Cover Page for LCSA Ecology Full Proposal

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Blurring the Lines Between Working and Conservation Lands: Enhancing Bird and Pollinator Habitat using Prairie Strips

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Leopold Scope of Work Summary

Initial research at Neal Smith National Wildlife Refuge suggests the successful implementation of **prairie strips** across and beyond Iowa could substantially assist LCSA in meeting its goal of more diversified agricultural systems and practices for farm, ecosystem, and societal benefits. The proposed research project moves beyond the refuge to inform the development of this novel conservation practice and answers a remaining scientific question: how do birds and pollinators respond to prairie strips on farmers' fields within typical agricultural landscapes?

The proposed research project will enhance the biotic integrity component of the ongoing LCSA project: Science-based Trials of Row-crops Integrated with Prairie Strips (STRIPS; E2004-14). The central hypothesis of the STRIPS project is that the conversion of small amounts of row crops to prairie will provide environmental benefits (i.e., soil stability, water purification and attenuation, carbon sequestration, insect pest suppression, and wildlife and pollinator habitat) at levels disproportionately greater than expected based on the area of land converted. This approach maximizes environmental benefits while minimizing the land taken out of agricultural production, thereby maintaining farm profitability. Whereas initial STRIPS research was conducted at Neal Smith National Wildlife Refuge, this research will be located on farmers' fields throughout Iowa.

Our **research objectives** are to quantify bird and pollinator response to prairie strips planted on commercial farm fields. We hypothesize that bird and pollinator species richness and abundance, and bird nest success will be higher on fields will prairie strips as opposed to those without. Data on bird response will be collected via autonomous recording units, auditory and visual bird surveys, and nest searching and monitoring. Bee species richness and diversity data will be collected using pan traps, blue vane traps, and sweep netting. This grant will also support an **outreach objective**, which is to disseminate research results to a large and diverse group of knowledge users using effective channels already established by the STRIPS team. Partners include Des Moines Water Works, Iowa State University Research and Demonstration Farms, USDA Farm Service Agency (FSA), Whiterock Conservancy, and 16 private farmers/farmland owners. ISU's Department of Natural Resource Ecology and Management and USDA FSA have provided additional funding to support this work; other partners are cooperating on the implementation of prairie strips and access to land for research and demonstration.

The proposed research project specifically addresses the biotic integrity focus area and landscape subject portal within LCSA's current request for proposals. By experimentally evaluating the potential of prairie strips to provide bird and pollinator habitat on farmers' fields, the proposed project will help fill remaining knowledge gaps and continue to engender and broaden stakeholder support.

PROPOSAL NARRATIVE

BACKGROUND

Need for Research – Agricultural land cover comprises nearly half of the global land base (Ellis and Ramankutty 2008). With rising global population and changing diets, demand for provisioning services in the form of agricultural products is expected to grow in coming decades (Godfray et al. 2010, Naylor 2011). The Millennium Ecosystem Assessment established that increases in provisioning services have historically equated to declines in the remaining suites of ecosystem services (MEA 2005). While tradeoffs between provisioning and other services were more justifiable in an "empty world," this strategy is no longer acceptable on a "crowded planet" due to diminishment in Earth's capacity to absorb the negative consequences of production and salience of ethical issues for current and future generations (Palmer et al. 2004, Rockström et al. 2009, Power 2010). Effective mechanisms for balancing provisioning with other ecosystem services—or blurring the lines between production and conservation—are sorely needed.

Results from the STRIPS (Science-based Trials of Row-crops Integrated with Prairie Strips; www.prairiestrips.org) experiment conducted in 0.5-3.2 ha experimental watersheds indicate that **prairie strips** provide promising approach for balancing the delivery of ecosystem services from agricultural lands, and specifically garnering high levels of ecosystem services with minimal negative impact on the production of commodity row crops. Overall, this multi-year investigation at Neal Smith National Wildlife Refuge (NSNWR) near Prairie City, Iowa, has documented the accrual of ecosystem services at levels highly disproportionate to the extent of row crops converted to native prairie vegetation. Specifically, along with our colleagues on this project, we have documented large improvements in the following **regulating services** with just 10% of watersheds sown with prairie strips: a 95% increase in soil retention, a 90% increase in total phosphorus retention, an 84% increase in total nitrogen retention, and a 63% increase in rainfall infiltration (Helmers et al. 2012, Hernandez-Santana et al. 2013, Zhou et al. 2014). Regarding **provisioning services**, prairie strips do not affect average corn or soybean yields beyond the area taken out of production, and can provide harvestable biomass in the range of 6.9 Mg/ha that may be used as livestock bedding or as a biofuel feedstock (M. Liebman, unpublished data). We also have documented a 3.9-fold increase in plant diversity, a 1.6-fold increase in bird abundance, and a 1.9-fold increase in beneficial insects with prairie strips, relative to watersheds without prairie strips—as well as bee diversity equal to that of reconstructed prairie (MacDonald 2012, Hirsh et al. 2013, Cox et al. 2014, M. Harris unpublished data). Initial financial analysis indicates that prairie strips are more cost-effective than other agricultural conservation practices (Tyndall et al. 2013), which tend to provide singular ecosystem services rather than a full suite. **In sum, data from our catchment-based experimental study suggest the prairie strips provide a cost-effective mechanism to blur the historical lines between pro-**

