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CEAP Conservation Insight

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The Conservation Reserve Program Enhances Landscape-level Grassland Bird Species Richness

Summary Findings

- Grassland bird populations have declined in recent decades due to habitat loss and other factors.
- Breeding bird survey and land-use data from the 1990s indicate that local areas with lands enrolled in the Conservation Reserve Program (CRP) had, on average, 51 percent of the regional species pool of grassland birds, whereas local landscapes without CRP land had on average only 35 percent of the pool.
- Landscapes with CRP had higher grassland bird species richness—that is, more species of grassland-nesting birds—than did landscapes without CRP in eight of 16 bird conservation regions (BCRs) examined.
- Grassland bird species richness was also correlated with higher landscape percentage in cropland in ten BCRs.
- The CRP has been effective in preserving diversity of grassland birds at local and ecoregional landscape scales.

Western meadowlark— Gary Kramer

Background

Populations of grassland birds have been declining throughout North America in recent decades (Sauer et al. 2008). In response, much effort has been placed on addressing habitat loss and other factors affecting these population declines (Brennan & Kuvlesky 2005). Less effort has been made to track the status of grassland bird species richness at landscape scales. If overall population declines are great enough, some species could be locally extirpated (Hamer et al. 2006).

Availability of habitat for foraging and breeding may be one factor that prevents local extirpation and hence supports species richness. For example, landscapes with more grassland habitat should contain more grassland-nesting species than do landscapes with less grassland.

Such landscapes should also contain a greater proportion of the regional pool of grassland bird species. Local landscapes are embedded within greater land areas (e.g., ecoregions) that support a particular set of species. This regional species pool limits the species expected to occur within a given local landscape. Local species richness should approach the regional species richness as the amount of suitable habitat in the local landscape increases.

Since inception of the Conservation Reserve Program (CRP) in 1985, approximately 15 million ha of long-term cover has been established on environmentally sensitive croplands in the United States. These CRP habitats have provided substantial benefits to wildlife, including grassland birds (Haufler 2005).

Assessment Approach

Through an agreement pursuant to the wildlife component of the Conservation Effects Assessment Project (CEAP), investigators at the University of Northern Colorado conducted an assessment to determine the effects of CRP enrollments and other land covers on the species richness of grassland nesting birds and neotropical migratory birds.

Since most CRP enrollments occur in the central and eastern United States, the assessment focused in these areas. With the exception of tree planting in portions of the Southeast, grass cover was established on the majority of CRP lands in this area. The assessment tested whether the proportion of CRP land within a landscape has a positive effect on local species richness of grassland nesting birds or neotropical migrants. The effect was expected to be greater for grassland birds than for neotropical migrants because most species in the latter group utilize forest, not grassland, as breeding habitat. The effect of the amount of active cropland within landscapes was also assessed for these bird groups.

Bird Data

Data from the North American Breeding Bird Survey (BBS) (Sauer et al. 2008) were used to estimate bird species richness within 30-km radius circular landscapes. The BBS is an annual roadside survey of birds seen and heard along 39.2-km routes (rural roads and secondary highways) distributed throughout North America. Only those BBS routes within Bird Conservation Regions (BCRs) of the central and eastern United States were used.

Breeding bird data from routes that were surveyed 5 or more years between 1990 and 2000 were used to correspond to the years (1992 and 1997) for which land-cover data, including CRP land, were available. Using at least 5 years of sur-

vey data per route also maximized the likelihood that all species present in each BBS route-centered landscape were recorded. A total of 1,610 BBS routes in 16 BCRs were used in the assessment.

For each survey route, BBS raw data were used to derive a list of all bird species recorded at least once (between 1990 and 2000) on the route. The number of species in each list was an estimate of BBS route-specific local landscape species richness. Regional richness was defined as the total number of species recorded between 1966 and 2005 within the BCR (from the BBS Web site: www.mbr-pwrc.usgs.gov/bbs/bbs.html).

In all analyses, the main response variable was local landscape species richness as a percentage of regional species richness. For each route, local richness was converted to a percentage of total possible richness to control for the effect of differences among routes (in different BCRs) in the number of species potentially available in the regional species pool. In this way, the effects of land cover on local species richness of all birds, grassland birds (22 species) and non-grassland neotropical migrants (110 species), as defined by Peterjohn and Sauer (1990), were examined.

