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DENSITY AND FLEDGING SUCCESS OF GRASSLAND BIRDS IN CONSERVATION RESERVE PROGRAM FIELDS IN NORTH DAKOTA AND WEST-CENTRAL MINNESOTA

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Abstract. The Conservation Reserve Program, initiated in 1985, was designed primarily to reduce soil erosion and crop surpluses. A secondary benefit was the provision of habitat for wildlife. Grassland bird populations, many of which declined in the decades prior to the Conservation Reserve Program, may have benefited from the Conservation Reserve Program if reproduction in this newly available habitat has been at least as high as it would have been in the absence of the Conservation Reserve Program. On study areas in North Dakota and Minnesota, I examined breeding densities and fledging success of grassland birds in Conservation Reserve Program fields and in an alternative habitat of similar structure, idle grassland fields on federal Waterfowl Production Areas. Fields were 10 to 25 hectares in size. The avifaunas of these two habitats were similar, although brush-dependent species were more abundant on Waterfowl Production Areas. The common species in these habitats included ones whose continental populations have declined, such as Grasshopper Sparrow (*Ammodramus savannarum*), Savannah Sparrow (*Passerculus sandwichensis*), and Bobolink (*Dolichonyx oryzivorus*). These ground-nesting species were pooled with other ground nesters in an analysis of fledging success, which revealed no significant differences between habitats, between states, or among years (1991–1993). Predation was the primary cause of nest failure. I concluded that Conservation Reserve Program fields in this region were suitable breeding habitat for several species whose populations had declined prior to the Conservation Reserve Program era. This habitat appeared to be as secure for nests of ground-nesting birds as another suitable habitat in North Dakota and Minnesota.

LA DENSIDAD Y EL ÉXITO DE LOS POLLUELOS VOLANTONES DE AVES DE PASTIZAL EN CAMPOS DEL PROGRAMA DE RESERVAS DE CONSERVACIÓN EN DAKOTA DEL NORTE Y EN EL OESTE CENTRAL DE MINNESOTA

Sinopsis. El Programa de Reservas de Conservación, iniciado en 1985, fue diseñado principalmente para reducir la erosión de la tierra y los excedentes de cosechas. La disposición de hábitat para la fauna silvestre constituyó un beneficio secundario. Las poblaciones de aves de pastizal, muchas de las cuales disminuyeron durante las décadas anteriores al Programa de Reservas de Conservación, pueden haberse beneficiado con el Programa de Reservas de Conservación si su reproducción en este nuevo hábitat disponible ha sido por lo menos tan alta como habría sido sin el Programa de Reservas de Conservación. En áreas de estudio en Dakota del Norte y en Minnesota examiné las densidades reproductivas y el éxito de los polluelos volantones de aves de pastizal en campos del Programa de Reservas de Conservación y en otro hábitat de estructura similar: los campos de pastizal fuera de producción en Áreas de Producción para Aves Acuáticas del gobierno federal. El tamaño de los campos varió entre 10 y 25 hectáreas. Las avifaunas de estos dos hábitats fueron similares, aunque las especies que dependían de broza fueron más abundantes en las Áreas de Producción para Aves Acuáticas. Las especies comunes en estos hábitats incluyeron algunas poblaciones continentales que han disminuido, como el Gorrión Chapulín (*Ammodramus savannarum*), el Gorrión Sabanero (*Passerculus sandwichensis*) y el Tordo Arrocero (*Dolichonyx oryzivorus*). Estas especies que anidan en suelo fueron reunidas con otras especies que anidan en suelo en un análisis del éxito de los polluelos volantones, que no reveló ninguna diferencia significativa entre hábitats, entre estados o entre años (1991–1993). La depredación fue la causa principal del fracaso de los nidos. Concluí que los campos del Programa de Reservas de Conservación en esta región fueron el hábitat adecuado de reproducción para varias especies cuyas poblaciones habían disminuido antes del Programa de Reservas de Conservación. Para los nidos de las aves que anidan en suelo este hábitat parecía ser tan seguro como otro hábitat adecuado en Dakota del Norte y en Minnesota.

Key Words: Bobolink; Conservation Reserve Program; Grasshopper Sparrow; grassland birds; habitat quality; nest success; North Dakota; Minnesota; productivity; Savanna Sparrow; Waterfowl Production Areas.

