotic grasses (CP1) in Michigan (L. T. Furrow, H. Campa, III , S. R. Winterstein, K. F. Millenbah, R. B. Minnis, and A. J. Pearks, unpublished data). Deer mice and white-footed mice (*Peromyscus spp.*) dominated younger fields, and meadow voles (*Microtus pennsylvanicus*) dominated older (≥2 years) fields. *Peromyscus* numbers were positively correlated with bare ground and forb canopy cover, and voles were positively correlated with litter depth. Fields ≤2 years old had a greater diversity of small mammalian species than older fields, while relative abundance increased with age. Millenbah (1993) reported greater insect abundance on 1–2-year-old fields, which may have contributed to greater small mammal diversity on these age classes. Hall and Willig (1994) captured 10 rodent species on CRP in Northwest Texas, including deer mice and white-footed mice. No significant differences in mammalian diversity were detected among sites, and diversity was not correlated with heterogeneity of vegetation or site age. However, species composition was significantly different among all sites in each season. In a crop-depredation study in Nebraska, Hygnstrom et al. (1996) trapped small mammals in a 9-year-old, 64-ha field planted to brome. Trapped species included (in decreasing order) deer mouse (*Peromyscus maniculatus*), short-tailed shrew (*Blarina brevicauda*), least shrew (*Cryptotis parva*), and meadow jumping mouse (*Zapus hudsonicus*). No voles were captured, although they were observed the preceding season. Meadow voles constituted 95% of captures in Wisconsin (Evrard 2000).



White-tailed deer fawn in Iowa. (L. Betts, USDA-NRCS)

Few studies have directly measured use of CRP by midsized and large mammals. Furrow (1994) noted a decreasing trend in mammal detections at scent stations with increasing age of the CRP field. The decreasing trend was attributed to decreases in ease of movement and prey diversity. From most to least abundant, the 6 species were recorded were raccoon (*Procyon lotor*), striped skunk (*Mephitis mephitis*), marmot (*Marmota monax*), domestic cat, domestic dog, and Virginia opossum (*Didelphis virginiana*). Raccoons were the most abundant detections across field ages in most months sampled, and skunks also were recorded in almost every month. In Northwest Texas, Kamler et al. (2003) reported that both adult and juvenile swift fox (*Vulpes velox*) strongly avoided CRP fields. Whereas CRP comprised 13% and 15% of the available habitat for each age class, respectively, only 1 of 1,204 locations was recorded in a CRP field. Kamler et al. (2003) believed this was due to the taller, denser vegetation of introduced warm-season grass plantings compared to the native shortgrass prairie preferred by swift foxes. A study of white-tailed deer (*Odocoileus virginianus*) habitat use in South Dakota revealed that CRP fields were used proportionately greater than habitat availability during periods of deer activity in the spring, and during evening and midnight periods during summer (Gould and Jenkins 1993). Increased use of CRP between spring and summer corresponded with rapid vegetation growth and fawning.

Other, more anecdotal information exists for mammalian use of CRP. Hughes et al. (2000) listed potential nest predators at their sites in Kansas including coyotes (*Canis latrans*), raccoons, striped skunks, opossums, feral cats, and badgers (*Taxidea taxus*). Evrard (2000) attributed duck nest predation to mammalian predators, including red fox (*Vulpes vulpes*), striped skunk, and raccoon, though hard evidence was lacking. Other mammalian species incidentally noted in CRP included white-tailed jackrabbits (*Lepus townsendii*), white-tailed deer fawns, and a coyote den with 3 pups (Evrard 2000).

Other Wildlife

Other terrestrial wildlife studied or observed in CRP plantings included invertebrates and snakes. Most studies of invertebrates in CRP have been conducted relative to crop pests or avian food supplies. Carroll et al. (1993) assessed CRP grasses (native and exotic) to be marginal overwintering habitat for boll weevils (*Coleoptera: Curculionidae*) in Texas.

Alternatively, Phillips et al. (1991) detected a low incidence of cotton pests and found beneficial predator species in Texas CRP. Also in Northwest Texas, McIntyre and Thompson (2003) reported that CRP supported avian prey and that CRP types were similar in abundances (i.e., no support that different types of CRP possess different prey availabilities for grassland birds). Millenbah (1993) measured greater insect abundance on 1–2-year-old CRP fields than fields ≥3 years old in Michigan. In Northeast Kansas, data collected by Hull et al. (1996) did not support the hypothesis that invertebrate biomass was correlated positively with forb abundance (but see Burger et al. 1993). McIntyre (2003) surveyed 4 planting types and 1 native prairie in the Texas panhandle for endangered Texas horned lizards (*Phrynosoma cornutum*) and their food supply, harvester ants (*Pogonomyrmex spp.*). Ant nest densities varied within the classes but not between, suggesting that planting type (exotic vs. native) did not affect habitat value. Lizards also were seen on all types of CRP, but only at sites with ant nests. Davison and Bollinger (2000) identified 4 species of snakes common on their study sites in east-central Illinois, including prairie kingsnake (*Lampropeltis calligaster*), common garter snake (*Thamnophis sirtalis*), black rat snake (*Elaphe obsoleta obsoleta*), and blue racer (*Coluber constrictor*). Hughes et al. (2000) listed bullsnakes (*Pituophis melanoleucus*) as a potential nest predator in Kansas CRP fields.

Evidence of High Wildlife Abundance in CRP Fields

Birds

Best et al. (1997) compared avian abundance in paired CRP and row-crop fields in 6 midwestern states (Indiana, Michigan, Iowa, Missouri, Nebraska, and Kansas) in the early 1990s. Best et al. (1997) detected from 1.4 to 10.5 times more birds in CRP grasslands than in row-crop fields during the breeding season. Similarly, King and Savidge (1995) reported avian abundance to be 4 times greater in CRP fields than in cropfields in Nebraska. Best et al. (1997) further reported 16 species of birds that were unique or substantially more abundant in CRP fields than in nearby row-crop fields. Three of the 4 bird species they frequently observed in CRP (dickcissels, grasshopper sparrows, and bobolinks [*Dolichonyx oryzivorus*]) have been undergoing significant population declines. Additionally, Henslow's sparrow (*Ammodramus henslowii*) and sedge wren, species of high conservation concern in the Midwest (Herkert et al. 1996), occurred only in CRP fields. Of the 5 species unique or substantially more abundant in row crops than in CRP fields (Best et al. 1997), only the lark sparrow (*Chondestes grammacus*) is of moderate conservation concern (Herkert et al. 1996).

Direct comparisons of avian abundance in CRP and alternative grassland vegetation have been rare. Klute and Robel (1997) documented higher abundances of dickcissels, grasshopper sparrows, meadowlarks (*Sturnella spp.*), and upland sandpipers (*Bartramia longicauda*) in grazed pastures versus CRP plantings in Kansas. Summer observations of pheasants in western Kansas analyzed by Rodgers (1999) showed that pheasants used CRP fields more than their availability in northwestern Kansas, but not in southwestern Kansas where shorter grass plantings may not provide better habitat than cropland. Pheasant indices in Wisconsin CRP fields were 10-fold higher than in surrounding private farmland (Evrard 2000). Morris (2000) compared winter use by grassland birds of CRP, crop fields, pastures, and restored and native prairies. In this study, species diversity was highest in crop fields, followed by restored prairie, CP2 fields (a mixture of native warm-season grasses and 2 forbs), native prairie remnants, and pastures, while avian abundance was highest in pastures, followed by restored prairie, CP2, crop fields, and native prairie. No species were observed using CP1 fields (a mixture of introduced grasses and legumes) in this study. Avian abundance in crop fields and native prairie was higher during periods of incomplete snow cover than during periods with 100% snow cover, while the reverse was true for restored prairie and CP2 sites.

During the winter months, ring-necked pheasants, northern bobwhites (*Colinus virginianus*), American tree sparrows (*Spizella arborea*), dark-eyed juncoes (*Junco hyemalis*), and American goldfinches were the most abundant or widely distributed species observed in CRP fields (Best et al. 1998). All species but the goldfinch have been undergoing long-term population declines (Sauer et al. 1996). In a separate study, Burger et al. (1994) provided evidence that CRP plantings in Missouri provided important winter cover for northern bobwhites. They documented that 69% of nighttime roosts occurred in CRP fields in an area where CRP made up only 15% of the landscape. Rodgers (1999) used dropping counts to compare winter pheasant use of weedy wheat stubble and CRP in north-central Kansas. Despite offering comparable concealment, dropping density was 2.75 times greater in wheat stubble than CRP. Dropping data suggested that pheasants were using CRP for nighttime roosting. CRP may be less valuable to pheasants in winter due to fewer food sources, excessive litter, and less rigid stems.

Mammals

Comparison of mammal use of CRP relative to other vegetation types has been rare. A 3-phase, winter wheat (*Triticum aestivum*) rotation in southeastern Wyoming had higher rodent abundance and diversity than CRP at both sites in both years (Olsen and Brewer 2003). Evrard (2000) reported a catch/effort ratio for small mammals in Wisconsin of 19.37, much higher than Evrard (1993 [in Evrard 2000]) reported for Waterfowl Production Area (WPA) grasslands (6.8). Hall and Willig (1994) found that CRP grasslands simulated shortgrass prairies of Northwest Texas in species diversity but not in species composition, suggesting that CRP was not mimicking natural conditions. Of the 11 species captured in the study, only the southern plains woodrat (*Neotoma micropus*) was not captured on CRP. White-tailed deer in southeastern Montana used CRP in greater proportion than its availability in all seasons except fall (Selting and Irby 1997).

Other Wildlife

Direct comparisons of other wildlife abundance in CRP and alternative vegetation types have been extremely rare. McIntyre and Thompson (2003) sampled invertebrates with pitfall traps in 4 CRP field types in Northwest Texas and compared trap results with those of a shortgrass prairie. CRP field types had less vegetative diversity and lower arthropod diversity than prairie, but CRP fields did support avian prey groups. McIntyre (2003) found fewer harvester ant mounds on CRP plantings than on indigenous grasslands, but no significant differences between exotic and native CRP plantings.

Evidence of Nesting or Other Reproductive Behaviors in CRP Fields

Birds

CRP plantings have been extensively used for nesting by grassland birds in the Midwest. Murray and Best (2003) found 20 species nesting in switchgrass CRP fields in 1999 and 2000 in Iowa; red-winged blackbirds (*Agelaius phoeniceus*) comprised 56% of the sample. Best et al. (1997) located 1,638 nests of 33 bird species in CRP fields versus only 114 nests of 10 species in a similar area of row crops. In row-crop areas, they most frequently detected red-winged blackbird, vesper sparrow (*Pooecetes gramineus*), and horned lark (*Eremophila alpestris*) nests. Nests of red-winged blackbirds, dickcissels, and grasshopper sparrows were the most frequently located in CRP fields by Best et al. (1997). Similar lists of species nesting in CRP have been produced by recent studies (Davison and Bollinger 2000, McCoy et al. 2001). House sparrow (*Passer domesticus*) was the most common avian species nesting in CRP fields in Northeast Kansas (Hughes et al. 1999). CRP also appears to be important nesting habitat for mourning doves in Kansas (Hughes et al. 2000). In Wisconsin, ring-necked pheasant, gray partridge (*Perdix perdix*), northern harrier (*Circus cyaneus*), short-eared owl (*Asio flammeus*), and duck nests have been reported (Evrard 2000). In Northwest Texas, Berthelsen et al. (1990) found approximately 6 pheasant nests per 10 acres of CRP land, but no nests in cornfields. In Missouri, 55% of northern bobwhite nests and 46% of brood foraging locations occurred in CRP fields that constituted only 15% of the largely agricultural landscape (Burger et al. 1994).

