USDA Natural Resources Conservation Service
U.S. DEPARTMENT OF AGRICULTURE

Can cover crops help grassland-breeding birds? Corn Belt insights from Iowa.

Conservation Effects Assessment Project (CEAP) Conservation Insight

As the use of cover crops to improve soil health and reduce water quality concerns on working cropland has increased in recent years, questions have emerged regarding the value of cover crops to wildlife. For example, do cover crops provide needed habitat for grassland birds, a group that has experienced widespread population decline in recent decades? The U.S. Department of Agriculture's Conservation Effects Assessment Project (CEAP), in partnership with Iowa State University and the U.S. Department of the Interior, U.S. Geological Survey's South Dakota Cooperative Fish and Wildlife Research Unit at South Dakota State University, assessed grassland-breeding bird responses to the integration of cover crops in a corn-soybean cropping system in Iowa. Findings from this study may be used to support on-the-ground cropland management decisions informed by a better understanding of the potential role cover crops play in grassland bird conservation efforts in Iowa and similar cropping systems in the heart of the Corn Belt.

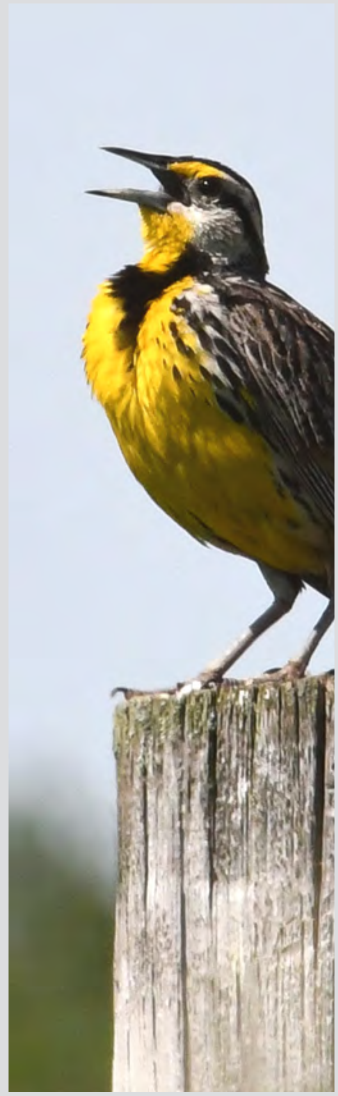
Key Takeaways

- Pheasants and other grassland-breeding birds were largely unimpacted by the availability of cereal grain cover crops between corn and soybean rotations.
- Pheasant nest densities were over 20 times greater in native warm season grasses than in cover crop fields.
- Pheasants selected nest sites with greater litter depths and high vegetation densities, which were achieved in cover crop fields only where the previous crop was no-till corn and cover crop growth was exceptional.
- Grassland bird abundance and richness were greatest in perennial grass cover, followed by cover crops, then row crops.
- The grassland bird community found in cover crop fields included all species found in row crops as well as other species, including some found in perennial cover. Perennial cover supported some species not found in either cover crops or row crops.

Background

Populations of grassland-breeding birds are among the most rapidly declining in North America, primarily because of loss of breeding habitat to agricultural land uses in the Central United States (U.S.) and Canada (Samson and Knopf 1994, Igl et al. 2018). One recent study estimated over half of the grassland birds present in the U.S. in the 1970s have been lost, with conversion of grasslands to annual crop production systems among the many stressors driving population decline (Rosenberg et al. 2019). Homogenization of annual crop rotations in the Central U.S. may have exacerbated the decline among grassland birds as more diverse rotations that included small grains, hay, and fallow fields were replaced by alternating between corn and soybeans (Warner 1994). Small grains including oats, wheat, barley, and rye are known to provide suitable nesting habitat for many species of grassland-breeding birds (Skon et al. 2016, Pauly et al. 2018), and loss of these grain crops could affect the capacity of landscapes in the Central U.S. to support grassland-breeding birds.