Several species of grassland birds are significantly less numerous in North America in the mid-1990s than they were in the mid-1960s, when extensive population monitoring began with the North American Breeding Bird Survey (BBS). More grassland species have undergone population declines than have other classes of birds (Askins 1993, Knopf 1994, Peterjohn et al. 1994, Herkert 1995).

Several factors may have contributed to these widespread declines. One important factor has been loss of habitat (Askins 1993, Herkert

1995). Although most of the original prairie was lost long before the BBS started, habitat loss has continued in recent decades (Herkert 1991, Samson and Knopf 1994). Grassland birds now breed in many kinds of grassland habitat that are structurally similar to various types of prairie vegetation. Recent population declines in the northeastern United States may be due largely to loss of old-field habitats that have undergone succession to woody vegetation unsuitable for grassland birds (Askins 1993). Habitat loss in the Midwest has been due to loss of pasture and hayland, along with a general loss of strip cover as farming has become more intensive (Herkert 1991, Askins 1993, Herkert et al. 1996). Alfalfa (*Medicago sativa*) has generally replaced more diverse vegetation as the primary source of hay (Bollinger et al. 1990, Warner 1994, Herkert et al. 1996). Older hayfields, which provide more diverse habitat, are usually not promoted by current practices (Bollinger 1995). Few species nest in row crops and small-grain fields, although many species nest in alfalfa fields, pastures, and idle grassland (Best et al. 1995). Finally, many of the small fields common in current agricultural landscapes do not attract the full suite of breeding grassland birds, perhaps because some species are area sensitive (Herkert 1994, Vickery et al. 1994, Warner 1994).

Low quality of suitable nesting habitat may have contributed to population declines of grassland birds (Askins 1993). Prairie remnants and fields of non-native grassland, although suitable for nesting, may be of lower quality than large expanses of prairie. Small fields have a high ratio of edge to area, and many fields have wooded edges that may contribute to high frequencies of nest predation and brood parasitism by Brown-headed Cowbirds (*Molothrus ater*; Best 1978; Gates and Gysel 1978; Graber and Graber 1983; Johnson and Temple 1986, 1990).

If habitat loss, fragmentation, and degradation have contributed to population declines, then restoration of large amounts of grassland would be expected to slow or reverse those declines. The Conservation Reserve Program (CRP), administered by the U.S. Department of Agriculture (USDA), dramatically increased the amount of grassland in the late 1980s, particularly in the tall- and mixed-grass regions of the central United States. The addition of this habitat presents the opportunity to evaluate the benefit to birds of restoring a large amount of grassland habitat.

The potential benefit from the CRP is enormous. This program has taken millions of hectares of highly erodible cropland, almost a tenth of U.S. cropland, out of production under 10-yr contracts (Johnson and Schwartz 1993). Except in the southeastern United States, most of this land was seeded with perennial grasses and legumes, creating suitable feeding and nesting habitat for some bird species but possibly eliminating some habitat for a few species that nest in cropland and very short vegetation (Basore et al. 1986, Johnson and Igl 1995, King and Savidge 1995). Fields enrolled in the CRP cannot be grazed but can be partially hayed in weather-related emergencies. Johnson and Schwartz (1993) examined bird use of CRP fields in the northern Great Plains and found that most grassland species had higher breeding densities in CRP fields than had been reported for cropland.

Among the species that have higher breeding densities in CRP fields than in cropland are several that declined in the central United States from 1966 to 1990 according to BBS data (Johnson and Schwartz 1993, Johnson and Igl 1995). These declining species include Grasshopper Sparrow (*Ammodramus savannarum*), Baird's Sparrow (*A. bairdii*), Clay-colored Sparrow (*Spizella pallida*), Dickcissel (*Spiza americana*), Lark Bunting (*Calamospiza melanocorys*), and Bobolink (*Dolichonyx oryzivorus*). Savannah Sparrow (*Passerculus sandwichensis*), which also had higher densities in CRP fields, has experienced a continental population decline (Peterjohn et al. 1994). Other studies have confirmed the widespread use of CRP fields by grassland birds (Granfors 1992, Millenbah 1993, Klute 1994, Patterson and Best 1996). The potential of the CRP to slow or reverse declines of these species (e.g., Reynolds et al. 1994) depends on whether birds nesting in CRP fields have higher reproductive success than they would have had in the absence of the CRP. Ducks such as the Mallard (*Anas platyrhynchos*), which also declined during the 1980s, had relatively high hatching success in CRP fields compared with hatching success on Waterfowl Production Area (WPA) fields (Kantrud 1993, Reynolds et al. 1994).