Mammals

Evidence of reproductive activity by mammals is rare. Some of this is likely due to incomplete reporting as none of the small mammal papers reviewed mentioned the incidence of pregnant female mice, though this has been recorded in grass filter strips (CP21) in Missouri (D. T. Farrand, unpublished data). The only direct reproductive evidence found was reported by Evrard (2000), who observed a coyote den with 3 pups at 1 site. Indirectly, Gould and Jenkins (1993) concluded that CRP fields were important in South Dakota for female white-tailed deer during fawn-rearing, particularly at night.

Other Wildlife

None of the papers reviewed reported reproductive activity of other terrestrial wildlife species. Although it can be assumed that most semi-aquatic species (e.g., toads) do not use grasslands for reproduction, some reptiles and many invertebrates likely do.

Evidence of High Reproductive Success Relative to Alternative Vegetation Types

Birds

Nest success of birds breeding in CRP fields has been equal to or greater than that reported for alternative agricultural types. Apparent nest success for 1,526 nests monitored in CRP fields by Best et al. (1997) was 40% versus 36% for 113 nests monitored in row-crop fields. Using a subset of the data from Best et al. (1997), Patterson and Best (1996) reported apparent nest success of 38% in CRP fields and 32% in row-crop fields in Iowa. McCoy (1996), using the Missouri subset of the Best et al. (1997) data, reported significantly higher Mayfield nest success in CRP fields versus row-crop fields in 2 of 3 years (1993: CRP = 45%, row crop = 12%; 1995: CRP = 46%, row crop = 9%; 1994: CRP = 43%, row crop = 53%).

Pheasant population indices and Mayfield estimates for blue-winged teal (*Anas discors*) and mallards (*A. platyrhynchos*) in CRP did not differ from fields in WPA in Wisconsin (Evrard 2000). McCoy et al. (1999) noted that reproductive success of grasshopper sparrows, field sparrows (*Spizella pusilla*), dickcissels, American goldfinches, and common yellowthroats (*Geothlypis trichas*) breeding in CRP fields in Missouri was similar to or higher than that reported from alternative grasslands in a variety of prior studies. Klute et al. (1997) compared Mayfield nest success of 7 species breeding in CRP fields and pastures in Kansas. They detected no differences; however, sample sizes of nests were very small. Granfors et al. (1996) reported Mayfield nest survival for eastern meadowlarks (*Sturnella magna*) in CRP and grazed grasslands in Kansas. Nest success in CRP and grazed grass did not differ (1990: CRP = 17%, grazed = 25%; 1991: CRP = 10%, grazed = 20%), but they noted the low power of their statistical tests. Gransfors et al. (1996) also reported no difference in the mean number of nestlings fledged, for radiomarked females occupying CRP and grazed fields (CRP = 1.9 fledged/female, grazed = 0.7).

Recently published studies have compared reproductive success among CRP planting types and management regimes. McCoy et al. (2001) found that species-specific Mayfield nest success often differed between CP1 and CP2 within years, and the better type switched between years in several cases. However, means differed only for red-winged blackbirds. Parasitism rates did not differ between conservation practices (CPs) for any species, but varied with host species (mean = 18%, range = 0–40%). More pheasant broods were recorded in old cool-season than in warm-season CRP fields in South Dakota (Eggebo et al. 2003). Murray and Best (2003) found that non-harvested switchgrass fields had higher nest success and lower predation than strip-harvested or total-harvested fields. Failure due to brood parasitism did not differ between treatments. Grasshopper sparrow nest success in total-harvested fields (48%) was similar to that reported for Missouri by McCoy et al. (2001) (49% in warm-season and 42% in cool-season plantings). However it was higher than that reported for cool-season grass plantings in Iowa (Patterson and Best 1996). Common yellowthroat daily survival rate did not differ between treatments, and nest success was higher (41%) than reported in Missouri (McCoy et al. 2001; 32% in warm-season and 21% in cool-season plantings).

Mammals and Other Wildlife

We found no published data on reproductive success of mammals, reptiles, amphibians, or invertebrates relative to other vegetation types.

Evidence of Reproductive Success or Survival Adequate for Positive Population Growth

Birds

We found no published data on survival of adult or post-fledging juvenile birds in CRP. Few studies have examined fecundity in CRP; most research examined nest success (defined as ≥1 nestling fledged per nest) and implicitly assumed nest survival is the limiting factor in population growth. Duck species are the best studied in terms of reproduction. In Wisconsin, Mayfield nest success for blue-winged teal and mallards in CRP fields was above the level needed for population stability, but duck production was lower in CRP fields due to lower estimated nest densities (Evrard 2000).

McCoy et al. (1999) quantified seasonal fecundity for 8 grassland bird species breeding in CRP fields in Missouri and assessed whether it was adequate to offset annual mortality (i.e., achieve $\lambda > 1.0$). They concluded that CRP fields were of sufficient quality for 4 species (grasshopper sparrow, field sparrow, eastern meadowlark, and American goldfinch) to produce young in excess of that needed to maintain stable populations. Common yellowthroat reproductive success in CRP fields varied substantially among years, with output being in excess of that needed for maintenance of a stable population in only 1 of 3 years (McCoy et al. 1999). Fecundity of dickcissels and nesting success and fecundity of red-winged blackbirds were higher on CP2 than on CP1 habitat, but both CPs were likely sinks ($\lambda < 1$) for these species. Both CPs were likely source (>1) habitat for grasshopper sparrows, whereas only CP1 fields were likely a source for eastern meadowlarks and American goldfinches (McCoy et al. 2001).

Murray and Best (2003) found that nest success rates of grasshopper sparrows in total-harvested fields and common yellowthroats in all management treatments were similar to those reported for switchgrass fields by other studies, and thought they might be sufficient to maintain stable populations. Mourning dove apparent nest success averaged 56% (n = 90) in CRP fields in Kansas (Hughes et al. 2000), among the highest estimates they found in the literature. Although Hughes et al. (2000) postulated that CRP may be a source habitat for increasing populations of doves in the Great Plains, they made no attempt to calculate the source–sink status of CRP fields they studied.

Recently published studies of dickcissels nesting in CRP found nest success rates within the range of those summarized by McCoy et al. (1999). On 11 CRP fields in Northeast Kansas, Hughes et al. (1999) located 186 dickcissel nests, of which 13.2% were successful in 1994 and 14.9% were successful in 1995. Davison and Bollinger (2000) reported apparent nesting success in east-central Illinois averaging 39% over the entire nesting cycle and 59% during approximately 12 days of incubation. Robel et al. (2003) observed natural dickcissel nests in 5–6-year-old CRP fields in northeastern Kansas planted to native warm-season grasses. Of 97 nests, 68 (70%) were lost to predation or abandonment. A daily survival rate of 0.92 was calculated using the Mayfield method. Maddox and Bollinger (2000) observed male dickcissels feeding nestlings in Illinois CRP fields in 1997 but not in 1998. This extremely rare behavior was postulated to be a response to low food supplies.

Patterson and Best (1996) reported apparent nest success of ring-necked pheasants breeding in Iowa CRP fields as 34%, considerably higher than that reported for alternative agricultural fields studied previously in Iowa (see Ryan et al. 1998 for review). The 34% rate reported by Patterson and Best (1996) exceeded the level of nest success predicted by Hill and Robertson (1988) as necessary to maintain stable populations. However, Warner et al. (1999) reported that chick survival on their study area in Illinois remained low from 1982 to 1996 despite increases in brood habitat provided by CRP.

No direct measures of survival of grassland birds occupying CRP fields for all or significant portions of the annual cycle are available. However, Burger et al. (1995) did not detect a difference in annual survival of northern bobwhites occupying a landscape comprised of 15% CRP fields (5.4%) versus an agricultural area without CRP (5.1%).

Mammals and Other Wildlife

We found no published data on survival or reproductive success of mammals, reptiles, amphibians, or invertebrates relative to other habitats.

Evidence of Population Growth Related to CRP Fields

Birds

Murphy (2003) examined the impact of changes in agricultural land-use variables on population indices of grassland and shrubland bird species in the eastern and central U.S. from 1980 to 1998. Both groups experienced declines (15 of 25 and 13 of 33 species, respectively), but only the grassland bird group had an average rate significantly less than zero. Declines in grassland bird populations were independent of migratory behavior or nesting ecology. Changes in landscape variables accounted for more of the variation in grassland than shrubland bird population trends. Most of the trends significantly correlated to CRP acreage were negative (7 of 8); only the loggerhead shrike (*Lanius ludovicianus*) was positively correlated with increases in CRP acreage. Of the species negatively correlated with CRP, most (5 of 7) were shrubland species and the others nest in sparse grasslands—a condition CRP does not continually provide without management (e.g., Greenfield et al. 2002, 2003). Lack of positive relationships may be due to the fact that recent areas of CRP expansion tended to be in the eastern U.S. (outside most grassland bird ranges) or the relatively small land area in CRP. CRP comprises only 3.6% of the eastern and central U.S. and may be overwhelmed by other factors (Peterjohn 2003).

Based on Breeding Bird Survey data from Illinois, Herkert (1997) demonstrated a significant positive relationship between the population trend for Henslow's sparrow and the percentage of CRP in a county. Five of 8 counties with ≥3% of the area in CRP had positive population trends for Henslow's sparrow, whereas 8 of 11 counties with <3% CRP had negative trends. Unfortunately, the effect of CRP establishment was not sufficient to reverse the long-term declining trend in Henslow's sparrows in Illinois (Herkert 1997). However, recent reanalysis by Herkert (2004), using BBS data from the last 8 years (1995–2003), has shown that population trends are still positively correlated with CRP enrollments and that Illinois' populations of Henslow's sparrow are now at a 30-year-high level. Herkert (1998) reported a significant change in the slope of the population trend for grasshopper sparrows after the initiation of the CRP. In the 8 years prior to the CRP, 179 (64%) of 278 Breeding Bird Survey routes had negative trends. In the 8 years after, only 149 (54%) of the routes had negative trends. The overall trend prior to CRP initiation was strongly negative, but was essentially level during the CRP years. Herkert (1998) also showed a greater increase in trend slopes in areas with higher CRP acreages (>3.8% of the landscape). However, in the last 8 years (1995–2003) population trends again have become negative and are declining at a rate comparable to pre-CRP conditions (Herkert 2004).

Hughes et al. (2000) reported that mourning dove numbers have increased in the Great Plains region since the mid-1980s when the CRP was initiated. Mueller et al. (2000) quantified the relative effects of Minnesota CRP on abundance and distribution of mourning doves and found dove indices were positively related to CRP abundance.