Agricultural activities that have contributed to widespread and persistent declines of grassland-breeding birds throughout the Central U.S. (Rosenberg et al. 2019) may also contribute to declines in surface water quality through nutrient enrichment and the degradation of soil health and fertility due to erosion, disturbance, and loss of biological diversity (Veenstra and Burras 2015, Jones et al. 2018). Consequently, many farmers across this region are seeking means to improve soil health and environmental outcomes



The eastern meadowlark is a grassland breeding bird considered a Species of Greatest Conservation Need by the Iowa State Wildlife Action Plan.
Photos by Jim Hudgins, U.S. Fish and Wildlife Service.

on farms through a variety of conservation practices to positively affect soil, water, and wildlife (Pfrimmer et al. 2017). One such practice gaining in popularity and adoption across the Midwest is the integration of cover crops into cropping systems (Cates et al. 2018).

Cover cropping is an ancient agronomic technique that seeks to cover exposed soil with actively growing plants to bind nutrients and prevent loss between periods of cash crops such as corn or soybeans (Unger et al. 1998). Thus, "cover crop" can mean many different things in many different cropping systems. In the Midwest, cover crops are used primarily between the harvest of one cash crop in the fall and the planting or early growth of another the following spring (Reicosky and Forcella 1998). Most cover crops in the Midwest are winter-hardy, cool-season grains that can be planted late in the growing season, survive the winter, and resume growth early the following spring (Figure 1; Cates et al. 2018). In the absence of cover crops, soil in row crop fields is generally bare following tillage or, in no-till cropping systems, covered only with residue from the previous year's crop. Cover crops integrated into these cropping systems grow initially during late fall after harvest of the cash crop, are slow growing over winter, and resume growth in early spring before planting of the next cash crop. The early spring growth of cool-season, winter-hardy grains coincides with the period during which many grassland-breeding birds are looking for and establishing nesting sites (Figure 1) and these grains may provide suitable nesting habitat (Wilcoxen et al. 2018).

Anecdotal observations of birds nesting in cover crop fields have been reported throughout the Midwest, but little empirical research on nest density or fate has been conducted. A recent study in Illinois documented the occurrence of 43 species of birds in fields with cover crops that were previously planted to corn, which aligns with anecdotal evidence suggesting their possible use for nesting (Wilcoxen et al. 2018). Similarly, Zagorski et al. (2021) found that American kestrels, a declining grassland raptor once common in agricultural landscapes, were positively associated with cover crop fields in Indiana during winters 2018 and 2019. Assessment of grassland bird nesting biology in cropping systems with high adoption of cover crops could further enhance our understanding of how cover crops may improve wildlife conservation outcomes in working agricultural landscapes, particularly for Iowa grassland breeding birds of greatest conservation need including northern bobwhite, upland sandpiper, field sparrow, grasshopper sparrow, dickcissel, bobolink, and eastern meadowlark.

