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Blurring the lines between working and conservation lands: Bird use of prairie strips in row-cropped watersheds

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Keywords
Natural Resource Ecology and Management, Conservation practices, Watershed and ecoregion, Wildlife and recreation

Disciplines
Natural Resources and Conservation | Natural Resources Management and Policy | Water Resource Management

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Budget:
$20,158 for year one
$16,828 for year two

Q Can row-cropped agricultural catchments with small amounts of reconstructed prairie support greater native bird biodiversity than row-cropped catchments without prairie?

A At the scale and location of the STRIPS experiment, the answer was yes; however, it may not be possible for all grassland bird species to be conserved through prairie strips.

ECOLOGY

Background

The widespread conversion of native ecosystems to row crops in the midwestern United States has led to phenomenal agricultural productivity. However, agricultural intensification also has caused declines in soil and water quality and losses in native biodiversity. Establishing perennial vegetation in crop-dominated landscapes has been shown to improve ecosystem functioning and expand the suite of ecosystem services provided by agricultural landscapes. Incorporating perennial vegetation also can provide wildlife habitat that is lacking in row-cropped landscapes. Given that most agricultural lands are privately owned, and the landowners depend on farm income, it may not be feasible to transform large areas of row crops to perennials.

In 2007, the Science-based Trials of Row-crops Integrated with Prairies (STRIPS) project team at Neal Smith National Wildlife Refuge (near Prairie City, Iowa) initiated an experiment. The central hypothesis of the STRIPS project is that the conversion of small amounts of row crops to reconstructed prairie within agricultural landscapes will provide disproportionately greater than expected environmental benefits (i.e., soil stability, water purification and attenuation, carbon sequestration, insect pest suppression and wildlife habitat provision) based on the area of land converted. This approach may maximize environmental benefits while minimizing the land taken out of agricultural production, thereby maintaining farm profitability. The keys to this conservation practice are strategic integration of a perennial land cover that is biologically diverse and native to this landscape. These features allow persistent soil conservation and water quality issues to be directly and efficiently addressed. The STRIPS project also is potentially addressing the habitat needs of grassland-dependent species in Iowa by establishing diverse native prairie vegetation.

The research objective of this project was to quantify how grassland birds respond to the novel and economically practical STRIPS conservation practice. The PIs tested these hypotheses in relation to bird habitat provision at the STRIPS project study site at the Neal Smith National Wildlife Refuge:

1: Total bird abundance, species richness, and diversity will be greater in catchments with prairie treatments than entirely row-cropped catchments.
2: Total bird abundance, species richness, and diversity will increase in the years following prairie establishment.

STRIPS Prairie strips (Photo credit:Anna MacDonald)

3: Total bird abundance, species richness, and diversity will increase as the proportion of prairie increases.
4: Total bird abundance, species richness and diversity will be influenced by landscape context.*
(In this case, species richness is the number of species found within the bird community. Species diversity is a more holistic measure of the bird community, which combines the number of species with the evenness of their abundances.)
The outreach objective of the project was to share the research results with a large and diverse group of knowledge users.

Approach and methods

While the overall STRIPS experiment addresses several aspects of ecosystem functioning and service delivery, this study evaluated how birds respond to small amounts of prairie integrated into row crops. Bird response was measured in terms of total bird abundance, species richness, and diversity. The researchers derived these measurements from surveys of breeding birds in 15 small experimental catchments (0.5-3.2ha) with five experimental treatments of varying percentages (0, 10, 20, and 100 percent) and configurations of row crop and prairie cover.

Results and discussion

The results indicate that birds respond positively to the establishment of small prairie strips within row-crop fields; the data demonstrate large shifts in abundance, species richness and diversity from 0 percent prairie treatments to 10-20 percent prairie treatments, and from the planting year to post-establishment years. The investigators documented 52 bird species in the STRIPS sites from 2007 to 2012, ranging from 20-37 species each year, with an average of 29 species per year. They did not include unknown bird taxa (e.g. unknown bird, unknown sparrow, unknown shorebird, etc.) in summaries of species.