Haroldson et al. (2004) quantified the relationships between amount of CRP fields in 15 agricultural landscapes in Minnesota and relative abundance of ring-necked pheasants, gray partridge, and meadowlarks in south-central Minnesota over a 10-year CRP enrollment cycle. For each 10% increase of grass in the landscape, pheasant indices averaged 12.4 birds/route higher in spring and 32.9 birds/route higher in summer, and meadowlark indices averaged 11.7 birds/route higher in summer. Partridge indices declined dramatically regardless of amount of grass habitat available. Pheasant populations in Nebraska increased from <2 birds/100 miles of survey route during 1983–1985 to >10 birds/100 miles in 1994 as CRP was established. King and Savidge (1995) reported significantly more pheasant observations in study areas with 18–21% CRP landscape coverage versus areas with 2–3% CRP. In Iowa, Riley (1995) compared pheasant populations in the 5 years immediately prior to CRP initiation with those in the first 5 years after establishment. He recorded a significant increase in mean detections from 37/survey route to 48/route.

Most of the change occurred where CRP was established in landscapes initially comprised of >70% cropland.

Rodgers (1999) used long-term survey data to show that pheasant populations have not responded to increased grassland acreages due to CRP, and deduced that deterioration of abundant wheat stubble fields represented an overwhelming habitat loss in western Kansas for which CRP could not compensate. Additionally, the author postulated that anticipated pheasant benefits from CRP were not fully realized because of inadequate plant diversity, poor stand maintenance, and large field size. Warner et al. (1999) found that ring-necked pheasant chick survival remained low despite increases in grassland and food supplies in central Illinois since the early 1980s. Similarly, Roseberry and David (1994) detected no relationship between northern bobwhite population indices and amounts of CRP in the landscape in Illinois.

Mammals and Other Wildlife

Mueller et al. (2000) quantified the relative effects of Minnesota CRP on abundance and distribution of white-tailed jackrabbits, eastern cottontail rabbits (*Sylvilagus floridanus*), and white-tailed deer. In the 32 counties analyzed, CRP accounted for 91% of the increase in grassland acreage in the post-CRP period (1986–1997) over the pre-CRP period (1974–1985). Cottontail indices were positively related to CRP abundance, whereas jackrabbit indices were negatively related, and deer indices were not influenced. Gould and Jenkins (1993) concluded that CRP enhanced habitat options (improved forage and cover) for white-tailed deer, but would have little population consequences other than influencing harvest mortality by providing escape cover.

Respondents to a survey of landowners in Riley County, Kansas, by Hughes and Gipson (1996) felt that several wildlife species causing damage on their property had become more common due to CRP. White-tailed deer accounted for 64.3% of these observations, followed by wild turkey (*Meleagris gallopavo*), eastern cottontail, striped skunk, and opossum, which accounted for 14.3%, 7.1%, 7.1%, and 7.1% of the damage observations, respectively.

Conclusions

Significant new information has accumulated on wildlife response to the CRP, especially in terms of terrestrial wildlife use and the population response of grassland and shrubland birds. This information reveals the complex nature of wildlife response to changes in land use; research has come to conflicting conclusions regarding the benefits of CRP across and within species. Some of this is due to differences in methodology (especially true of invertebrate sampling), while some is due to differences in species' response by landscape (e.g., Best et al. 2001) or region (e.g., Morris 2000 vs. McCoy et al. 2001). Much more work needs to be done to understand the causes of this complexity and to fill holes in our understanding of CRP effects, especially in relation to effects on populations of non-avian wildlife.

Wildlife response to CRP is a multiscale phenomenon dependent upon vegetation structure and composition within the planting, practice-level factors (e.g., size, shape), and its landscape context, as well as temporal factors. Thus, changes in the CRP resulting from the 2002 re-authorization (e.g., managed haying and grazing) will impact each species uniquely. We know enough to predict the response of some avian species in some landscapes (e.g., Murray et al. 2003), and as information on additional wildlife species accumulates we will be better able to tailor the program. However, several studies have shown that vegetation conditions outside the CRP may have a bigger impact than CRP on avian populations (e.g., Rodgers 1999, Warner et al. 1999, Murphy 2003), and this may well be true for other wildlife (e.g., Kamler et al. 2003). CRP grasslands are only a small proportion of U.S. land area (Peterjohn 2003), constitute a small amount of total grassland (Herkert 2004), and tend to be implemented in landscapes already characterized by greater diversity (Weber et al. 2002). Thus, CRP's vital importance to wildlife conservation in intensive agricultural areas may need to be augmented by other changes in land management if we are to reach desired conservation goals.

Remaining Questions

To better evaluate the impact of the CRP on wildlife conservation and to improve the efficiency (i.e., increased conservation benefits per dollar expended) several lines of additional research are needed:

- Direct comparisons of abundance and reproductive success of species breeding in native prairie and CRP grasslands;
- Further evidence of population-level change attributable to the availability of CRP grasslands at regional levels;
- The effects of distribution of CRP plantings in different landscape contexts on avian use and reproductive success in CRP fields (e.g., should CRP contracts be clumped or dispersed in landscapes with high or low amounts of existing grassland?);
- Comprehensive analyses of the impacts of types, frequency, and extent of disturbances (e.g., mowing, burning, grazing) of CRP vegetation on avian abundance and reproductive success; and
- Greater focus on non-avian wildlife response to CRP fields, including nest-predator species.

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The Conservation Reserve Program in the Southeast: Issues Affecting Wildlife Habitat Value

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Abstract

Provision of wildlife habitat is one of the statuary objectives of the Conservation Preserve Program (CRP); however, the realized wildlife habitat benefits vary regionally in relation to specific cover crop, age, and management regimes. As of February 2005, 1,324,066 ha were enrolled in the CRP in 12 southeastern states. Approximately 57% of southeastern CRP was in 1 of 3 tree cover practices (CP3 new pine, CP3a new hardwood, or CP11 existing trees); 19% as CP10 existing grass (much of which was reenrolled CP1); 4% as CP1 cool-season grass; 3% in CP2 native warm-season grasses; and 12% in continuous-signup buffer practices. Targeted conservation practices resulted in enrollment of 75,014 ha of longleaf pine within the longleaf practice and 2,850 ha of hardwoods in the continuous bottomland hardwood practice. Plant communities on CRP fields are not static, but change over time. In the southeastern United States, natural succession progresses rapidly because of fertile soils, long growing seasons, and substantial rainfall. As such, the specific wildlife species that occur on CRP stands will vary over the life of the contract. Wildlife populations at a given point in time will be a function of conservation practice, age of the stand, establishment methods, and mid-contract management regimes. Provision and maintenance of wildlife habitat on CRP fields in the South requires active management. Planned disturbance (disking or fire) should be incorporated into the conservation plan of operation for all grass plantings in the Southeast. Exotic forage grasses may need to be eradicated to accrue substantive wildlife benefits. Tree plantings also require active management. Most pine CP11 plantings are now 15–17 years old and are characterized by closed canopies with dense litter accumulation and little herbaceous ground cover. Thinning, selective herbicide, and prescribed fire would enhance the habitat value of these stands. The CRP has had substantial impact on land use and landscape composition in the Southeast. However, the wildlife habitat value of fields enrolled in the CRP *in the Southeast has been diminished by selection of cover practices with short duration or minimal habitat value (i.e., CP1, CP1 reenrolled as CP10, CP3, CP11). Proactive management of extant CRP acreage and selective enrollment of high-value cover practices (e.g. longleaf pine) will be required to achieve the types of wildlife habitat benefits associated with the CRP in other regions.*

Introduction

The Conservation Reserve Program (CRP) was established under the Food Security Act of 1985 with the purpose of assisting owners and operators of agricultural land in conserving and improving soil, water, and wildlife resources. In 1996, Congress reauthorized the CRP with an acreage limit of 36.4 million acres. The 2002 Farm Act increased the enrollment limit to 39 million acres. Environmental goals of the CRP were expanded under the 1990 and 1996 Farm Bills, and the 2002 Farm Act included wildlife habitat as a CRP objective, explicitly requiring an equitable balance among conservation purposes of soil erosion control, water-quality protection, and wildlife habitat. Several specific programmatic changes designed to promote targeted enrollment have occurred since 2000 (USDA 2004a). In 2000, starting with continuous signup 22, signup enhancements including an up-front signup incentive payment, a 40% practice incentive payment, increased maintenance payments, and updated marginal pastureland rental rates were added to some Continuous CRP (CCRP) practices. In 2003, new marginal pastureland eligibility provisions were implemented under CCRP that allowed non-tree covers to be established under the wetland buffers (CP30) and wildlife habitat (CP29) practices (USDA 2003a). Additionally, in 2003 the bottomland hardwood tree initiative was adopted under CCRP CP31. In 2004, cost-share was permitted for selected mid-contract management practices (USDA 2003a). State technical committees were responsible for recommending a list of contract management activities that would enhance the CRP cover for the duration of the contract period (USDA 2003b). Also in 2004, a pilot program was established to allow enrollment of herbaceous crop land buffers under CCRP CP33 Habitat Buffers for Upland Wildlife. Under this practice, 250,000 acres were allocated for establishment of 30–120-foot field borders in 35 states within the range of the northern bobwhite (*Colinus virginianus*) (USDA 2004b). Starting with general CRP signup 15 in 1997, wildlife habitat was given co-equal status with water quality and soil erosion (USDA 2004a). The Environmental Benefits Index (EBI) for signup 15 was modified to selectively encourage practices with greater wildlife value. From 1998 to 2005, EBIs for subsequent general signups (16, 18, 20, 26, 29) were modified to reflect knowledge gained in previous signups and enhance ease of application.

CP11 stand, thinned, herbicided with Arsenal, and prescribe burned. Use of mid-contract management practices can produce a pine-grassland structure in CP11 stands, substantially enhancing wildlife habitat. (Wes Burger)

Insofar as provision of wildlife habitat is one of the statuary objectives of CRP, broad benefits through creation and enhancement of wildlife habitat might be an expected outcome of this program. However, the realized wildlife habitat benefits of the CRP vary considerably regionally and within region in relation to specific cover crop established, time since enrollment, and management regimes. In the southeastern United States, unlike in the Great Plains (Johnson 2000, Reynolds 2000) and the Midwest (Ryan et al. 1998, Ryan 2000), the wildlife habitat value and resulting population responses to CRP have been more equivocal and less thoroughly documented. Within the Southeast, the implementation of the program and practices established vary considerably among states and differ substantially from other regions. In the southeastern states, the wildlife benefits are less obvious and in some cases potentially negative. Burger (2000) reviewed wildlife responses to CRP in the Southeast and suggested that wildlife habitat benefits of the CRP had been limited by extensive enrollment in loblolly pine tree (*Pinus taeda*) plantings and exotic forage grasses. However, Burger (2000) reported that substantive conservation benefits had likely been achieved through hardwood restoration in floodplain regions and longleaf pine (*Pinus palustris*) restoration under the longleaf CPA. Furthermore, he observed that conservation benefits could be substantially enhanced with greater emphasis on selection of appropriate herbaceous cover crops, expanded longleaf restoration, broader implementation of herbaceous buffer practices, and active management of existing acres (thinning, prescribed burning, selective herbicide, and conversion of exotic to native species). Between 2000 and 2005, programmatic changes have facilitated many of these recommendations, and additional research has been conducted to evaluate wildlife benefits of select practices. This chapter characterizes the current CRP in the Southeast and reviews relevant new research documenting expected benefits.