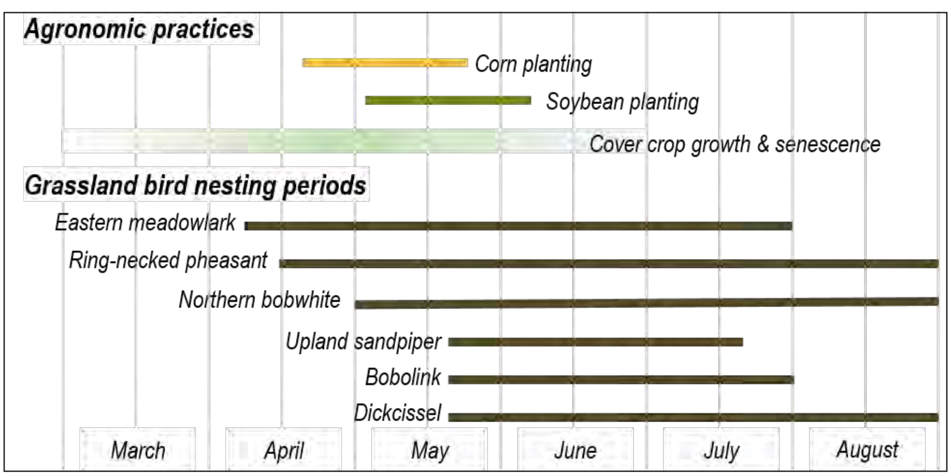


Figure 1. Conceptual graphic showing how cover crop integration into row crop systems in the Central U.S. could provide cover for grassland nesting birds. Corn and soybean planting dates are the range of the 10th and 90th percentiles of average planting dates in Iowa for the five-year period ending in 2020 according to the U.S. Department of Agriculture, National Agricultural Statistics Service (NASS 2019). Likely nesting periods are illustrated for common grassland birds according to the Iowa Breeding Bird Atlas II protocols.

Assessment Approach

Through a Conservation Effects Assessment Project (CEAP) partnership among the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS), Iowa State University, and the U.S. Department of the Interior, U.S. Geological Survey's South Dakota Cooperative Fish and Wildlife Research Unit at South Dakota State University, an assessment was conducted to evaluate bird responses to the integration of cover crops in a corn-soybean cropping system in Iowa. Specific objectives of the project included:

1. Documenting the use of cover crops by breeding ring-necked pheasants and other bird species of conservation need.
2. Comparing avian use of cover crops to other on-farm grassland conservation practices.
3. Evaluating factors related to the use of cover crop fields by grassland-breeding birds.

Assessments focused on pheasants because of their economic and social importance and decades-long declines in the region (Clark et al. 1999). Other breeding grassland bird species of greatest conservation need were assessed due to long-term declines in Iowa and across North American grasslands driving dedicated state and national interest in reversing these trends (Cox et al. 2014, Rosenberg et al. 2019). Crucially, this study sought to determine avian use of cover crops in southeastern Iowa during the breeding season and if these crops support successful nesting or are detrimental to the birds by providing nesting sites with low probability of nesting success or of otherwise poor quality.

Study Area

The study was conducted in Washington County in southeastern Iowa (Figure 2). This 365,155-acre county had around 215,090 acres planted to corn or soybeans at the time of the study. Geospatial layers provided by NRCS revealed that approximately 15% (32,265 acres) of the row crops in the county were planted to cover crops through an NRCS cost-share program during 2017 (Shirley and Janke 2023). Examples of cost-share programs include the Environmental Quality Incentives Program and the Conservation Stewardship Program.

Investigators established and used roadside transects throughout the county and estimated the total amount of cover crop adoption by surveying along these transects during April–June in both 2019 and 2020. Transect surveys revealed that cover crops were planted on approximately 11.9% of the area to be planted to corn and 16.8% of the area to be planted to soybeans during 2019. In 2020, cover crops were planted on 17.8% of the area to be planted to corn and 22.3% of the area to be planted to soybeans. Thus, county-wide, cover crops were planted and visibly growing on 13.9% and 19.8% of row crop acres during 2019 and 2020, respectively.

This estimate of cover crop adoption was two to four times greater than rates seen throughout the rest of Iowa and nationally, which was estimated in 2017 to be around 5% of crop acres (Wallander et al. 2021). Washington County, Iowa had among the highest cover crop adoption rates in the entire Corn Belt of the Central U.S. (Wallander et al. 2021), increasing the relevance of this assessment of bird responses to the landscape-scale application of cover crops. The assessment team worked closely with NRCS staff and dozens of farmers and landowners in the region to access more than 6,000 acres of row crop fields with and without cover crops and more than 2,700 acres of former cropland converted to grassland through the Conservation Reserve Program (CRP).