To compare CRP fields with another grassland habitat frequently used by grassland birds that have declined, I studied birds in CRP fields and in idle grasslands on WPA fields. Numerous WPA fields, mostly small tracts of grassland and wetlands in the U.S. prairie pothole region, are managed by the U.S. Fish and Wildlife Service (USFWS) to provide nesting and brood-rearing habitat for waterfowl. These fields attract all of the declining species listed above (Renken and Dinsmore 1987), although these species rarely nest in cropland, the habitat that CRP fields have replaced (Johnson and Schwartz 1993, Best et al. 1995). Thus, addition of CRP fields to the landscape has provided these species, which typically nest in hayfields and pastureland (Best et al. 1995), with an additional habitat they may find suitable for nesting.

To determine how similar the avifaunas of CRP and WPA fields were, I estimated densities of breeding birds on the study areas. I also estimated fledging success. Variation in fledging success probably contributes greatly to variation in reproductive success, and techniques for monitoring nests are better developed than are techniques for estimating survival of juveniles.

METHODS

STUDY AREAS

I selected two study areas: Stutsman County in east-central North Dakota and Stevens and western Pope Counties in west-central Minnesota. These areas were chosen to represent mixed- and tallgrass regions of the northeastern Great Plains, respectively, and were studied from 1991 to 1993.

In each study area I identified idle WPAs with well-established grassland comprising at least 10 ha. Idle WPAs were not subjected to disturbance from farming activities, although normal management activities continued, such as prescribed burning (1 field, 1 yr) and mowing to control weeds (2 fields, 3 yr). Furthermore, idle WPAs did not experience variation in densities of breeding birds associated with variation in grazing intensity (Kantrud 1981, Kantrud and Kologiski 1982, Renken and Dinsmore 1987, Bowen and Kruse 1993). From the identified WPAs, I selected six in North Dakota and five in Minnesota that were dispersed throughout the study areas. All 11 WPA fields were bordered by potential perch sites (e.g., trees, fences, power lines) for Brown-headed Cowbirds, and some, especially the native-prairie fields, had woody vegetation in the field. Minnesota fields had been seeded with several native warm-season grasses. North Dakota fields were either native prairie (four fields, invaded by cool-season exotic grasses) or had been seeded with cool-season grasses in the 1970s (two fields).

With the assistance of personnel in the Farm Service Agency (formerly Agricultural Stabilization and Conservation Service) and Natural Resources Conservation Service (formerly Soil Conservation Service), both agencies of the USDA, I identified the CRP fields in the vicinity of each selected WPA. I chose the CRP field closest to a selected WPA field that met four criteria: (1) it was not adjacent to a selected WPA field, (2) it comprised 10–16 ha, (3) it was enrolled in the CRP prior to 1989, and (4) it had potential cowbird perches on at least one side. In a few cases I had to use a portion of a larger field because a field smaller than 16 ha was not available. All CRP fields were dominated by cool-season grasses.

The same WPA and CRP fields were studied in all 3 yr (1991–1993) except for one CRP field that was replaced by a nearby field in 1992 after the initial field was flooded in 1991.

ESTIMATING DENSITY

Each year, birds were counted twice on each field between 26 May and 23 July. I established parallel transect lines 100 m apart to cover the entire field. Data were collected on distance (using rangefinders) and angle relative to the transect line for each bird seen, according to truncated line-transect methodology (Burnham et al. 1980, Buckland et al. 1993). This method used counts of observed birds to derive density estimates that accounted for birds that were not observed. The primary assumption was that all birds on the transect line itself were seen. Detectability decreased with perpendicular distance from the transect line, and the method estimated the shape of this detection function. Another assumption was that each individual bird was counted only once, where it was first observed. We attempted to track the movements of birds that were observed flying from one transect to another, although this was especially difficult for male Bobolinks early in the nesting season (see below). To minimize the likelihood of double-counting birds that moved unobserved between transects, we avoided surveying adjacent transects consecutively. Transect lines were walked at a pace of 1.5–2.0 km/hr between sunrise and 1300 central daylight time (Dawson 1981). Surveys were not conducted during rain, if the temperature was below 0 C or above 32 C, or when the wind speed exceeded 30 km/hr (Dawson 1981).