Land-Cover Data

Land-cover data from the 1992 and 1997 National Resources Inventories (NRI) (Nusser and Goebel 1997, U.S. Department of Agriculture 2000) were used to characterize habitat conditions in the vicinity of BBS routes analyzed. From the NRI data, seven different land-cover types were recognized: CRP land, cropland, pasture, rangeland, forest, urban, and water. The proportion of land in each of these cover types was estimated by tallying the number of NRI points within 30 km of the BBS route centroid and dividing by the number of NRI points within the 30-km radius circular landscape. Only BBS route-centered local landscapes containing at least 100 NRI points were used in this assessment.

Data Analyses

General effects of CRP land and extent of cropland on overall bird species richness, grassland bird species richness, and number of non-grassland neotropical migrants were assessed using analysis of variance for all 16 BCRs. To facilitate comparisons, BBS route-centered landscapes were divided into two groups based on the presence or absence of CRP land (>0 percent and 0 percent) and two groups based on the amount of cropland. Because nearly all landscapes contained some cropland, landscapes were assigned to groups based on whether the landscape had more cropland than the median value for the BCR ("high" cropland) or less than the median value ("low" cropland). The response variable for each was local (BBS route-level) species richness as a percentage of regional (BCR-level) species richness ("richness ratio").

Effects of CRP land and cropland on bird species richness were also assessed using a series of t-tests comparing landscapes with CRP land to those without CRP land and comparing landscapes with high cropland to those with low cropland. These tests were applied to the three bird groups (all birds, grassland birds, and non-grassland neotropical migrants) with local species richness again expressed as a percentage of regional species richness (richness ratio). Multiple regression models were also used to look for effects of land use on bird communities.

Study Findings

The number of species in the 16 BCRs ranged from 123 to 207. Species richness within BCRs ranged from 4 to 19 species for grassland birds and from 33 to 66 for neotropical migrants. Among the 1,610 BBS routes, richness ratio ranged from 19.6 to 78.4 (mean 52.2) for all birds, from 0 to 100 (mean 44.5) for grassland birds, and from 12.0 to 93.9 (mean 54.0) for neotropical migrants. However, richness ratio for all three bird groups varied among the BCRs; analysis of variance detected significant BCR effects within bird groups.

Of the 1,610 BBS route-centered local landscapes, 1,022 (63.5 percent) had some CRP land. Cropland occurred in 1,580 (98.1 percent) landscapes. The greatest percentage of CRP land in any landscape was 27.2 percent; the greatest percentage of cropland was 94.3 percent. The BCR-level range of mean percentages of all land cover types within BCRs is presented in table 1.

The ANOVA revealed slight differences in total bird and neotropical migrant bird species richness between landscapes with and without CRP. However, for grassland birds there were striking differences in richness ratio between landscapes with and without CRP (51.1 vs. 35.0, respectively) ($P < 0.001$) and between areas with high and low cropland cover (51.4 vs. 37.7, respectively) ($P < 0.001$). The effect of cropland on the other bird groups was much less.

In eight of the 16 BCRs, richness ratio for grassland birds was greater in landscapes with than without CRP (table 2, figure 1). In none of the BCRs or bird groups was the richness ratio greater in the landscapes without CRP. Cropland also had significant effects on bird species richness in some BCRs, particularly for grassland birds. In 10 BCRs the richness ratio for grassland birds was greater in landscapes with high cropland cover and only one BCR where richness ratio was greater in the landscapes with low cropland cover (table 2, figure 2). For neotropical migrants, there were four BCRs where richness ratio was greater and one BCR where richness ratio was less in landscapes with high cropland cover (table 2).