CRP Enrollment in the Southeast

As of February 2005, 1,324,066 ha were enrolled in the CRP in 12 southeastern states (Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, Virginia, and West Virginia) (USDA 2005). Enrollment in the CRP was not equitably distributed among states, with Mississippi (29%) and Alabama (15%) having the highest enrollment. Georgia (9%), Kentucky (10%), Tennessee (8%), Louisiana (7%), and South Carolina (6%) had moderate enrollments, and the remaining 5 states collectively accounted for 16% of total enrollment. As of February 2005, more than 756,314 ha, or 57% of CRP in the Southeast was enrolled in 1 of 4 tree cover practices, including CP3 pine plantings (12% of total enrollment), CP3a longleaf (6% of total enrollment), CP3a hardwood plantings (10% of total enrollment), and CP11 existing trees (30% of total enrollment) (USDA 2005). Most of the 75,014 ha enrolled in CP3a longleaf pine was established as part of the national longleaf Conservation Priority Area (USDA 2005). In addition to the 129,737 ha planted to hardwoods under CP3a, 2,850 ha of floodplain hardwoods were established under the bottomland hardwood initiative, CP31. Approximately 19% (252,201 ha) of the total acreage was enrolled as CP10 existing grass, 4% (57,517 ha) in CP1 cool-season grass, 3% (38,088 ha) in CP2 native warm-season grasses, and 12% (153,546 ha) was enrolled in various buffer practices, principally CP21 filter strips and CP22 riparian forest buffer. Given the preponderance of enrollment in CP3, CP11, CP1, and CP10 (much of which was reenrolled CP1) more than 68% of total enrollment in the Southeast was in practices that have limited or short-duration wildlife benefits.

Within the Southeast, the distribution of enrollment among various cover practices differed substantially among states. Kentucky (79% of state enrollment) and Tennessee (81% of state enrollment) enrolled principally grass practices (CP1, CP2, CP4, CP10), whereas Alabama (66% of state enrollment), Mississippi (68% of state enrollment), Louisiana (72% of state enrollment), South Carolina (72% of state enrollment), Florida (93% of state enrollment), and Georgia (94% of state enrollment) enrolled primarily tree practices (CP3, CP3a, CP11). Only Kentucky (15,433 ha) and Tennessee (16,726 ha) enrolled substantive amounts of CP2, native warm-season grasses. However, Kentucky and Tennessee continued to enroll substantial acreage of CP1, cool-season exotic grass (35,837 ha and 12,786 ha, respectively). Existing grass (CP10) totaled 252,201 ha, with most occurring in Alabama (46,968 ha), Kentucky (56,642 ha), Mississippi (52,822 ha), and Tennessee (56,076 ha). Additional incentives associated with national priorities areas and continuous signup were seemingly effective in some states in increasing enrollment in practices with higher perceived environmental benefits. Enrollment in the CP3a longleaf practice was substantive in Georgia (48,682 ha) and Alabama (17,888 ha), but only moderate in Florida (4,640 ha) and North Carolina (3,020 ha). Enrollment in various continuous signup buffer practices was high in Mississippi (56,607 ha), Kentucky (20,453 ha), Arkansas (18,018 ha), North Carolina (14,106 ha), and South Carolina (13,719 ha).

Wildlife Benefits

Burger (2000) reported that the evaluation of wildlife responses to the CRP in the SE has been neither as extensive nor as thorough as in the Midwest (Best et al. 1997, 1998; Ryan et al. 1998; Ryan 2000), that few studies had directly monitored wildlife populations on CRP fields, and even fewer have documented population performance. However, numerous studies throughout the region had characterized wildlife populations on non-CRP lands established with management practices similar to those implemented under the CRP (e.g., pine plantations, hardwood afforestation). From these accounts, Burger (2000) inferred likely wildlife benefits of the principal CRP practices in the Southeast. This update summarizes general conclusions from Burger (2000) and expands upon recent research findings, where available.

Wildlife and Tree Planting Practices

Pine Plantations

Avian community composition in regenerating pine stands is influenced by stand age, site-preparation methods, competition control methods, and landscape context. Burger (2000), summarizing the extant literature, concluded that in southern pine plantations, overall avian diversity and species richness tend to increase with age (Johnson and Landers 1982, Repenning and Labisky 1985, Dickson et al. 1993, Wilson and Watts 2000), but may decline during the pole stage, finally peaking during the sawtimber stage. In general, avian abundance increases with age until canopy closure at 7–9 years (Johnson and Landers 1982, Dickson et al. 1993), then declines and remains low through the early pole stage (Darden et al. 1990, Dickson et al. 1993, Wilson and Watts 2000), then increases as the stand approaches sawtimber size (Darden et al. 1990).

Effects of Stand Age

Of the extant CP3 acres in the Southeast, 81% were enrolled between 1998 and 2001 and, as such, are currently 3–6 years old (Burger 2006). No studies were identified in the extant literature that specifically monitored birds on young pine plantations established under CRP; however, plant and bird communities on recently established pine plantations have been characterized (Johnson and Landers 1982, Dickson et al. 1993, Wilson and Watts 2000). Young pine plantings are characterized by low-growing grasses and forbs and, as such, are occupied by grassland and early successional bird species (Wilson and Watts 2000). Wilson and Watts (2000) studied bird communities on pine plantations 1–35 years of age in North Carolina. Over all age classes, they reported 68 different species of birds using pine plantations. They documented 30 bird species using pine plantations during the first 2 years after planting. Wilson and Watts (2000) observed 33 species using pine plantations 3–4 years old, 28 species in stands 5–6 years old, and 33 species in stands 9–11 years old.

Longleaf pine planting as part of a CRP contract. (J. Vanuga, USDA-NRCS)

During the establishment period, bird communities in pine plantings are dominated by grassland and early successional species, such as eastern meadowlark (*Sturnella magna*), eastern bluebird (*Sialia sialis*), Bachman's sparrow (*Aimophila aestivalis*), northern bobwhite, and mourning dove (*Zenaida macroura*) (Dickson et al. 1993). As the stand ages, herbaceous plants are replaced by shrubby species, and height and structural complexity increase. In response to these vegetational changes, grassland and early successional bird species such as eastern meadowlark and northern bobwhite decline, and shrub-successional species such as indigo bunting (*Passerina cyanea*), yellow-breasted chat (*Icteria virens*), common yellowthroat (*Geothlypis trichas*), and prairie warbler (*Dendroica discolor*) increase, peaking 3–10 years following establishment (Dickson et al. 1993).

Wilson and Watts (2000) reported that some generalist species, such as the common yellowthroat, gray catbird (*Dumetella carolinensis*), white-eyed vireo (*Vireo griseus*) and eastern towhee (*Pipilo erythrophthalmus*) occurred throughout much of the 30–35-year rotation, whereas other species tended to occur only within a given successional window. For example, killdeer (*Charadrius vociferus*) and eastern meadowlark were principally associated with stands during the first 2 years. Eastern bluebird, eastern kingbird (*Tyrannus tyrannus*), blue grosbeak (*Passerina caerulea*), indigo bunting, and field sparrow (*Spizella pusilla*) were associated with stands during the first 4 years after planting. American goldfinch (*Carduelis tristis*) was associated with stands 1–6 years old, prairie warblers were associated with stands 1–11 years old, and yellow-breasted chats occurred in stands that were 3–6 years old (Wilson and Watts 2000). As the stand matures, grassland birds disappear, shrub-successional species decline, and forest birds such as red-eyed vireos (*Vireo olivaceus*), white-eyed vireos, pine warblers (*Dendroica pinus*), Carolina wrens (*Thryothorus ludovicianus*), and hooded warblers (*Wilsonia citrina*) begin to permanently occupy the site (Dickson et al. 1993).

When pine stands reach 7–10 years after planting, the young pine trees form a dense, closed canopy and light penetration to the forest floor is reduced. During this period, herbaceous and shrub ground cover declines. Consequently, closed-canopy mid-rotation pine plantings provide relatively poor wildlife habitat and support a relatively simple faunal community between the time of canopy closure and the first thinning. The majority (91.5%) of CP11 acreage in the Southeast was enrolled between 1998 and 2000. Presuming most of these contracts were reenrolled following an initial 10-year contract, these stands are currently 15–17 years old and in the middle of this closed-canopy window unless recently thinned. Thinning opens the canopy, allows sunlight to penetrate to the forest floor, and stimulates development of herbaceous and shrub ground cover. Wilson and Watts (2000) reported that during the latter portion of the rotation, following thinning, species typical of second-growth and mature forest habitats predominated, including downy woodpecker (*Picoides pubescens*), Carolina wren, blue-gray gnatcatcher (*Polioptila caerulea*), Acadian flycatcher (*Empidonax virescens*), ovenbird

(*Seiurus aurocapilla*), Carolina chickadee (*Poecile carolinensis*), eastern wood-peewee (*Contopus virens*), great crested flycatcher (*Myiarchus crinitus*), tufted titmouse (*Baeolophus bicolor*), worm-eating warbler (*Helmitheros vermivorum*), pine warbler, summer tanager (*Piranga rubra*), and northern cardinal (*Cardinalis cardinalis*). The short-term overlap between the grassland/shrub-successional bird species and the forest species produces the high species richness prior to the pole stage (occurring during mid-rotation, characterized by closed canopy, low plant species diversity, and little herbaceous ground cover). The early successional species decline following canopy closure, leaving the early colonizing forest bird species. This pattern of colonization/extinction contributes to the reduced species richness associated with pole-aged stands. Although total avian diversity increases with age of plantations, diversity and abundance of regionally declining grassland and early successional species will decline with stand age.

Some species, such as yellow-breasted chat and indigo bunting, occur during early successional stages and again 1–2 years after first and second thinnings (Wilson and Watts 2000). Other early successional species, such as northern bobwhite, mourning doves, eastern bluebirds, and meadowlarks, may occur both in very young plantations (1–2 years) and in mature, open, pine/grasslands (Repenning and Labisky 1985). As an example, in South Carolina, Bachman's sparrows were relatively abundant in 1–3-year-old replanted clearcuts and mature (>80 years) stands but occurred in low density in young plantings (6–12 years) and middle-aged (22–50 years) stands (Dunning and Watts 1990). The ground cover and understory composition and structure of mature, fire-maintained stands provides the herbaceous and shrub communities utilized by many grassland and shrub/successional bird species. Thus, as stands reach economic or ecological maturity, they may once again provide habitat for grassland/shrub-successional species, particularly if thinned and burned.

Mid-contract Management

Starting with CRP signup 15, participants that wished to re-enroll CP3 pine tree plantings (as CP11) had the opportunity to increase their Environmental Benefits Index (EBI), and hence their probabilities of having their bids accepted, by agreeing to thin the pine planting within the first 3 years of the second contract period. Prospective program participants could further increase the EBI of their offer by agreeing to convert 15–20% of the stand to early successional habitat. Although avian diversity in pine plantations tends to decline during the mid-rotation period, thinning may enhance habitat quality for many regionally declining species. Wilson and Watts (2000) reported that thinned pine plantations had greater species richness than unthinned plantations of similar age. They reported that of the 68 species documented using pine plantations during the study, 7 species (10%) were detected exclusively in stands before thinning and 11 species (16%) were detected exclusively in thinned stands. Several species (e.g., indigo bunting and yellow-breasted chat) occurred in young stands and again 1–2 years after the first and second thin. One species, brown-headed nuthatch (*Sitta pusilla*), occurred in greater density in stands 1–2 years following thins (Wilson and Watts (2000).