duction and conservation in Iowa agriculture, but we now need to determine whether these promising results accrue at the broader scale of commercial farm fields. This specific proposal from the STRIPS team aims to determine the extent to which prairie strips sown within row crops enhance bird and pollinator habitat on commercial farm fields.

Literature Review – Along with colleagues, we recently conducted and published an extensive review of the general topic of this proposal, titled *Targeting perennial vegetation in agricultural landscapes for enhancing ecosystem services* (Asbjornsen et al. 2014). Our review covered 324 reference citations, and found that diverse perennial plant communities can enhance hydrologic regulation (Gerla 2007), improve water quality (Duchemin and Hogue 2009), foster carbon sequestration and storage (Zan et al. 2001), promote populations of beneficial organisms for pest control and pollination (Fiedler and Landis 2007), and foster better soil quality (Moonen and Barberi 2008) and enhance ~~general~~ biological functioning (Fonte and Six 2010) relative to simpler cropping systems. Although perennial plants provide a range of provisioning services to society, including food, fiber, fuel and feed, and contribute to diversified production and reduced economic risk, they also produce ~~societal benefits far in~~ negative effects of excess of their areal extent in terms of positive impacts to regulating, ~~supporting, and~~ cultural services (Milestad et al. 2011). Perennial plants can furthermore assist with mitigating and adapting to climate change, which poses a major threat to the sustained delivery of provisioning services, including agricultural production (Schlenker and Roberts 2009, Deryng et al. 2011). Tilman et al. (1997) noted that, relative to simplified plant communities, landscapes with a greater diversity of native perennial species tend to have greater resilience (the ability to recover rapidly from stress) and greater stability (the ability to resist change or withstand stress without loss of function).

As a part of our review, we proposed the **Disproportionate Benefits Hypothesis**, in which perennial vegetation is hypothesized to produce benefits disproportional to its areal extent within landscapes (Fig. 1). While the science supporting this hypothesis is strong, key gaps remain for additional research. These include the need to: (1) disentangle the functional role of the perennial plant form from biodiversity with respect to impacts on ecosystem services; (2) conduct research at scales beyond small (i.e., > 0.5 ha) highly controlled experimental plots; and (3) conduct non-market valuation studies to more fully account for the value of full suites of ecosystem services (Asbjornsen et al. 2014). With respect to the need for research at broader scales, we noted a particular need to conduct research at the scale of farming operations—with farmer participation—and for replicated watershed-scale studies to better understand the impacts of perennials on hydrological services and their relation to other ecosystem services. **The proposed project directly addresses the second knowledge gap and also will be conducted at the scale of farmer operations with farmer participation; it furthermore establishes a framework for addressing the first knowledge gap.**

this addresses the landscape and strip vs whole field issues in reviews

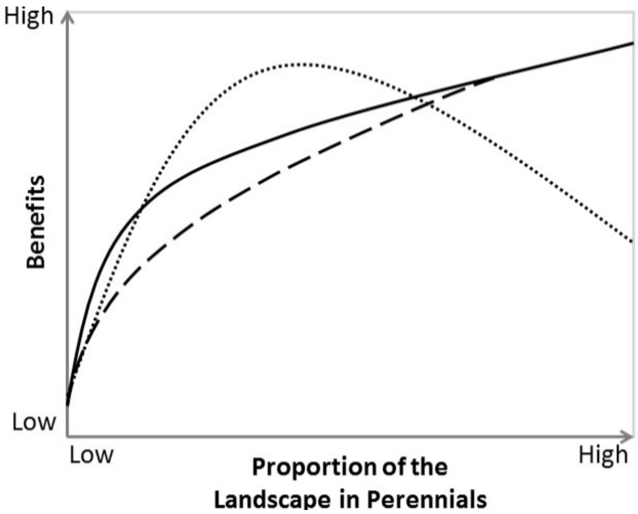

Fig. 1. A graphical representation of the ***Disproportionate Benefits Hypothesis;*** *the dashed line represents ecosystem benefits of non-targeted perennial cover, the solid line represents ecosystem benefits of targeted perennial cover, and socio-economic benefits are represented with the dotted line (Asbjornsen et al. 2013).*