Pheasant Nesting Surveys

Field crews searched 365 one-acre plots for active pheasant nests in grasslands (199 plots) and cover crop fields (166 plots) during May–July 2019 and 2020. Plots were randomly placed in fields using coordinates derived using a Geographic Information System and stratified into three field types:

- Perennial grasslands dominated by native warm season grasses,
- Perennial grasslands dominated by cool season grasses, and
- Crop fields with cover crops.

Plots were searched during two periods in the nesting season — May 15 to June 1 and June 16 to July 15 — with four-week intervals between searches on individual plots. Observers systematically traversed plots while spaced approximately three feet apart and using sticks to move vegetation and encourage hen pheasants to flush (Figure 3). When a nest was found, the number of eggs, incubation stage of the nest, and nest bowl dimensions were recorded.

Figure 3. Field crews conduct searches for ring-necked pheasant nests in one-acre plot in a fall-seeded cover cropped field in Washington County, Iowa, U.S.

Nest contents were examined to estimate hatch date and to measure characteristics of the vegetation at the nest site. A visual obstruction pole divided into two-inch strata (Robel et al. 1970) was placed directly in the pheasant nest bowl, and 100% visual obstruction readings (VOR) from 13 feet in each cardinal direction were used to characterize the density of the vegetation around nests. Technicians also measured vegetation height and visually estimated percent ground cover of grasses, forbs, woody vegetation less than three feet in height, bare ground, cover crop, row crop, litter, and litter depth to the nearest quarter inch within a 39-inch × 20-inch sampling frame centered around the nest bowl and 13 feet in each cardinal direction (Figure 4). In grasslands, litter was dead, flattened vegetation from the previous year's growth, whereas in crop fields litter was the standing residual crop remaining after the previous year's harvest. The same vegetation measurements were made at a paired random point selected from a randomized list of compass bearings and distances ranging 66 to 262 feet from the nest site and falling within the same cover type. Statistical analyses (e.g., logistic regression) were conducted to compare nest density among field types and to summarize vegetation characteristics at nest sites (Shirley and Janke 2023).

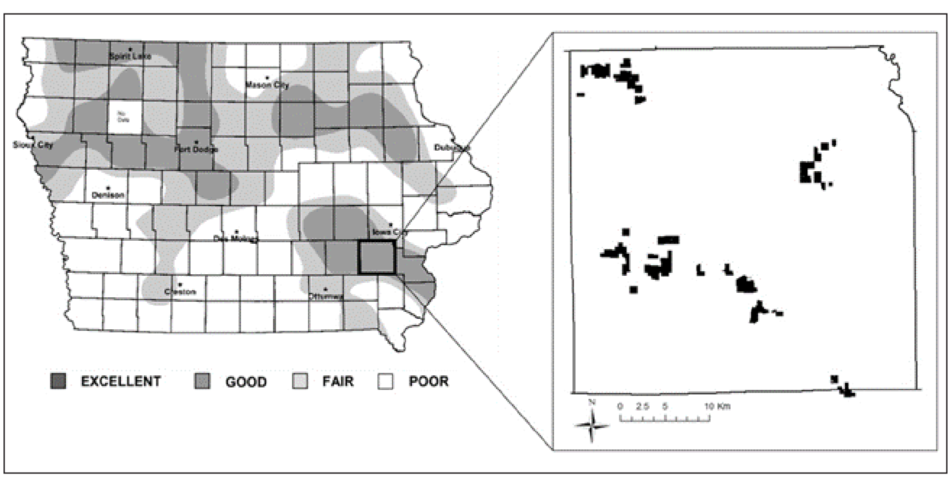


Figure 2. Location of study sites in Washington County, Iowa, U.S. and ring-necked pheasant distribution across Iowa (IA DNR 2020). From Shirley and Janke (2023).