Sixteen species comprised 99 percent of the observations, including many generalist species and some species of greatest conservation need. Red-winged Blackbird, Common Yellowthroat, American Goldfinch, Dickcissel, Field Sparrow, and Brown-headed Cowbird were the most common species observed across all years. Researchers documented nesting for 11 species. Total bird abundance, species richness, and diversity all were significantly higher in experimental treatments containing prairie than in the entirely cropped treatment. Year and experimental block also had significant effects on the bird response. This experiment demonstrates that prairie strips incorporated into row crops have the potential to provide habitat for birds, including some species of conservation concern. A remaining question is whether the habitat quality of prairie strips is beneficial enough to help improve bird populations.

Conclusions

The objective was to determine how birds respond to habitat provided by diverse prairie strips in row-crop fields, and the findings showed an overall positive response to the prairie strips in terms of total bird abundance, species richness, and diversity.

Researcher observation. (Photo credit: Lisa Schulte Moore)

This research, combined with other studies conducted for the STRIPS project, indicates that prairie strips in small agricultural catchments can effectively address the most important environmental issues associated with row-crop agriculture, by bringing vast improvements in water quality and biodiversity while only taking small amounts of land out of row-crop production.

Initial findings demonstrated that prairie strips have the potential to provide habitat for a variety of plants, insects, birds, and other wildlife, but they also affirm the need to learn more about how prairie strips function as habitat on the landscape. Despite having six years of data, the high inter-annual variation for weather (e.g., floods, droughts), crop management, and fluctuation in bird populations has limited the ability to fully understand the processes that drive the patterns seen in the data. The limited extent of the small experimental catchments also yielded limited ability to assess the impacts of prairie strips on bird breeding success. Continued monitoring will be necessary to determine the effects of such variation.

The STRIPS research sites are experimental watersheds; smaller than the practical scale at which a landowner would implement prairie strips within a row-cropped field. Additionally, these research sites are nested within an extensive restored grassland matrix which may affect the findings. Therefore, a key objective for future research is to test the STRIPS practice on the farm field-scale, in a variety of landscape contexts, to determine how those factors may affect bird use of habitat strips in crop fields.

Understanding of the habitat value of prairie strips could be supplemented by future research conducted during migration and wintering seasons. Also, understanding the ecosystem services provided by birds in crop fields (e.g., consuming weed seeds, preying on insect pests) could encourage farmers to implement prairie strips in their own fields. Finally, though these data indicate that even small strips and patches of prairie vegetation can provide beneficial habitat for some wildlife, future research should consider testing their additional function as corridors.

Overall, the STRIPS experiment is showing that prairie strips can be a valuable tool for improving ecosystem health in agricultural lands, especially in terms of improving water quality and increasing biodiversity and landscape heterogeneity.

Impact of results

The project objectives were achieved to the extent possible within the STRIPS project experimental design. The results indicate that total bird abundance, species richness, and diversity generally respond positively to small prairie strips. Ideally, the investigators would have been able to analyze nest success, but the sample sizes for individual species were not adequate for conducting statistical analyses, due in part to the small size of the experimental catchments. However, the fact that nesting by several bird species in the prairie strips was documented, and some nest success was observed, indicates that prairie strips may provide nesting habitat for some species.

The success of nests in farm field-scale implementations of prairie strips is likely to be influenced by a variety of factors including landscape context, vegetation diversity and maturity, and the local predator community.

The specific results from the bird biodiversity component of the STRIPS project strengthen the overall message about the conservation benefits of prairie strips. Though soil and water quality may be the primary concerns that attract land managers to adopt conservation practices such as prairie strips, the wildlife habitat provided by a diverse mix of native plants is a benefit missing from many traditional in-field conservation practices. The results from this project may influence Iowans to consider wildlife habitat when choosing agricultural conservation practices for their land.

Education and outreach

A Master's thesis based on this work has been completed. Additionally, project results were part of a published book chapter and three journal papers.