In previous work at the scale of 0.5-3.2 ha experimental watersheds, we generated data that strongly support the Disproportionate Benefits Hypothesis; that is, the strategic integration of small amounts of diverse, perennial vegetation into areas primarily managed for row-crop production provides an effective mechanism for balancing provisioning with other ecosystem services. **Specifically, through the multi-year data collected at our NSNWR experimental site, we have shown that converting 10% of the row-cropped area of agricultural watersheds used for corn-soybean production to native prairie vegetation resulted in the generation of ecosystem services highly disproportionate to the prairie's extent** (Fig. 2; Helmers et al. 2012, MacDonald 2012, Hernandez-Santana et al. 2013, Hirsh et al. 2013, Cox et al. 2014, Liebman et al. 2014, Zhou et al. 2014,). We also found that the level of ecosystem services produced from converting 10% of row-cropped watersheds to prairie strips was similar to that produced from converting 20% of watersheds. Finally, while converting 10% of watershed area to native prairie vegetation resulted in an immediate loss of row-crop production, this loss in provisioning services is partially offset by the generation of harvestable prairie biomass in the range of 6.9 Mg/ha (M. Liebman, unpublished data) and retention of sediment and nutrients (Tyndall et al. 2013).

Specific to this proposal, loss of biodiversity and ecosystem services from agricultural lands are persistent and growing challenges despite decades of investment in agricultural conservation practices in the US (Hull Sieg et al. 1999, Turner and Rabalais 2003, Robertson and Swinton 2005, NRC 2010, Heathcote et al. 2013, McGranahan et al. 2013, Wright and Wimberly 2013). Increasing the amount and connectivity of native prairie habitat throughout the Corn Belt is considered vital to the conservation of grassland biota, which have experienced some of the steepest population declines among all terrestrial taxa in the U.S (Knopf 1986, Herkert et al. 2003, IDNR 2007). In the US, 55 grassland species are threatened or endangered, and 728 species are candidates for listing (Samson and Knopf 1994). In terms of grassland birds, 48% of species in the U.S. are of conservation concern, and 55% have declining populations (NABCI

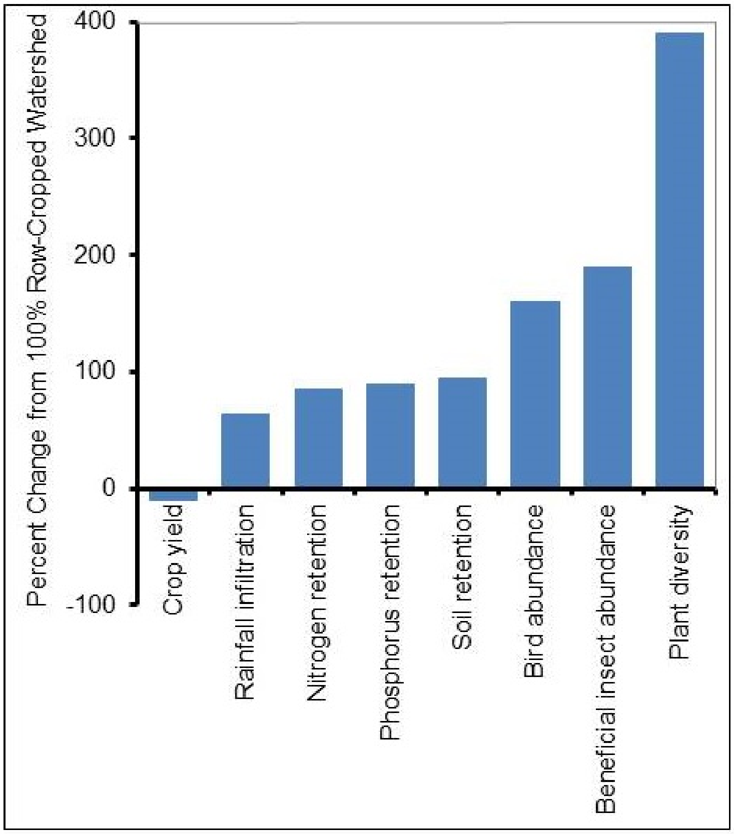

Fig. 2. A graphical summary of results from the STRIPS experimental site at NSNWR, Prairie City, IA, comparing impacts of 10% prairie strips in 90% row-cropped watersheds to watersheds without strips. Note that the maximum percent change for the retention measures is 100%.