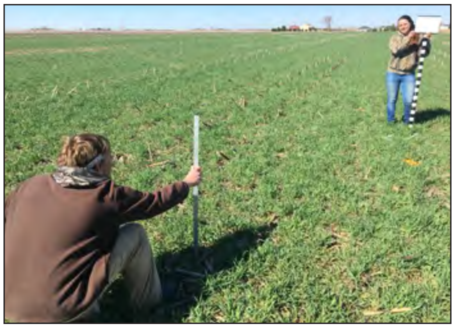


Figure 4. Field crews measure vegetation density with a Robel pole in a cover crop field to compare to nest sites used by ring-necked pheasants and other grassland breeding birds.

Pheasant Crowing and Brood Surveys

Investigators conducted surveys for crowing male pheasants and pheasant broods along 10 random survey transects (mean length = 9.6 miles, range = 8.2 to 10.7 miles) on secondary roads in Washington County, Iowa, to evaluate pheasant population responses to cover crops. Three rounds of point count surveys — from April 20 to May 1, May 2 to May 20, and June 1 to June 20 — captured peak pheasant crowing in both 2019 and 2020. Point count surveys were conducted every 0.62 miles on each route following standardized protocols. Nine roadside brood surveys were conducted along each transect from July 20 to August 15 in 2019 and 2020 to examine the distribution of pheasant broods relative to landscape features, such as grassland, woody vegetation, and forests. Land cover, for example the type and estimated cover of cover crops, was documented along each survey route. Regression models were used to evaluate relationships between cover crops and the abundance of calling males and the occurrence of broods.

Grassland Bird Surveys

In 2021, surveys for grassland birds were conducted from May 1 to July 31 to draw inferences about grassland-breeding bird use of cover crops and other cover types. Fields surveyed were selected from pheasant survey locations, and all survey fields with cover crops were planted with cereal rye. Study fields were classified by dominant land use: cover crop, row crop, or perennial cover. Sample sizes of the three cover types were constrained by availability (12 cover crop fields, four row crop fields, and six perennial cover fields).

Investigators randomly selected points in each study field, with number proportional to field size. Survey points were greater than or equal to 325 feet from field boundaries, edges, and structures and greater than or equal to 650 feet from other sampling points. Five-minute standardized bird point count surveys were conducted between solar twilight (approximately 0.5 hours before sunrise) and 4.5 hours after sunrise. Upon arrival at a station, observers waited for two minutes prior to initiating the count to minimize any disturbance effects from traveling to survey sites. All species detected during five-minute surveys were recorded, and observers alternated between study fields throughout the season so that each field was surveyed the same number of times by each observer to control for observer bias.

Avian abundance (number of individuals) and species richness (number of species) were characterized among the three field types for two groups: all birds observed and only those considered to be Species of Greatest Conservation Need (SGCN) under the Iowa State Wildlife Action Plan. Non-parametric statistical techniques were used to test for differences in avian abundance and richness among study fields by field treatment and to evaluate whether bird communities were compositionally different among field treatments

Findings

Pheasant nest densities were low in cover crops, high in native grass fields. A total of 31 pheasant nests were found among the 365 plots surveyed, with only two nests occurring in cover crop fields (rye). Estimated pheasant nest densities were highest in native warm season grass (0.24 nests/acre) and lowest in cool season grass and cover crop fields (both 0.01 nests/acre, Shirley and Janke 2023). Four additional nests, all unsuccessful, were found in cover crop fields, either incidentally by field crews or by partner farmers. Pheasant nest densities observed in native warm season grass CRP fields were comparable to other studies (Clark et al. 1999). These results are presented in detail in Shirley and Janke (2023) and summarized here.

Conditions in cover crop fields fall short of pheasant nesting needs. Nest-site selection analyses revealed that pheasants were selecting for vegetation characteristics at the landscape scale, such as the types of fields, and the patch scale, such as the characteristics of vegetation within individual fields (Shirley and Jenke 2023). Greater percent litter cover in fields was associated with greater probability that a pheasant would nest there, which may reflect the type of material used by pheasants to build nests (Figure 5; Shirley and Janke 2023). Similarly, fields with greater vegetation density were more likely to contain pheasant nests. Comparison between important cover attributes at nest sites and conditions measured in cover crop fields revealed that cover crop fields rarely had sufficient litter for nest construction or vegetation growth for nest concealment, potentially explaining the rare occurrence of nests in cover crop fields (Shirley and Janke 2023).