Density was estimated from 1992 data with program DISTANCE (Buckland et al. 1993) using a polynomial function to model the detectability function. This program emphasizes estimation of parameters rather than tests of hypotheses. The 95% confidence intervals were tabulated for the density estimates. Densities are likely to be truly different if their confidence intervals do not overlap.

For most species, I report estimates from the first count each year because the second count may have been confounded by the inclusion of some fledglings. The exception was the Bobolink, for which I report data from the second count each year. Estimated densities of Bobolinks were notably higher in the first count. Bollinger et al. (1988) noted that Bobolink densities were easily overestimated with transect methodologies. To the extent that this overestimation was related to the frequent long-distance flights of males early in the nesting season, the estimates from the second count probably more accurately reflect the breeding densities for this species. The estimates were intended to represent species nesting in the study fields. Thus, I have not reported densities of Yellow-headed Blackbirds (*Xanthocephalus xanthocephalus*), which frequently were seen foraging in our study fields in Minnesota.

ESTIMATING FLEDGING SUCCESS

Most nests were found with the aid of a 25-m rope, weighted with sections of chain and aluminum pipe. Two people pulled the rope, and one to three observers walked behind the rope to observe birds that flushed from nests and to find the nests. Two nest searches were conducted in 1991 and three in 1992 and 1993. Some nests were found opportunistically or incidental to other field activities. We identified the nesting species from the appearance of the flushed bird, eggs, or nestlings. We placed flagged wires 4 m from each nest in a randomly selected cardinal direction and marked nest locations on field maps. Nestling ages, estimated by noting body size and development (Bent 1942:350;

TABLE 1. NUMBERS SEEN, ESTIMATED DENSITIES (BIRDS/10 HA), AND 95% CONFIDENCE INTERVALS (CI) FOR DENSITY ESTIMATES FOR BIRDS COUNTED ON CONSERVATION RESERVE PROGRAM (CRP) OR WATERFOWL PRODUCTION AREA (WPA) FIELDS IN STUTSMAN COUNTY, NORTH DAKOTA, AND STEVENS AND POPE COUNTIES, MINNESOTA

State	CRP			WPA		
Species	N	Density	CI	N	Density	CI
North Dakota						
Eastern Kingbird	0	–		18	3.4	1.9–6.3
Common Yellowthroat	6	–		0	–	
Clay-colored Sparrow	4	–		24	4.9	2.4–9.9
Savannah Sparrow	13	2.4	1.0–5.8	10	–	
Grasshopper Sparrow	45	8.0	4.1–15.6	14	2.1	1.2–4.0
Bobolink	7	–		6	–	
Red-winged Blackbird	58	10.8	5.5–20.7	3	–	
Western Meadowlark	9	–		4	–	
Brown-headed Cowbird	7	–		11	2.5	0.8–7.3
Minnesota						
Common Yellowthroat	7	–		1	–	
Clay-colored Sparrow	1	–		15	4.7	1.5–14.0
Savannah Sparrow	13	3.6	1.9–6.8	41	12.3	8.8–17.3
Grasshopper Sparrow	19	4.2	1.6–11.1	6	–	
Bobolink	13	4.5	1.8–11.3	13	3.7	1.2–11.1
Red-winged Blackbird	11	5.9	1.3–25.7	2	–	
Western Meadowlark	0	–		1	–	
Brown-headed Cowbird	10	–		1	–	

Note: Estimates are from the first survey, 27 May–15 June 1992, except for Bobolink estimates, which are from the second survey, 11 June–9 July 1992. Densities were estimated only for species in which more than 10 individuals were seen.

1968:171–172; Fairfield 1968:1643–1644; Smith 1968:732), were used to estimate fledging dates.

Nests were visited at intervals of 3–7 d. The final visit was shortly before fledging (i.e., 6–8 d old). Late nest visits (>8 d) were avoided so that field personnel did not induce nestlings to leave the nest prematurely and did not have to judge whether or not any young had fledged from an empty nest. Such judgment would have required analysis of the appearance of the nest and the parental behavior of the adults, both of which might have been subject to error.