In one of the few southeastern studies in which bird communities were surveyed in pine plantations enrolled in CRP, Schaefbauer (2000) documented 30 bird species using mid-rotation stands in Georgia. During 1998–1999, breeding bird communities were sampled using point counts in 6 CRP stands, 2 of which were third row-thinned, 2 of which were strip-thinned plus row-thinned, and 2 controls. Species richness, diversity, and total abundance were generally similar among thinning treatments in both years. Schaefbauer (2000) anticipated increased species richness following thinning. The lack of evidence for increased richness was attributed to a lag time in response between thinning implementation and colonization by early successional and grassland species. The most abundant species included northern cardinal, indigo bunting, eastern towhee, great crested flycatcher, gray catbird, pine warbler, tufted titmouse, and mourning dove. The number of species detected per year and treatment varied from 5 to 25. Total relative abundance (indexed by point counts) in CP11 stands under all treatments was relatively low, ranging from 0.22 to 2.0 birds/ha and did not differ among treatments. Only indigo bunting abundance differed among treatments and was higher in strip + row-thinned stands than in control during the second year of the study (Schaefbauer 2000).

Parnell et al. (2002) monitored habitat use of radiomarked bobwhite in a forest–agricultural matrix in Georgia. They observed that northern bobwhite selectively used fallow fields and thinned pine forests, including those enrolled in the CRP. They reported an avoidance of agricultural fields and closed-canopy pine plantations. Parnell et al. (2002) concluded that thinning regimes that open the canopy and encourage herbaceous ground cover would create habitats preferred by bobwhites. In the context of this study, an EBI that provides incentive to simultaneously thin CP11 stands to an open structure and convert portions to fallow herbaceous vegetation would provide preferred bobwhite habitat and increase usable space in a forest–agricultural matrix.

In pine CRP stands in Georgia, Schaefbauer (2000) documented nesting by 8 bird species in a first year and 12 species in a second year. In the first year of the study, more species were documented nesting in the row-thinned stands (8.5) than in either strip-thinned plus row-thinned (5), or control stands (4). Nesting activity increased the second year following thinning. Nests of eastern towhee, mourning dove, brown thrasher, northern cardinal, and summer tanager were located in all thinning treatments (row-thinned, strip-thinned plus row-thinned, control). Indigo bunting, pine warbler, and blue grosbeak nests were located in both row-thinned and strip-thinned plus row-thinned stands. American crow (*Corvus brachyrhychos*) and white-eyed vireo nests were found in control stands and stands strip- plus row-thinned. Field sparrow and Carolina wren nests were located only in stands strip- plus row-thinned, and gray catbird nests were found only in unthinned control stands. Blue grosbeak, field sparrows, indigo buntings, pine warblers, and summer tanagers apparently benefited from thinning in that these species did not nest in unthinned control stands. Overall apparent nest success was 6.2% in the first year and 24.2% in the second year (Schaefbauer (2000). Apparent nest success of individual species ranged from 0.0% to 66.7%. Only for northern cardinals was a sufficient number of nests located to estimate Mayfield success (32%).

Effective 2004, FSA approved cost-share for mid-contract management activities, including prescribed fire, disking, and herbicidal control of invasive species. In thinned mid-rotation pine plantations, recolonization by early successional species may be accelerated by thinning and burning, thereby enhancing the herbaceous and shrub ground cover. For example, Bachman's sparrows typically occur in both mature pine forests with scattered shrubs and extensive herbaceous ground cover and in recently regenerated pine stands (1–5 years). Previous studies had reported Bachman's sparrows were absent from pine plantations during mid-rotation. However, in northern Florida, Bachman's sparrows extensively used mid-rotation (17–28-year-old) slash pine (*Pinus elliottii*) stands that had been thinned (Tucker et al. 1998). Bachman's sparrows were more abundant in thinned plantations that had been burned than in similar-aged stands that were unburned.

An ongoing study in central Mississippi is examining breeding bird abundance in 24 thinned mid-rotation (19–23-year-old) loblolly pine plantations under 4 different management regimes (thin only, thin/burn, thin/Imazapyr herbicide, thin/Imazapyr herbicide/burn). During the first breeding season following treatment application, 34–39 breeding bird species were observed in these stands, including 14 shrub-successional species (Thompson 2002). Total breeding bird abundance, bird species diversity, and total avian conservation value (TACV; Nuttle et al. 2003) were highest in control (thin only) plots and lowest in herbicide treatments during the first year following treatment. However, as the herbaceous community recovered following herbicide and fire treatments, more high-priority early successional bird species colonized treated stands, and by the second growing season following treatments, total bird abundance and TACV were highest in stands that were thinned, herbicided, and burned. In the second growing season following treatment, species associated with the midstory (white-eyed vireo and Kentucky warbler [*Oporornis formosus*]) were most abundant in control stands, whereas early successional, shrub, and open forest birds (northern bobwhite, eastern wood-pewee, gray catbird, common yellowthroat, and indigo bunting) were most abundant in herbicide/burned stands (Thompson 2002). Two pine–grassland species (Bachman's sparrow and brown-headed nuthatch) were detected only in herbicide/burned stands. By the third and fourth growing seasons following treatments, total bird abundance, TACV, bird species richness, and diversity were highest in herbicide/burned stands and lowest in control stands (Woodall 2005). Black-and-white warbler (*Mniotilta varia*) and hooded warbler (*Wilsoni citrina*) were most abundant in control stands, whereas common yellowthroat, eastern towhee, indigo bunting, northern bobwhite, red-headed woodpecker (*Melanerpes erythrocephalus*), tufted titmouse, and eastern wood-peewee were most abundant in herbicide/burned stands (Woodall 2005). In this study, the herbicide/prescribed burn treatment combination created an open forest structure that mimicked regionally scarce pine–grasslands and resulted in colonization by regionally declining early successional and pine–grassland bird species. Although some species declined following mid-rotation management (i.e., Kentucky warbler), the net effect was a more diverse bird community characterized by regionally declining species with high conservation value. Similar conservation benefits might be accrued by broadly implementing mid-contract management practices on extant CP11 CRP stands.

To specifically address bird response to mid-contract management on CRP CP11, an ongoing study in central Mississippi is characterizing bird abundance and community structure on 24 pine stands enrolled in CRP CP11 (L. W. Burger, unpublished data). This study, in its third year, compares breeding bird communities in thinned CP11 stands treated with Imazapyr and prescribed fire to those in CP11 stands thinned, but not herbicided or burned. Half of the stands are in the upper coastal plain and half are in the lower coastal plain. During the first year post-treatment, 31 bird species were detected using control stands in the upper coastal plain, whereas 36 species were detected using treated stands. In the lower coastal plain, 29 species were detected using control stands, whereas 33 species were detected using treated stands. During the second year post-treatment, 33 bird species were detected using control stands in the upper coastal plain, whereas 38 species were detected using treated stands. In the lower coastal plain, 31 species were detected using control stands, whereas 30 species were detected using treated stands. The most abundant species in control stands included eastern towhee, northern cardinal, indigo bunting, hooded warbler, yellow-breasted chat, pine warbler, Carolina chickadee, and Carolina wren. The most abundant species in herbicided and prescribe-burned stands included indigo bunting, eastern towhee, yellow-breasted chat, northern cardinal, pine warbler, Carolina wren, and northern bobwhite. During the first 2 growing seasons following treatment, community metrics were similar between treated and control stands. However, during the second year following treatment, brown-headed nuthatch, Bachman's sparrow, eastern bluebird, and northern bobwhite were detected in treated stands, but not in untreated stands. If CP11 pine stands exhibit similar patterns to those reported in Thompson (2002) and Woodall (2005), plant and bird communities on sites treated with Imazapyr and prescribed fire will continue to diverge from those in untreated stands, and treated sites will be characterized by a pine overstory with a rich herbaceous understory occupied by early successional, shrub, and pine–grassland bird species.

Mammals and Herpetofauna in Pine Plantations

No studies were identified that specifically documented mammal or herpetofaunal populations in pine stands enrolled in CRP. However, Hood (2001) sampled both small mammals and herpetofauna in 24 mid-rotation pine plantations under 4 management regimes (thin only, thin/burn, thin/Imazapyr herbicide, thin/Imazapyr herbicide/burn) in east-central Mississippi. Small mammal and herpetofaunal abundance was largely independent of mid-rotation management practice. She documented 21 mammalian species using mid-rotation pine plantations: white-tailed deer (*Odocoileus virginianus*), armadillo (*Dasypus novemcinctus*), bobcat (*Lynx rufus*), coyote (*Canis latrans*), raccoon (*Procyon lotor*), opossum (*Didelphis virginiana*), eastern cottontail (*Sylvilagus floridanus*), swamp rabbit (*Sylvilagus aquaticus*), eastern gray squirrel (*Sciurus carolinensis*), fox squirrel (*Sciurus niger*), cotton mouse (*Peromyscus gossypinus*), eastern harvest mouse (*Reithrodontomys humulis*), golden mouse (*Peromyscus nuttalli*), house mouse (*Mus musculus*), white-footed mouse (*Peromyscus leucopus*), pine vole (*Pitymys pinetorum*), rice rat (*Oryzomys palustris*), hispid cotton rat (*Sigmodon hispidus*), eastern mole (*Scalopus aquaticus*), least shrew (*Cryptotis parva*), and shorttailed shrew (*Blarina brevicauda*). In the same stands, Hood (2001) documented 12 amphibian and 15 reptile species. Amphibians included American toad (*Bufo americanus*), eastern narrowmouth toad (*Gastrophryne carolinensis*), Fowler's toad (*Bufo woodhousii fowleri*), gray treefrog (*Hyla chrysoscelis*), green treefrog (*Hyla cinerea*), southern cricket frog (*Acris gryllus gryllus*), southern leopard frog (*Rana utricularia*), spring peeper (*Pseudacris crucifer*), upland chorus frog (*Pseudacris feriarum*), Mississippi slimy salamander (*Plethodon mississippi*), smallmouth salamander (*Ambystoma texanum*), and central newt (*Notophthalmus viridescens louisianensis*). Reptiles included corn snake (*Elaphe guttata*), eastern hognose snake (*Heterodon platirhinos*), speckled kingsnake (*Lampropeltis getula holbrooki*), midland brown snake (*Storeria dekayi wrightorum*), Mississippi ringneck snake (*Diadophis punctatus stictogenys*), rough green snake (*Opheodrys aestivus*), southern black racer (*Coluber constrictor priapus*), cottonmouth (*Agkistrodon piscivorus*), southern copperhead (*Agkistrodon contortrix contortrix*), timber rattlesnake (*Crotalus horridus*), western pygmy rattlesnake (*Sistrurus miliarius streckeri*), five-lined skink (*Eumeces fasciatus*), green anole (*Anolis carolinensis*), ground skink (*Scincella lateralis*), and northern fence lizard (*Sceloporus undulatus hyacinthinus*). Similar aged pine plantations in a similar landscape context might be expected to support many of these species.