Figure 5. Ring-necked pheasant nest in a soybean field built with residue from the previous year's corn crop and decaying cover crop biomass. Pheasants build their nests with material in the immediate vicinity of the nest, so litter is essential for providing suitable nest sites for pheasants and many other grassland-breeding birds.

Cover crop adoption was not associated with increased pheasant calling or occurrence of broods. Statistical models based on roadside surveys revealed that abundance of calling males or occurrence of broods were no different in areas with greater cover crop adoption on row crop fields than areas without cover crops (Shirley 2021). This corroborated in-field findings indicating that use of cover crops had no discernable impact on local population trends of pheasants, through improvements in reproduction or through changes in habitat use during the study (Shirley and Janke 2023).

Grassland birds preferred perennial cover over cover crops during the nesting season. Bird surveys detected 4,985 individuals of 66 species across all field types. Twenty-two (33%) species were considered Iowa SGCN. The most abundant species were red-winged blackbird (24.2%), dickcissel (20.7%), eastern meadowlark (10.6%), common yellowthroat (6.6%), killdeer (4.1%), barn swallow (3.4%), field sparrow (3.2%), American robin (3.1%), song sparrow (2.4%), and grasshopper sparrow (2.1%). Bird survey data indicated that perennial cover fields had the greatest abundance and species richness of all bird species, including SGCN species. Total species abundance and SGCN abundance and richness were second greatest in cover crops and least in row crops (Figura 2022).

The bird community in perennial cover differs from that in cover crops and crop fields. The avian community found in perennial cover fields differed from that in cover cropped and row cropped fields. The bird communities in cover cropped and row cropped fields were similar for all bird species as well as for only SGCN species (Figura 2022). These results do not tell the entire story and are partly the result of small sample sizes for row cropped fields. When examining the bird communities using non-metric multidimensional scaling, the bird community observed in cover crop fields tended to include more species than either of the other two cover types, which completely overlapped the communities in row cropped fields, but also included some of the community found in perennial cover fields (Figure 6). Perennial cover fields supported the most unique species (n = 50), whereas cover cropped fields contained most of those species (n = 43) as well as most species found in row cropped fields (n = 29; Figure 6).

Cover and depth of ground litter influenced bird use. Litter cover and depth most influenced bird abundance in study fields (Figura 2022). For example, average bird abundance increased by 9.4 birds with each 10% increase in litter cover. Practices that promote litter accumulation in cover cropped fields, such as extending the date at which the cover crop is terminated and the cash crop planted, could increase cover cropped field use by grassland bird species (Figura 2022).

Cover crop management methods affected bird response. Total growth, or biomass, of cover crops at the time of cash crop planting is a consistent correlate with other environmental benefits of cover crops such as weed suppression, nutrient retention, and prevention of soil erosion (Florence 2016). Similarly, this study found that substantial growth of cover crops prior to termination and planting was related