Fledging success is the probability that a nesting attempt (i.e., at least one egg laid) will produce at least one fledgling. I estimated fledging success with the Mayfield (1975) method for the entire nesting cycle, that is, not analyzing egg and nestling stages separately. Altricial species that nest on the ground were pooled for statistical analysis, to maximize the power of statistical tests. Ground nesters probably share many of the same nest predators. To estimate fledging success, I raised the estimated daily survival rates of nests to the 25th, 27th, or 29th power (Ehrlich et al. 1988).

Field personnel assigned each nest failure to the most likely cause. If eggs or nestlings were missing or damaged in a manner consistent with predation, failure was attributed to predation. If the nest was unattended and there was no change in the number of host eggs between visits, failure was attributed to abandonment. Abandonment between the first and second nest visit was attributed to investigator disturbance unless cowbird eggs had been added, in which case abandonment was attributed to cowbird parasitism. Other abandonments were not attributed to a specific cause, although some may in fact have been due to cowbird parasitism (see Elliott 1978, Koford et al. in press).

I used a Summary procedure (SAS Institute 1987) to tabulate fledging success by species for each study area and field type. I used a General Linear Model procedure (SAS Institute 1987) to examine variation in daily survival rates of nests of altricial ground-nesting birds between field types (CRP vs. WPA), between study areas (North Dakota vs. Minnesota), and among years (1991, 1992, and 1993). The response variable was an angular transformation (Steel and Torrie 1980) of daily survival rates of nests, weighted by exposure days. Fields were the sampling units. I used a blocked design structure with pairs of fields in each study area as blocks (Milliken and Johnson 1984). A repeated-measures analysis of variance was conducted to account for the non-independence of the fields, which were sampled in all 3 yr (Milliken and Johnson 1984). Statistical significance was indicated by $P < 0.05$. Least squares means (Milliken and Johnson 1984, SAS Institute 1987) were used in the analysis because samples of nests were not available from all fields in all years. Least squares means are the expected values of class or subclass means that would be expected for a balanced design and may be substantially different from arithmetic means. Nests that had apparently been abandoned because of investigator disturbance ($N = 6$) were not analyzed.

RESULTS

DENSITY

Nine species were fairly common in the grassland study fields (Table 1). In North Dakota, Eastern Kingbirds (*Tyrannus tyrannus*) and Clay-colored Sparrows, both of which nest in shrubs, were more abundant in WPA than in

TABLE 2. ESTIMATED FLEDGING SUCCESS OF GRASSLAND BIRDS FOR WHICH AT LEAST 10 NESTS WERE MONITORED IN 1991–1993 ON CONSERVATION RESERVE PROGRAM (CRP) AND WATERFOWL PRODUCTION AREA (WPA) FIELDS IN STUTSMAN COUNTY, NORTH DAKOTA, AND STEVENS AND POPE COUNTIES, MINNESOTA

	CRP				WPA			
State Species	N	Exposure days	DSR	Fledging success (%)	N	Exposure days	DSR	Fledging success (%)
North Dakota								
Mourning Dove[a]	7	75.0	0.920	8.9[b]	3	41.0	1.0	100.0[b]
Clay-colored Sparrow	8	81.0	0.975	53.5[c]	49	422.5	0.934	18.0[c]
Vesper Sparrow[a]	6	59.0	0.949	27.1[c]	7	71.5	0.944	21.3[c]
Savannah Sparrow[a]	4	30.0	0.933	15.5	4	55.0	0.945	22.0
Grasshopper Sparrow[a]	38	347.5	0.950	28.5[c]	14	116.5	0.914	10.6[c]
Song Sparrow[a]	0	–	–	–	0	–	–	–
Bobolink[a]	8	78.5	0.975	47.3[b]	7	60.5	0.901	6.0[b]
Red-winged Blackbird	70	634.0	0.921	10.9	9	79.0	0.937	17.1
Western Meadowlark[a]	20	207.5	0.952	23.9[b]	13	79.5	0.874	2.0[b]
Minnesota								
Mourning Dove[a]	0	–	–	–	1	5.0	0.800	0.2[b]
Clay-colored Sparrow	1	11.0	0.909	9.2[c]	24	309.0	0.968	43.9[c]
Vesper Sparrow[a]	1	5.0	0.800	0.4[c]	1	2.0	0.500	0.0[c]
Savannah Sparrow[a]	12	81.0	0.864	1.9	30	259.0	0.950	24.9
Grasshopper Sparrow[a]	13	98.0	0.918	11.9[c]	1	16.0	1.0	100.0[c]
Song Sparrow[a]	8	74.0	0.946	22.3	9	66.5	0.910	7.8
Bobolink[a]	16	154.5	0.922	9.6[b]	31	269.5	0.926	10.7[b]
Red-winged Blackbird	25	153.0	0.856	1.5	1	7.0	1.0	100.0
Western Meadowlark[a]	6	88.5	0.955	26.1[b]	3	37.5	0.973	45.7[b]