Table 1. Range of mean BBS-route centered landscape land-cover percentages within the 16 Bird Conservation Regions assessed

Land-cover type	Lowest mean landscape percent cover	Highest mean landscape percent cover
CRP	0.5	9.0
Cropland	4.5	61.5
Pasture	1.5	23.4
Rangeland	0	52.8
Forest	0.6	58.7
Urban	0.4	20.1
Water	0.3	2.2

Table 2. Bird Conservation Regions where richness ratio was significantly greater ($P < 0.003$) in one type of landscape ("CRP land present vs. absent" and "high vs. low cropland") than the other

Landscape type	All birds	Grassland birds	Neotropical migrants
CRP land present	11, 17, 24, 28	11, 13, 17, 18 24, 27, 28, 30	17
CRP land absent	None	None	None
High cropland	17, 28, 30	12, 13, 17, 22, 24 26, 27, 28, 29, 30	21, 22, 23, 24
Low cropland	22, 23	11	17

Local and Landscape Effects

This assessment indicates that CRP cover enhances local grassland bird species richness during the breeding season. Landscapes with CRP land tended to have a greater proportion of the regional grassland bird fauna than did landscapes without CRP land. The enhancing effect of CRP land was also evident at broader landscape scales, in this case, at the BCR scale (figure 1). The enhancement was statistically significant ($P < 0.003$) in eight of the 16 BCRs.

In BCRs where local grassland bird species richness was enhanced by CRP land, the enhancement was not numerically great. Landscapes with CRP land typically had one or two additional grassland bird species not found in landscapes without CRP land. The greatest enhancement was in BCR 17—Badlands and Prairies—where CRP landscapes had a mean richness ratio of 68.6 compared to 39.2 for landscapes without CRP land. The regional grassland bird richness in BCR 17 was 18 species, so this difference translates into an enhancement of five species on average. On first glance, an enhancement of only one or two species may not seem substantial. However, the grassland bird group includes only 22 species, and most of these species have been declining in all or parts of their ranges. An important result of this assessment is the finding that the CRP can augment the local species richness of this at-risk group over a vast area of the United States, from the East Coast to the Great Plains.

Along with CRP land, cropland was also associated with greater local species richness of grassland birds in many of the BCRs (table 2, figure 2). This enhancement was generally one to three additional grassland bird species in landscapes with a high proportion of cropland compared to landscapes with a low proportion of cropland.

In six BCRs (13, 17, 24, 27, 28, and 30) both CRP land and cropland appeared to enhance local bird species richness. Greater grassland bird species richness in landscapes associated with CRP and cropland may be because these land uses are associated with open non-forested habitats, especially in largely forested eastern BCRs.

Overall, CRP land and cropland did not enhance the total bird species richness of non-grassland neotropical migrants within landscapes. On average over all landscapes, local species richness of all birds and neotropical migrants ranged between 52 and 54 percent with slight differences between landscapes with and without CRP land and those with and without cropland. The lack of a strong effect of CRP land on total bird species richness and neotropical migrant richness is probably due to the fact that a majority of species in these groups do not depend on grassland habitat for breeding.

Multiple regression analysis found that rangeland, which is essentially natural grass and shrub land typically grazed by

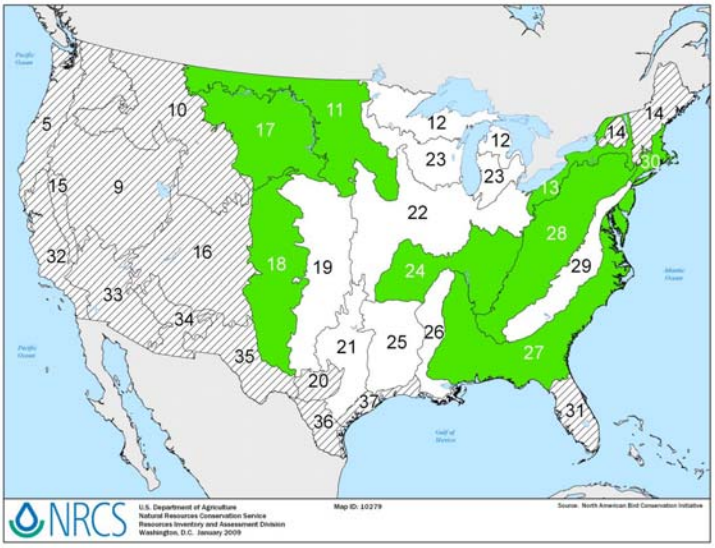

Figure 1. Bird Conservation Regions where richness ratio was significantly higher for grassland birds in BBS route-centered local landscapes containing CRP lands than those landscapes without CRP lands. Areas shaded with diagonal lines were outside the study area.