Pine Summary

In summary, pine plantations created under the CRP will provide habitat that will be used by a variety of bird, mammal, and herpetofaunal species. As the stand structure and composition changes over the life of the contract, the specific assemblage of bird species occupying pine plantations will change. Grassland and early successional species will occupy the stand during the first 1–3 years, then will be replaced by bird species associated with shrub-successional and young forest communities. Avian diversity and abundance may decline during the mid-rotation period. Much of the mid-rotation pine plantations enrolled in the CRP can be expected to support populations of regionally abundant and stable forest bird species such as northern cardinal, Carolina wren, pine warbler, and indigo bunting. Although an understanding of bird responses to management in pine plantations is still incomplete, thinning, prescribed fire, and in some cases selective herbicide can enhance the conservation value of these stands by creating a stand structure that mimics regionally scarce pine–grassland communities. When mid-contract management practices are applied to create this open pine structure, regionally declining bird species of high conservation concern, such as Bachman's sparrow, brown-headed nuthatch, and northern bobwhite, will benefit. Pine plantations managed for an open structure will support a bird community with greater total avian conservation value than unmanaged stands. As such, thinning, prescribed burning, and selective herbicide practices should be encouraged through the use of incentives and regulations. The longleaf pine ecosystem has been identified as critically endangered and of highest conservation priority in the region. The CRP longleaf conservation priority area provides a programmatic opportunity to facilitate longleaf restoration in the Southeast to help achieve regional conservation objectives. (It should be noted that the restoration of longleaf pine, an important management objective in the Southeast that CRP can help to accomplish, is not specifically addressed in this paper.)

Hardwood Plantations

Conservation of the bottomland hardwood ecosystem in the Southeast has been identified as requiring highest priority for avian conservation (Hunter et al. 1993). Bottomland hardwoods are regionally scarce forest communities in the Southeast and support a particularly diverse avian community (>70 species), including numerous Neotropical migrants of international conservation concern. As such, restoration of hardwood bottomland has been established as a conservation priority by numerous public, private, and interagency groups (Myers 1994). The CRP provides an important programmatic vehicle for restoring bottomland hardwoods. Collectively, more than 253,041 ha of hardwoods, most in bottomlands, have been established under CP3a, CP22, and CP31. Additionally, some unknown portion of CP11 contracts are hardwoods initially established under CP3a. Although no studies have directly assessed avian response to bottomland afforestation under the CRP, numerous recent studies have evaluated avian use, abundance, and productivity on hardwood afforestation sites and provide a very good approximation to expected benefits of CRP plantings.

Effects of Stand Age

Agricultural lands afforested with hardwoods undergo successional processes similar to pine stands; however, the rate of succesional changes and attainment of canopy closure is slower in hardwoods. During the first 4 years after establishment, hardwood plantings support high densities of grassland birds, such as red-winged blackbird (*Agelaius phoeniceus*) and dickcissel (*Spiza americana*), and may also be occupied by northern bobwhite, eastern meadowlark, and northern mockingbird (*Mimus polyglottos*) (Nuttle and Burger 1996). Peak abundance of shrub-successional species, such as yellow-breasted chat, indigo bunting, and common yellowthroat, occurs 7–15 years after planting. However, with the exception of indigo bunting, none of the previously identified species persist in older plantations (>20 years of age) (Nuttle and Burger 1996). Thus, hardwood plantings established for bottomland hardwood conservation will provide temporary habitat for some regionally declining grassland and shrub-successional species, particularly during winter (Hamel et al. 2002). In a study of wintering bird communities, Hamel et al. (in press) detected 36 bird species on recently afforested sites (still in grassland/herbaceous stage) in the Mississippi Alluvial Valley (MAV). They reported a mean density of 13.0 birds/ha as measured by Project Prairie Bird survey methods or 3.0 birds/ha as estimated by Winter Bird

Population Study surveys. The most commonly detected species included northern harrier (*Circus cyaneus*; 9.5/100 ha), red-tailed hawk (*Buteo jamaicensis*; 6.0/100 ha), loggerhead shrike (*Lanius ludovicianus*; 3.1/100 ha), Carolina wren (0.6/100 ha), sedge wren (*Cistothorus platensis*; 5.3/100 ha), northern mockingbird (1.0/100 ha), eastern towhee (1.2/100 ha), field sparrow (0.8/100 ha), Savannah sparrow (*Passerculus sandwichensis*; 56.6/100 ha), fox sparrow (*Passerella iliaca*; 1.0/100 ha), song sparrow (*Melospiza melodia*; 25.6/100 ha), swamp sparrow (*Melospiza georgiana*; 96.8/100 ha), red-winged blackbird (57.6/100 ha), and eastern meadowlark (21.0/100 ha). The duration of grassland habitat in hardwood afforestation sites will vary from 4 to 15 years depending on the specific requirements of the species and the establishment practices.

The long-term objective of hardwood bottomland afforestation is to produce a forest that is similar in structure and function to mature hardwood bottomlands. Nuttle (1997) characterized breeding bird communities in afforested sites in the MAV. When compared to bird communities in mature hardwood bottomland hardwood forests, Morisita's index of similarity was 2.6–4.6% for plantations 0–4 years of age, 35–42% for plantations 7–15 years of age, and 74–85% for plantations 21–27 years of age (Nuttle 1997). Thus, within 20 years after planting, hardwood plantations are supporting many bird species characteristic of natural sawtimber stands. However, much of this similarity is attributable to high abundance of many habitat generalists, including Carolina wren and northern cardinal. Older plantations still lacked certain species that are considered area-sensitive (require large tracts of forested habitat) or require late-successional forest (Nuttle and Burger 1996).

The benefits of afforestation to forest birds are positively associated with the speed at which afforestation and succession occur. As such, rapid afforestation has been assumed to be beneficial to wildlife (Hamel et al. 2002). This assumption is based on the premise that many bird species of highest conservation concern in the MAV are late-successional species (Ribbeck and Hunter 1994). Toward this end, Twedt and Portwood (1997) suggested that the addition of fast-growing, early successional species, such as cottonwood (*Populus deltoides*), willow (*Salix sp.*), sycamore (*Platanus occidentalis*), and green ash (*Fraxinus pennsylvanica*) to oak (*Quercus sp.*) plantings, would accelerate the development of a 3-dimensional forest structure and facilitate earlier colonization by forest bird species. They reported that 5–7 years after planting cottonwood plantations supported 36 species of birds, including forest birds such as yellow-billed cuckoo (*Coccyzus americanus*), Acadian flycatcher, yellow-breasted chat, warbling vireo (*Vireo gilvus*), indigo bunting, orchard oriole (*Icterus spurius*), and Baltimore oriole (*Icterus galbula*). Conversely, 6-year-old oak plantings only supported 9 species, which were mostly grassland species such as dickcissel, red-winged blackbird, and eastern meadowlark. Cottonwood stands 5–9 years old support greater species richness (16.7) and territory density (411.9/100 ha) than similar-aged oak plantings (species richness 8.1, territory density 257.3/100 ha)(Twedt et al. 2002).

The intent of rapid afforestation is to accelerate the development of vertical wooded structure to more quickly attain a plant and bird community that resembles mature bottomland hardwood forests. The rate of vegetation development in bottomland afforestation sites varies among establishment methods. Hamel et al. (2002) characterized vegetation structure on afforestation sites in the MAV. These sites were afforested using 1 of 4 techniques: natural regeneration, sown Nuttall oak (*Quercus texana*) acorns, planted Nuttall oak seedlings, and planted cottonwood stem cuttings. Five years after establishment, cottonwood trees on the site established with cottonwood cuttings were >10 m in height. Nuttall oak saplings were 3–4 m in height on the site planted to Nuttall oak seedlings, and 1–3 m in height on the site sown with Nuttall acorns. On the naturally regenerated site few woody stems exceeded 1–3 m. Vegetation structure in afforested sites is a function of the intensity of management at establishment, age of the propagules at planting, and growth rates of the species planted (Hamel et al. 2002). Not surprisingly, vegetation structure develops more rapidly when more intense effort is applied to establishing vegetation (Hamel et al. 2002).

During rapid afforestation, the early successional window is shorter than under natural succession. Wintering birds, in particular, use the early successional herbaceous communities in recently afforested hardwood sites. Hamel et al. (2002) characterized wintering bird communities on sites afforested using different establishment methods. The mean number of bird species detected was greatest in sites afforested with cottonwood cuttings (30), followed by sites planted to oak seedlings (13). A similar mean number of species (11) were detected in sites naturally regenerated or sown with acorns (Hamel et al. 2002). A total of 47 species were detected in cottonwood cutting stands, 19 in oak seedling stands, 14 in oak acorn stands, and 17 in naturally regenerated stands. As woody vegetation develops, some high conservation–priority bird species associated with herbaceous ground cover disappear. Although bird species richness increased with vegetation structure (rapid afforestation), the average conservation priority score does not because of loss of several high-priority species. Hamel et al. (2002) concluded that "… rapid afforestation provides winter habitat for a number of species quickly, at the expense of a few high-priority species found in early successional habitats." Given that the rate of structural development is a function of afforestation efforts and will subsequently determine bird community structure, management goals should seek to provide bird habitat through the whole successional continuum. This may require using a variety of afforestation methods to achieve various management objectives and intentionally maintaining some early successional communities through planed disturbance.

The conservation value of a given hardwood planting has been indexed by weighting measures of avian abundance with a measure of species-specific regional conservation value (Partners in Flight conservation scores)(Nuttle 1997). Indexed in this manner, during the breeding season hardwood plantings 0–4 years of age provide 34% the conservation value of mature natural hardwood bottomlands. Plantings 7–15 years of age have 46% the conservation value of mature natural bottomlands, and plantings 21–27 years provide 65% the conservation value of mature natural bottomlands. Highest-priority species are most abundant in natural forest stands; thus mature natural stands have the greatest conservation value. During the breeding season, newly established hardwood plantings are relatively species-poor, and the species present in this age class are relatively common species such as red-winged blackbird and eastern meadowlark. Restoration plots 11–12 years old are populated by a few high-priority shrubland birds such as yellow-breasted chat and painted bunting (*Passerina ciris*), and high-priority grassland bird species such as dickcissel, and consequently will have intermediate conservation value. As restoration stands reach 22 to 27 years old, they will be populated by high-priority forest species, such as prothonotary warbler (*Prothonotaria citria*) and yellow-billed cuckoo, contributing to their increased conservation value (Nuttle 1997.) Similarly, Twedt et al. (2002) indexed conservation value of oak plantings 5–9 years old and cottonwood plantings 0–4 and 5– 9 years old by weighting territory density (territories/100 ha) by Partners in Flight prioritization scores. They reported that the conservation value of 5–9-year-old cottonwood stands were generally twice as large as those of oak stands less than 10 years old. Younger cottonwood stands had conservation values intermediate between oak-dominated and older cottonwood stands.