Note: Number of nests (N), exposure days, daily survival rate (DSR) of nests, and fledging success (Mayfield estimate) are presented. Nesting cycles were assumed to be 27 d unless otherwise noted.
[a] Ground nests.
[b] 29-d nesting cycle assumed.
[c] 25-d nesting cycle assumed.

CRP fields. All of the Clay-colored Sparrows observed in WPA fields were in native-prairie fields that had western snowberry (*Symphoricarpos occidentalis*) shrubs. Grasshopper Sparrows and Red-winged Blackbirds (*Agelaius phoeniceus*), by contrast, were more abundant in CRP than in WPA fields. On about half of these CRP fields, Red-winged Blackbirds were by far the most abundant breeding birds; on the other fields their numbers ranged from zero to three birds per field. These differences are largely due to the variation among fields in the presence of vegetation such as sweetclover (*Melilotus* spp.), which supports nests and serves as song perches. Sweetclover, a biennial, would be expected to decline in abundance over time in many CRP fields.

In Minnesota, Clay-colored and Savannah sparrows were more abundant in WPA than in CRP fields. Almost all of the Clay-colored Sparrows seen in WPA fields were in one field; many nested in sweetclover. It is possible that Savannah Sparrows preferred the denser cover associated with WPA fields, which were dominated by warm-season grasses. Most CRP fields were dominated by cool-season grasses such as smooth brome (*Bromus inermis*).

FLEDGING SUCCESS

Estimates of fledging success were obtained for 657 nests, including 166 nests of precocial species (mostly dabbling ducks) which were not the focus of this paper. Among the altricial species for which at least 10 nests were monitored, estimated fledging success was variable (Table 2). A total of 263 ground nests, mostly of Savannah Sparrows, Grasshopper Sparrows, and Bobolinks (see Table 2), were pooled and analyzed statistically for differences in daily survival rate. There were no significant differences in fledging success between field types ($P = 0.65$), between states ($P = 0.67$), or among years ($P = 0.06$). None of the interaction terms was significant. I therefore failed to reject the primary null hypothesis of interest, that fledging success of ground nesters was the same in the two types of fields.

The great variability in daily survival rate of ground nests (Table 2) affected the reliability of the estimated daily survival rates of ground nests in the two field types (Table 3). The standard errors associated with the mean daily survival rates were quite large.

Predation was the overwhelming cause of nest

TABLE 3. LEAST SQUARES MEAN DAILY SURVIVAL RATES (DSR) ± 1 SE FOR NESTS OF GROUND-NESTING SPECIES IN CONSERVATION RESERVE PROGRAM (CRP) AND WATERFOWL PRODUCTION AREA (WPA) FIELDS IN STUTSMAN COUNTY, NORTH DAKOTA, AND STEVENS AND POPE COUNTIES, MINNESOTA

Field type	DSR	DSR − 1 SE	DSR + 1 SE	Fledging success (%) for 27-d cycle
CRP	0.9458	0.9338	0.9566	22
WPA	0.9527	0.9417	0.9627	27

failure. For the nine species in Table 2, predation accounted for 80–96% of the nest losses. For most destroyed nests we have no information on the identity of nest predators. On two occasions we saw garter snakes (*Thamnophis* sp.) eating nestlings.

DISCUSSION

DENSITY

The CRP fields attracted the same species as did the WPA fields, with the exception of the Eastern Kingbird, which I did not observe in CRP fields. This species, however, was observed in CRP fields by Johnson and Schwartz (1993). Two species, Eastern Kingbird and Clay-colored Sparrow, appeared to be much more abundant in WPA fields. These species nest in shrubs, which occurred in some of the WPA fields but not in CRP fields. The CRP fields, which had been tilled before being enrolled in the CRP, had not been invaded by much woody vegetation. The dearth of Clay-colored Sparrows in CRP fields contrasts with counts as high as 12 indicated pairs per 100 ha (countywide average) reported by Johnson and Schwartz (1993) for CRP fields in the same general area.