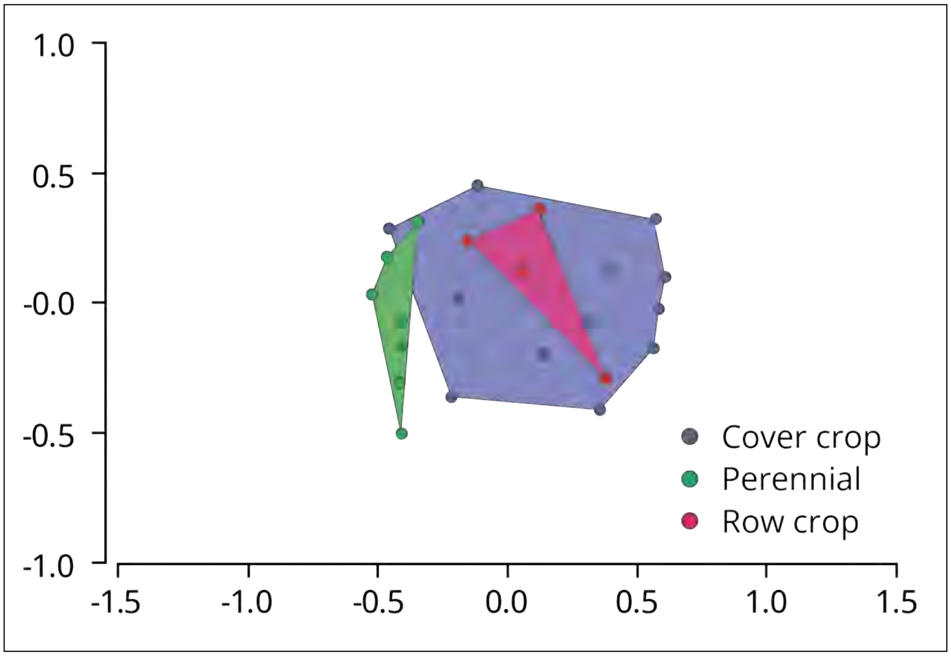


Figure 6. Non-metric multidimensional scaling (NMDS) ordination plot of observations of avian communities grouped in convex hulls by cover type (perennial cover, cover crops, and row crops) using Jaccard's index for dissimilarity. Overlapping boxes indicate overlapping bird communities (i.e., bird communities are more similar).

to field suitability for nesting pheasants and other grassland birds. Agronomic changes that facilitate increased cover crop growth, such as early timing of cover crop planting in the fall, later termination in the spring, or more vigorous varieties, could benefit grassland-breeding birds. However, increasing the attractiveness of cover crop fields to nesting birds prior to field operations may expose birds to greater risks of nest failure and abandonment, as seen with ducks nesting in North and South Dakota (Gallman et al. 2023).

Conclusions

As currently implemented in a corn-soybean rotation, small grain cover crops are likely not effective for increasing nesting grassland birds in midwestern cropping systems. This conclusion is especially apparent in comparison with perennial conservation cover, like CRP, that showed greater bird use in this and many other studies (Reynolds et al. 2001, Skone et al. 2016). Therefore, the positive environmental and agronomic benefits of cover crops appear to have minimal impact on avian breeding habitat use but may have other positive impacts on birds by improving surface water quality and increasing small grain production in the Midwest (e.g., by supplying a market for small grain seed for cover crop plantings, Cates et al. 2018). Integrating diverse native perennial vegetation into working landscapes with practices such as field borders, riparian buffers, wetland restoration, or conversion to grass-based agriculture could have positive effects on migrating and nesting bird populations (Henningsen and Best 2005, Smith et al. 2005).

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Conservation Effects Assessment Project: Translating Science into Practice

The Conservation Effects Assessment Project (CEAP) is a multi-agency effort led by USDA's Natural Resources Conservation Service (NRCS) to build the science base for conservation. Project findings help guide USDA conservation policy and program development and support farmers and ranchers in making 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 wildlife is affected by conservation actions on a variety of landscapes, national CEAP Wildlife Assessments complement the CEAP National Assessments for cropland, wetlands, and grazing land. CEAP Wildlife Assessments work through numerous partnerships to support relevant assessments and focuses on regional scientific priorities.

This project was conducted through a collaborative effort by CEAP, Iowa State University, and the U.S. Department of the Interior, U.S. Geological Survey's South Dakota Cooperative Fish and Wildlife Research Unit at South Dakota State University. Primary authors of this document were Adam Janke with Iowa State University and Joshua Stafford with South Dakota State University. NRCS's Charlie Rewa, CEAP Wildlife Lead, was the primary editor.

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