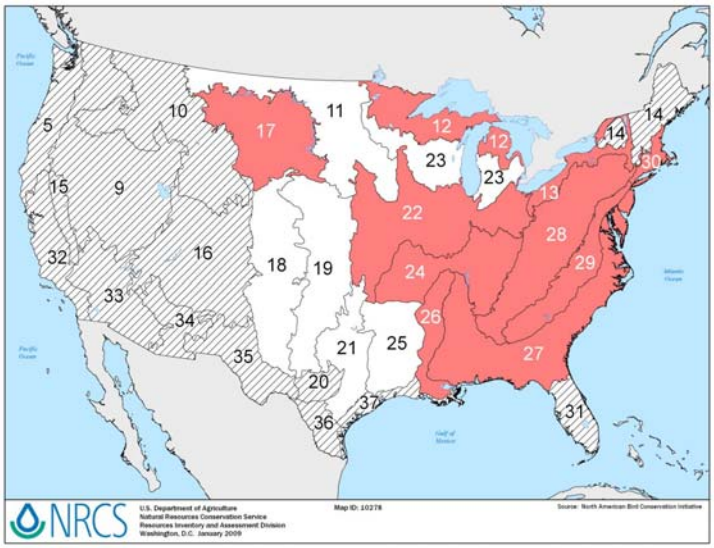

Figure 2. Bird Conservation Regions where richness ratio was significantly higher for grassland birds in BBS route-centered local landscapes with high amounts of cropland than those landscapes with low amounts of cropland. Areas shaded with diagonal lines were outside the study area.

livestock, had a stronger positive effect on grassland bird species richness than did CRP land. This result suggests that natural grasslands (i.e., rangeland) may be superior to the semi-natural CRP grassland cover in terms of habitat quality for grassland birds at landscape scales.

Conclusion

A novel aspect of this assessment is the focus on the effects of the CRP on bird species richness rather than individual species population trends, a focus largely missing from previous studies on the effects of the CRP on wildlife. This approach gives perspective on the effects of the CRP on grassland birds as a group. At landscape scales, grassland bird species richness is influenced by many factors beyond availability of habitat (e.g., habitat spatial arrangement, characteristics of the dominant land use matrix, and prey base) (Hamer et al. 2006). Nonetheless, this assessment revealed an enhancement of local species richness in landscapes that contain lands enrolled in the CRP, despite the fact that many other unmeasured variables likely also affected species richness within the landscapes.

The results of this work suggest that the CRP has benefits beyond just facilitating growth and maintenance in the populations of individual species. CRP land within a landscape increases the likelihood that the assemblage or community of grassland birds occupying the landscape is as complete as possible within the limits imposed by the regional species pool. Thus, CRP can be viewed as an important channel for restoring populations of at-risk grassland birds as well as for preserving species richness of this group at local landscape scales.

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The Conservation Effects Assessment Project: Translating Science into Practice

The Conservation Effects Assessment Project (CEAP) is a multi-agency effort to build the science base for conservation. Project findings will help to guide USDA conservation policy and program development and help farmers and ranchers make informed conservation choices.

One of CEAP's objectives is to quantify the environmental benefits of conservation practices for reporting at the national and regional levels. Because fish and wildlife are affected by conservation actions taken on a variety of landscapes, the wildlife national assessment draws on and complements the national assessments for cropland, wetlands, and grazing lands. The wildlife national assessment works through numerous partnerships to support relevant studies and focuses on regional scientific priorities.

This effort assesses the local and landscape-scale benefits of the Conservation Reserve Program to grassland birds using existing data from the USGS North American Breeding Bird Survey and the USDA NRCS National Resources Inventory. The primary investigator was Dr. Joseph Veech of the University of Northern Colorado (now at Texas State University).

For more information:
www.nrcs.usda.gov/technical/NRI/ceap/