Avian productivity in hardwood plantings has received less research focus than avian abundance and species composition. Twedt et al. (2001) reported that in the Lower Mississippi Alluvial Valley, nest success of blue-gray gnatcatcher (18%), eastern towhee (28%), indigo bunting (18%), northern cardinal (22%), and yellow-bellied cuckoo (18%) did not differ between mature bottomland hardwood forests and cottonwood plantations. However, nest success of open cup nests of 19 bird species in natural bottomland hardwoods (27%) was greater than that of 18 species in cottonwood plantations (15%). Differences in nest success were attributed to differences in predator community and species composition of bird communities. Rates of parasitism by brown-headed cowbirds (*Molothrus ater*) were greater in cottonwood plantations than in bottomland hardwood forests (Twedt et al. 2001).

Hardwood Summary

In summary, hardwood bottomlands are a regionally scarce resource of high priority for conservation of avian diversity. The CRP provides a programmatic vehicle for creating long-term conservation benefits on bottomland hardwood sites. The availability of continuous enrollment and automatic acceptance of eligible offers under the bottomland hardwood initiative (CP31) increases the opportunities for hardwood restoration. However, participation in this practice to date has been relatively small. During the first 5 years after establishment, and particularly during winter, hardwood plantings provide ephemeral habitats for regionally declining early successional grassland and shrub-successional species, thus contributing to regional avian conservation. Over time, hardwood plantings established under CRP will likely provide substantial benefits for conservation of high-priority forest bird species. Colonization of hardwood plantings by forest birds may be accelerated by interplanting with fast-growing early successional species such as cottonwood. However, management goals that include a variety of establishment methods and management regimes will provide long-term conservation for a broader avian community.

Wildlife and Grassland Plantings

In the Great Plains (Johnson 2000, Reynolds 2000) and Midwest (Ryan et al. 1998, Ryan 2000), grasslands created through the CRP have undoubtedly provided habitat for many grassland bird species and in some case altered population trajectories. However, in the Southeast, avian communities on CRP grasslands have received less research attention and consequently the conservation benefits are less clear. This is, in part, because the Southeast has relatively few breeding grassland bird species and also because grassland practices are a relatively small component of total CRP enrollment. However, grasslands created under CRP may provide regionally scarce resources for grassland and early successional bird species during both the breeding and winter seasons. Bird use of these grasslands will likely be influenced by the type of cover established, the age of the stand, and the management regime implemented over the life of the contract (Burger et al. 1990).

Effects of Grassland Cover Type

Throughout the Southeast, much of the CP1 and CP10 acreage was established in exotic forage grasses such as Kentucky tall fescue (*Lolium* *arundinaceum*), Bermuda grass (*Cynodon dactylon*), or bahia grass (*Paspalum notatum*). CRP fields planted to tall fescue have dense vegetation with little bare ground and low plant species diversity (Barnes et al. 1995; Greenfield et al. 2001, 2002, 2003). Fescue stands typically provide few food resources for granivorous birds (Barnes et al. 1995; Greenfield et al. 2001, 2003). Although tall fescue may support abundant and diverse insect communities, these food resources may be unavailable to ground-foraging birds because of the dense vegetation structure. It is generally acknowledged that exotic forage grasses, including tall fescue, provide poor habitat for bobwhites and other ground foraging granivores because it lacks the proper vegetation structure, floristic composition, and sufficient quality food resources. CRP fields revegetated through natural succession or with planted native species may provide better wildlife habitat than those established in exotic forage grasses (Washburn et al. 2000).

Native warm-season grasses are generally presumed to have greater wildlife benefits than exotic forage grasses (Washburn et al. 2000). Despite consistent promotion of native warm-season grasses (NWSG) by southeastern state fish and wildlife agencies, enrollment in CP2–native warm-season grasses amounted to only 3% of the total CRP enrollment in the Southeast. Only Kentucky and Tennessee enrolled substantial amounts of native grass cover, yet even within these states, CP2 enrollment accounted for only 11% and 15% of the respective total state enrollment.

In Tennessee, Dykes (2005) documented breeding bird use of 45 NWSG plantings established under the CRP. Bird communities on CRP CP2 fields were compared to those in remnant native grasslands at Fort Campbell Military Reservation. Dykes (2005) documented 85 species of birds using restored NWSG CRP fields. Although vegetation communities in planted NWSG fields and remnant native grasslands were both predominantly native grasses and forbs, planted fields had taller vegetation. Field size was the best predictor of bird species richness, with larger fields supporting a richer bird community. Most grassland bird species were positively associated with field size. Additionally, many species exhibited a negative relationship with vegetation height and NWSG cover, and a positive relationship with bare ground. Planted NWSG fields were occupied by regionally declining, high conservation–priority species such as Henslow sparrow (*Ammodramus henslowii*), eastern meadowlark, dickcissel, and northern bobwhite.

Program participants interested in re-enrollment of grass CRP contracts could increase their Environmental Benefits Index (EBI) by enhancing the wildlife habitat value of the existing cover. Washburn et al. (2000)

evaluated efficacy of various combinations of glyphosate and imazapic herbicides in eradicating tall fescue and establishing native warm-season grasses. They assumed that reductions in fescue coverage, establishment of native warm-season grasses, increases in plant species richness, and increases in bare ground were beneficial to bobwhites. They reported that 1 year post-treatment, all herbicide treatments reduced fescue coverage and enhanced bobwhite habitat quality relative to control plots. Furthermore, the spring burn, followed by imazapic application and seeding of native warm-season grasses treatment was most efficacious in eliminating fescue and establishing native warm-season grasses.

From 1997 to 2001, Smith (2001) and Szukaitus (2001) used radiotelemetry to monitor bobwhite habitat use, survival and reproduction on a 2,370-ha public wildlife management area in east-central Mississippi. This property included 781 ha of fields enrolled in CRP CP1 from 1987 to 1997. CRP fields were initially planted to fescue and at the start of the study comprised solid stands of fescue or a broomsedge (*Andropogon sp.*) overstory with a dense fescue understory. Annual mowing from 1987 to 1996 had produced low plant diversity and dense litter layers in all CRP fields (Greenfield et al. 2001). In 1997, annual mowing was ceased, a 3-year rotation prescribed fire regime was introduced, and a systematic program of herbicidal fescue eradication was implemented. From 1997 to 2001, an average of 259 ha were burned annually. Additionally, between 1997 and 2002, 314 ha were herbicidally treated to eradicate fescue. Fields were recolonized by native *Andropogon sp.*, legumes, and broad-leaved forbs. During 1997–2001, second-order habitat selection (habitat selection in establishment of seasonal ranges) varied somewhat among years; however, bobwhite consistently demonstrated selection of managed grasslands over other available habitats (woods, row crop, old fields, odd). Mean breeding season survival of bobwhite during 1997–2001 was 35% (range 20–48%; Smith 2001, Szukaitus 2001). From 1997 to 2001, mean apparent nest success of incubated nests was 52%. Twenty-four percent of nests were in managed grasslands (previously CRP fields) that had been burned the previous spring, 60% of nests were in managed grasslands burned ≥1 year prior, and 19% of nests were in other habitats (Smith 2001, Szukaitus 2001). From 1996 to 1998, breeding season relative abundance doubled and fall density increased by a factor of 4. Populations remained approximately stable from 1998 to 2000, then declined from 2000 to 2002 in response to prolonged drought, poor ground cover conditions, and associated high nest and adult predation (L. W. Burger, unpublished data).

Effects of Stand Age

Plant communities on CRP grasslands are not static, but rather change in species composition and structure over the 10-year lifespan of the contract. McCoy et al. (2001) studied vegetation changes on 154 CRP grasslands in northern Missouri and reported that during the first 2 years following establishment, fields are characterized by annual weed communities with abundant bare ground and little litter accumulation. Within 3–4 years, CRP fields became dominated by perennial grasses with substantial litter accumulation and little bare ground. They suggested that vegetation conditions 3–4 years after establishment might limit the value of enrolled lands for many wildlife species and some form of disturbance, such as prescribed fire or disking, might be required to maintain the wildlife habitat value of CRP grasslands.

Effects of Management Regime

Mowing or clipping is the most common management practice implemented on CRP grasslands. McCoy et al. (2001) reported that mowing had short-term effects on vegetation structure (reduced height within the year and increased litter accumulation) and resulted in accelerated grass succession and litter accumulation. As a result of longer growing seasons and greater rainfall, the rate of natural succession on CRP grasslands throughout the Southeast likely exceeds that observed in the Midwest, making planned disturbance even more important for maintaining habitat quality for early successional species. Dykes (2005) characterized vegetation structure on 45 CP2 fields in Tennessee and reported that litter cover and depth were greater on fields that had been mowed than those that had been burned. Litter cover and depth were intermediate on unmanaged fields. Conversely, forb coverage was greatest on burned fields, followed by unmanaged and mowed fields (Dykes 2005).

Madison et al. (1995) examined the effects of fall, spring, and summer disking and burning, and spring herbicide (Roundup®) treatments on bobwhite brood habitat quality in fescue-dominated, idle grass fields in Kentucky. They reported that during the first growing season following treatment, fall disking significantly enhanced brood habitat quality by increasing insect abundance, plant species richness, forb coverage, and bare ground relative to control plots. However, the benefits of disking were relatively short-lived, with diminished response during the second growing season. During the second growing season following treatment, herbicide treatments provided the best brood habitat quality. Greenfield et al. (2001, 2003), examining the effects of disking, burning, and herbicide on bobwhite brood habitat in fescue-dominated CRP fields in Mississippi, likewise reported that disking and burning improved vegetation structure for bobwhite broods during the first growing season after treatment. However, the benefits were short-lived (1 growing season). Herbicide treatment in combination with prescribed fire enhanced quality of bobwhite brood habitat for the longest duration (Greenfield et al. 2001).

Winter Bird Communities in Grasslands

Our understanding of bird responses to CRP is mostly based on studies of grassland birds conducted in the midwestern and plains states during the nesting season (summarized in Allen 1994, Ryan et al. 1998). Best et al. (1998) reported extensive use of midwestern CRP fields by birds during winter; however, numerous temperate nesting, migrant grassland bird species (e.g., sparrows) winter in the Southeast, and grasslands created under the CRP potentially provide substantial benefits for these wintering populations. Unfortunately, use of CRP by nonbreeding grassland birds has not been assessed in the Southeast.

Mammals in CRP Grasslands

Bond et al. (2002) estimated movements and habitat use of radiomarked cottontails on the same managed CRP grasslands studied by Smith (2001) and Szukaitus (2001). Although cottontails used a diversity of habitats, they exhibited consistent selection for managed CRP grasslands across multiple spatial scales, sexes, seasons, and diel periods (Bond et al. 2002). Additionally, movement rates of cottontails in managed CRP grasslands were less than those observed in hayfields or croplands (Bond et al. 2001).

Grassland Summary

Relative to the Midwest there is little information on responses of grassland-dependent birds to CRP in the Southeast. However, CP2 fields in Mid-South states are clearly used by a diversity of bird species, including high-priority, regionally declining grassland species. Larger NWSG CRP fields seemingly support greater bird diversity and fields managed with prescribed fire instead of mowing have more desirable plant species composition and structure (Dykes 2005). Several studies (Barnes et al. 1995; Madison et al. 1995; Greenfield et al. 2001, 2002, 2003; Washburn et al. 2000) have assessed the suitability of CRP grasslands or similar habitats for bobwhites. The primary conclusions of these studies were that (1) the habitat value of fields established in exotic forage grasses is low, (2) periodic disturbance is necessary to enhance or maintain quality early successional habitats, (3) disking and prescribed fire produce short-lived habitat enhancement, whereas herbicidal eradication of exotic forage grasses produces longer-lived benefits. In addition to birds, managed CRP fields can provide high-quality habitat for cottontails (Bond et al. 2001, 2002).