Bobolinks and Savannah Sparrows, whose densities were similar in the two states, occurred in both CRP and WPA fields. These species were two of the most abundant in alfalfa-wheatgrass (*Agropyron* spp.) mixtures in North Dakota WPAs studied by Renken and Dinsmore (1987). In Minnesota the density of Savannah Sparrows was higher in WPA than in CRP fields. Grasshopper Sparrow densities were not significantly different between states, but in Minnesota they were higher in CRP than in WPA fields. Renken and Dinsmore (1987) found this species to be more abundant in native prairie than in alfalfa-wheatgrass mixtures.

FLEDGING SUCCESS

I found no significant difference in fledging success of ground nesters between WPA and CRP fields, leading me to conclude that fledging success was similar in these two kinds of fields. This similarity indicates that CRP fields provided nesting cover as safe for ground nesters as the other habitat I examined. Patterson and Best (1996) estimated 30% fledging success (assuming a 23-d nesting cycle) for Grasshopper Sparrows in CRP fields in Iowa, which is very similar to the 28% fledging success calculated from the mean daily survival rate of ground nests in CRP fields (Table 3), assuming a 23-d cycle. Studies that have compared fledging success in CRP fields and pastures have found no significant differences between these habitats (Granfors 1992, Klute 1994). Thus, available evidence suggests that CRP fields are equivalent in quality to pastures and WPAs for the grassland birds that are common in CRP fields. In general, pasture and rangeland are much more common in midwestern landscapes than are CRP fields (Koford and Best 1996). The CRP fields appear to be better nesting habitat than hayfields, which also attract grassland birds. Fledging success tends to be low in hayfields because of nest losses from mowing operations (Bollinger et al. 1990).

Demonstrating that some habitats were of equivalent quality during the CRP era is not conclusive evidence that birds nesting in CRP fields had higher fledging success than they would have had in the absence of the CRP. The extensive CRP cover could have affected the distribution of birds and predators, making fledging success in suitable habitats different from what it would have been in the absence of the CRP. If one assumes, however, that recent estimates of fledging success in habitats other than CRP fields are similar to levels of fledging success in those habitats before the CRP era, and similar to what they would have been without the CRP, then the CRP has probably benefited grassland birds. The additional cover provided by CRP fields may have lowered breeding densities in all habitats, with possible benefits if reproduction is density dependent. The additional habitat also may have allowed birds to breed that otherwise would not have, such as second-year birds, thereby supporting higher population growth overall. The effect of loss of CRP habitat would be substantial for grassland species that nest in the dense cover provided by CRP fields (see also Johnson and Igl 1995).

Estimated fledging success of 22–27% (Table 3) appears to be relatively low but may be sufficient to maintain stable populations without immigration. Given this range of fledging success, if all pairs renested up to four times after failed nesting attempts, the percentage of pairs producing at least one fledgling in a nesting season would be 63% ($1.0 - [0.78]^4$) to 72% ($1.0 - [0.73]^4$). If each of these successful pairs fledged 3 young, the average production per pair in the population would be 1.9–2.1 fledglings per season. This level of reproduction is at the low end of the range expected for a stable population. Sherry and Holmes (1995) estimated that a pair of neotropical migrants would have to produce 1.7–4 fledglings per season to balance mortality. Rodenhouse et al. (1995), assuming only two nesting attempts, estimated that production of three fledglings would be necessary. More data are needed on mortality, renesting frequency, and double-brooding before definitive conclusions can be reached regarding the adequacy of fledging success in the CRP and WPA fields studied.

The relatively low estimated fledging success of grassland birds in this and other studies (Rodenhouse et al. 1995) raises questions about whether these estimates are accurate. It is possible that investigator effects caused the fledging-success estimates to be biased (Bart 1977, Westmoreland and Best 1985, Major 1990). Comparisons between treatments, as was done in this study, would be valid even if the estimates of fledging success were biased, assuming that biases were similar in all fields studied.

It is desirable to have studies of fledging success in CRP fields and other habitats from various geographic regions (e.g., Granfors 1992, Millenbah 1993, Klute 1994, Patterson and Best 1996). In parts of North Dakota and Minnesota, at least, this study indicates that the CRP provided nesting cover at least as safe as one other habitat. This suggests that declining species of grassland birds have probably benefited from this program which has converted so much former cropland to attractive nesting cover for grassland birds.

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