- Liebman, M., M.J. Helmers, and L.A. Schulte. 2010. Integrating conservation with biofuel feedstock production. Pages 131-142 in: P. Nowak and M. Schnepf (eds.), *Managing Agricultural Landscapes for Environmental Quality II: Achieving More Effective Conservation.* Soil and Water Conservation Society, Ankeny, Iowa.
- Heaton, E.A., L.A. Schulte, M. Berti, H. Langeveld, W. Zegada-Lizarazu, D. Parrish, and A. Monti. 2013. Managing a 2G crop portfolio through sustainable intensification: examples from the US and EU. *Biofuels, Bioproducts & Biorefining*.
- Jordan, N., L.A. Schulte, C. Williams, D. Mulla, D. Pitt, C. Schively-Slotterback, R. Jackson, D. Landis, B. Dale, D. Becker, M. Rickenbach, M. Helmers, and R. Bringi. 2013. Landlabs: an integrated approach to creating agricultural enterprises that meet the triple bottom line. Jo*urnal of Higher Education Outreach and Engagement* 17:175-200.
- Liebman, M.Z., M.J. Helmers, L.A. Schulte, and C. Chase. 2013. Using biodiversity to link agricultural productivity with environmental quality: results from three field experiments in Iowa. *Renewable Agriculture and Food Systems* 28:115-128.

Outreach to the broader scientific community included two posters and two oral presentations at four conferences. Outreach efforts to stakeholders included presentations to the STRIPS stakeholders group at annual meetings in 2010, 2011, and 2012.

MacDonald shared information about the STRIPS project with several Pheasants Forever Farm Bill wildlife biologists at the Pheasants Forever state meeting on January 6-7, 2012. MacDonald and Schulte Moore toured the STRIPS sites with Karl Brooks, Regional Administrator for the Environmental Protection Agency's Region 7, on May 11, 2012.

Other outreach activities included formal presentations to conservation groups:

- MacDonald, A.L. and L.A. Schulte Moore. 2010. Blurring the lines between conservation and agriculture: bird use of prairie strips in crop fields. October 23, Iowa Ornithologists' Union fall meeting, Neal Smith NWR, Prairie City.

- Schulte Moore, L.A. 2012. Tweak, Adapt, Transform: Growing a More Sustainable Agriculture for Iowa and Beyond. Iowa Environmental Council. October 4, Des Moines.
- MacDonald, A.L. 2013. Prairie Strips in Row Crop Fields: A conservation practice that provides habitat while improving water quality. Big Bluestem Audubon Society, April 18, Ames.
- MacDonald, A.L. 2013. The STRIPS Project: Science-based Trials of Row crops Integrated with Prairies. Loess Hills Prairie Seminar, June 1, Onawa.
- MacDonald, A.L. 2013. Harnessing the Power of Prairie. Iowa Prairie Heritage Week, September 10, Madison County Extension, Winterset.
- Schulte Moore, L.A. 2013. Tweak, Adapt, Transform: Growing a More Sustainable Agriculture for Iowa and Beyond. Iowa Chapter of the Sierra Club, October 5, Colfax.
- MacDonald, A.L. 2013. The STRIPS Project: Science-based Trials of Row Crops Integrated with Prairies. Project Coordinators meeting for the Southeast Iowa Basin, October 10, Monroe.
- MacDonald, A.L. 2013. Prairie Strips in Row Crop Fields: Blurring the Lines between Production and Conservation Lands. Des Moines Audubon Society, October 15, Des Moines

Leveraged funds

The project received $100 from an Iowa Ornithologists' Union Projects Grant in 2010 and also leveraged a half-time teaching assistantship from ISU's NREM department in spring 2011. The overall STRIPS project, of which this study is a part, has leveraged additional funds of $52,511 from the Iowa Department of Agriculture and Land Stewardship; $240,000 from the Walton Family Foundation; and $150,000 from the USDA Farm Services Agency to support Phase II implementation of the project.

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