Wildlife and Upland Habitat Buffers

Conservation buffer practices (field borders, filter strips, and riparian corridors) constituted a relatively small (12%) component of CRP in the Southeast, but may provide substantial benefits for wildlife in intensive agricultural systems. In 2004, USDA announced the availability of a new upland buffer practice under the continuous CRP. The CP33–Habitat Buffers for Upland Wildlife practice allows creation of 30–120-feet herbaceous field borders around the entire perimeter of crop fields that meet program eligibility criteria. This practice is designed to provide habitat for northern bobwhite and other grassland bird species. Although the practice was only recently approved, a number of recent studies had evaluated wildlife response to herbaceous idle field borders.

Herbaceous field border around a crop field in Georgia. (D. Paul, USDA-NRCS)

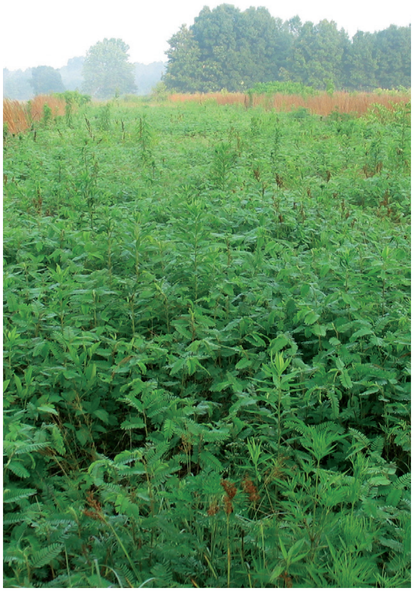
Although no study has directly evaluated wildlife population response to CP21, CP22, or CP33, several studies in North Carolina have evaluated use of fallow field borders by northern bobwhite and passerines. Results of these studies have application to field margin, non-crop vegetation created under CP21, CP22, or CP33.

Puckett et al. (1995) examined habitat use and reproductive success of radiomarked bobwhites on 4 farms in Dare County, North Carolina. On 2 of these farms, 9.4-m-wide, fallow vegetative filter strips were established along field borders and ditch banks. Spring capture rate of bobwhite and number of nests/female were greater on sites with filter strips, but nest success did not differ. Bobwhite on non-filter strip sites exhibited greater movement from capture to first nest location. Filter strips increased use of row-crop fields by bobwhite throughout the breeding season. In a related study of 24 farms in North Carolina, farms with filter strips (n = 12) supported higher bobwhite density in fall than farms without filter strips (W. Palmer, Tall Timbers Research Station, personal communication). Filter strips apparently benefited bobwhite populations by increasing usable space during the early breeding season, holding bobwhites on the landscape until cover in crop fields developed, increasing access and use of crop fields by bobwhites, and providing nesting and brood-rearing habitat.

Field borders may also produce substantial benefits for breeding and wintering passerines. During 1997 and 1998, fields on farms in the coastal plain of North Carolina with field borders (n = 4) supported greater abundance of wintering sparrows than fields on farms with mowed field margins or no borders (*n* = 4) (Marcus et al. 2000). Marcus et al. (2000) reported that, during winter, herbaceous field borders support nearly 3 times more wintering sparrows than mowed field edges. Most (93%) birds detected using field margins were sparrows, although northern cardinals, American robins (*Turdus migratorius*), and yellow-rumped warblers (*Dendroica coronata*) were also observed. In one study area, the most commonly observed sparrows (in rank order) were dark-eyed juncos, song sparrows, white-throated sparrows (*Zonotrichia albicollis*), Savannah sparrows, field sparrows, and chipping sparrows (*Spizella passerina*). Song sparrows, Savannah sparrows, and swamp sparrows were most abundant on a second study area. Field, chipping, and white-throated sparrows were observed only in field borders and not in mowed edges. Field borders may also increase use of interior portions of fields. For example, they may enhance the habitat value of agricultural fields by providing thermal and escape cover, increasing access to food resources in crop stubble, and increasing the proportion of agricultural landscapes available for use by grassland birds.

Conover et al. (2005) estimated density of grassland birds on narrow (7–10-m) and wide (20–40-m) NWSG field borders during winter and summer in an intensive agricultural landscape in the MAV. During winter, Conover et al. (2005) observed 59 bird species using managed NWSG field margins and associated cropland and wooded edges. The most abundant birds detected were mourning dove (18%), European starling (*Sturnus vulgaris*; 16%), red-winged blackbird (7%), common grackle (6%), and northern cardinal (6%). The most abundant sparrows were song sparrow (5%), white-throated sparrow (4%), and swamp sparrow (3%). Winter sparrows were more than 2 times as abundant along narrow field borders (8.1/ha) and more than 7 times more abundant along wide field borders (21.3/ha) as unbordered field margins (3.3/ha). In adjacent crop fields, sparrow densities were similar between non-bordered (1.2/ha) and narrow-bordered margins (1.8/ha). However, sparrow density in crop fields were much higher adjacent to wide-bordered margins (10.6/ha) (Conover et al. 2005).

During the breeding season, 73 species were observed using field margins and associated croplands and wooded edges. The most abundant species were red-winged blackbird (30%), northern cardinal (10%), common grackle (8%), mourning dove (5%), blue jay (5%), indigo bunting (5%), and dickcissel (5%) (Conover et al. 2005). Indigo buntings and northern cardinals were 3 times more abundant in bordered margins. Despite being forest birds, these 2 species exploited field borders for cover, nesting, and foraging. Dickcissel was completely absent from field margins without field borders. Over 3 breeding seasons, 434 total nests of 8 bird species were located in field borders. Red-winged blackbird (78%) and dickcissel (19%) represented the majority of nesting occurrences. Other birds that nested in field borders included northern cardinal, blue grosbeak, yellow-billed cuckoo, indigo bunting, mallard (*Anas platyrhynchos*), northern mockingbird, and northern bobwhite. Birds nested in both narrow and wide field borders, but had disproportionately higher nest densities in wide-bordered margins. The exceedingly low nest density of narrow-bordered field margins implies that increased border width substantially enhanced the attractiveness of field borders as nesting habitat. Overall, apparent nest success in all field borders was low at 22.4% (all years combined). Birds nesting in narrow borders experienced greater nesting success (29.2%) than wide borders (21.6%)(Conover et al. 2005).



Stripdisking in established grass CRP reduces litter, stimulates germination of annual forbs and legumes, and enhances wildlife habitat value. (Wes Burger)

Smith (2004) evaluated grassland songbird and northern bobwhite response to fallow herbaceous field borders in the Black Prairie Physiographic Region of east-central Mississippi. In his study, bordered and non-bordered field margins adjacent to large blocks of grass, grass strips, large blocks of woods, and wood strip habitats were sampled. During the breeding season, 53 species were observed using field borders and associated crop and edge habitats. The 6 most abundant species were mourning dove (8%), northern cardinal (7%), indigo bunting (15%), dickcissel (13%), red-winged blackbird (20%), and common grackle (6%). Dickcissel and indigo bunting were nearly twice as abundant where field borders were established, regardless of adjacent plant community type or width. Although indigo buntings are primarily a forest bird, the field borders provided an herbaceous plant community along existing wooded areas, edges making these areas more favorable for foraging, loafing, and nesting sites. Species richness was greater along bordered than non-bordered edges; however, diversity did not differ. Overall bird abundance was greater along bordered linear habitats than along unbordered similar edges. However, addition of field borders along larger patches of grasslands or woodlands did not alter the number of birds using these edges (Smith 2004).

During winter, 71 bird species were observed in field borders and associated croplands and field margins (Smith et al. in press). The 5 most abundant species were red-winged blackbird (45%), American pipit (*Anthus rubescens*; 11%), song sparrow (7%), Savannah sparrow (6%), and American robin (5%). Across most adjacent plant communities, song, field, and swamp sparrows occurred in higher density on bordered field margins than on unbordered. Song sparrow and swamp sparrow densities were greater where field borders were established along existing grasslands. Song sparrow densities were also greater along field borders adjacent to wooded strip habitats than comparable wooded strips without a field border. All other sparrows (pooled) were 4 times more abundant along bordered edges than along non-bordered (Smith et al. in press).

Upland Habitat Buffer Summary

In intensive agricultural ecosystems of the Southeast, field margins provide some of the only available idle herbaceous plant communities. Herbaceous conservation buffers, such as CP33, can provide important breeding and wintering habitats for grassland and early successional birds. Field borders may provide nesting, foraging, roosting, loafing, and escape cover. During winter, field borders may provide important habitat in southern agricultural systems where most short distance migrants overwinter. The availability of field borders may increase local abundance and species richness. Bird density, species richness, and nest survival may be influenced by border width. Wider borders are more likely to make substantive contributions to avian conservation in agricultural systems.

Conclusions

Although systematic evaluations of wildlife benefits of the CRP in the Southeast are lacking, probable patterns of wildlife occupancy and use may be inferred from studies of similar management practices on non-CRP lands. In contrast to the Midwest where grass establishment practices dominated CRP enrollment, in the Southeast 57% of CRP acres were enrolled in tree planting practices, primarily loblolly pine. During the first 1–3 years following establishment, pine plantations are characterized by low-growing grasses and forbs and provide habitat for grassland and early successional bird species. As the stand matures, herbaceous plants are replaced by shrubs and the developing pines. Avian diversity typically increases with stand age as bird species associated with shrubs colonize the stand. During the pole stage (mid-rotation 15–20 years), when canopy closure eliminates herbaceous ground cover, avian richness generally declines. In mid-rotation stands (15–20 years), thinning, prescribed fire, and selective herbicide may increase herbaceous ground cover, thereby enhancing habitat quality for regionally declining grassland, shrub, and pine–grassland birds. Bottomland hardwood plantings established under the CRP should be expected to support high densities of grassland birds during the first 5 years after establishment. Peak abundance of shrub-successional species will occur 7–15 years after planting. Stands over 20 years of age should support 75–85% of the avian community characteristic of mature bottomland hardwoods. Interplanting of rapidly growing tree species, such as cottonwood, sycamore, or green ash, would dramatically accelerate colonization by forest bird species. Grassland CRP in the Southeast is predominantly enrolled in CP1 or CP10 practices and is primarily established in exotic forage grasses. The wildlife conservation value of these fields has not been evaluated. However, CRP fields planted to native warm-season grasses in the Mid-South support diverse communities that include grassland species of regional conservation priority. Upland conservation buffers provide an important programmatic tool for adding idle herbaceous habitats to intensive agricultural landscapes. Recent studies have demonstrated that upland habitat buffers can support diverse and abundant bird communities on working landscapes during both winter and summer. In the Southeast, plant communities change rapidly through natural succession. Proactive management of extant CRP acreage and selective enrollment of high value cover practices will be required to achieve the types of wildlife habitat benefits associated with the CRP in other regions.

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