2009). Monarch Butterfly (*Danaus plexippus*), an iconic North American species, are in a precipitous population decline (Brower et al. 2011). Iowa's Wildlife Action Plan has identified 20% of the terrestrial "species of greatest conservation need" in the state as dependent on warm-season grassland habitat (IDNR 2007). While the plan seeks to create grassland landscapes of 800 ha or more to benefit grassland-obligate species that require large areas (IDNR 2007), converting large areas of agriculturally productive land is socially, economically, and/or politically challenging in Iowa and elsewhere in the Corn Belt (Atwell et al. 2009, Atwell et al. 2010, Wright and Wimberley 2013). Research suggests that farmers and farmland owners may be more amenable to incorporating native prairie on their land if it were a part of a targeted conservation strategy (Atwell et al. 2009, Atwell et al. 2010, D. Larsen et al., unpublished data), and the STRIPS project is experiencing substantial success in this regard: by the end of 2014, the team will have prairie STRIPS established on 22 farms across Iowa and two farms in Missouri.

Past research suggests that conservation practices that incorporate small amounts of perennial vegetation in and around crop fields may be a viable strategy from wildlife standpoint. Strips and patches of non-crop vegetation in and around row-crops have been solidly shown to support biologically diverse, native and naturalized plant and animal populations (Bryan and Best 1991, 1994, Best et al. 1995, Johnson 2000, Le Couer et al. 2002, Marshall and Moonen 2002, Van Buskirk and Willi 2004, Henningsen and Best 2005, Conover et al. 2009, Burger et al. 2010, Berges et al. 2010). For example, Best et al. (1995) found that, in agricultural landscapes, there was a greater abundance of bird species in strip-cover habitats (e.g. farmstead shelterbelts, grassed waterways) than in other agricultural habitat types. Many birds have been documented to positively respond to conservation practices such as grassed waterways (Bryan and Best 1991, 1994), field borders (Conover et al. 2009, Burger et al. 2010), and riparian buffer strips (Henningsen and Best 2005, Berges et al. 2010); the general trend among these studies is increased bird presence, abundance, and richness in response to the presence of those small habitats adjacent to row-crop fields. While it is fairly well established that many birds and pollinators respond positively to non-crop vegetation located in and around row-cropped lands, it is less clear whether the non-crop vegetation functions as source (areas of population growth) or sink (areas of population decline) habitat for grassland species (Pulliam 1988, Pulliam and Danielson 1991), and under what conditions (Hughes et al. 1999, McCoy et al. 1999, Henningsen and Best 2005). For example, in a study of grassland birds nesting in Conservation Reserve Program (CRP) fields in Missouri, McCoy et al. (1999) found that reproductive rates and fecundity varied among years and species. The CRP fields provided source habitat for Grasshopper Sparrows (*Ammodramus savannarum*), Field Sparrows (*Spizella pusilla*), and Eastern Meadowlarks (*Sturnella magna*), but sink habitat for Dickcissels (*Spiza americana*) and Red-winged Blackbirds (*Agelaius phoeniceus*); the demographics of Common Yellowthroats (*Geothlypis trichas*) vacillated between positive or negative depending on the year.

could include studies by Kremen etc for native bees

A unique component of prairie strips excluded from previous conservation approaches has been integration of diverse, native ecosystems within crop production areas. Most of the habitats assessed in previous grassland bird demographic studies have been composed of exotic or woody vegetation. Few data are available whether interjecting small amounts of reconstructed prairie habitat, as proposed here, will provide higher quality habitat than that employed in other agricultural conservation practices. STRIPS research at NSNWR suggests cropland with prairie strips is able to support a more diverse and abundant bird and pollinator community than cropland without: prairie strips increased watershed plant diversity by 380% compared to the 100% row-crop watersheds (Hirsh et al. 2013); prairie strips provided enhanced floral resources for a diverse community of 70 native bee species, matching the diversity of 100% prairie sites (Harris, unpublished data); watersheds with prairie strips provided habitat for 148% more bird species and 161% more total birds than watersheds with 100% no-till row-crops (MacDonald 2012). Bird species documented using prairie strips include several species of greatest conservation need (i.e., Eastern Meadowlark, Grasshopper Sparrow, Field Sparrow, and Dickcissel). The limited spatial extent of this research and situation in the fairly unique setting of a National Wildlife Refuge precludes understanding of the applicability of these results for more typical Midwestern landscapes. Because reconstructed prairie habitat is similar to the native habitat that grassland species evolved with, it is possible that it will function as an ecological trap (an area falsely perceived to provide quality habitat) for those species mobile enough to choose habitat among several patches (Battin 2004, Robertson and Hutto

2006). Given the critical state of grassland biodiversity in the U.S., it is imperative that depth understanding of the ecological function of any new conservation practice—and the prairie strips practice specifically—be developed prior to its implementation through state and federal conservation policies.

information should be included

Given the promising initial results of the STRIPS experiment and limited understanding of the function of small patches of diverse, native habitats within crop fields as wildlife habitat, our need now is to broaden the domain of inference associated with prairie strips beyond our NSNWR study site. The initial STRIPS experiment is located on the Southern Iowa Drift Plain landform, is surrounded by restored prairie/oak savanna vegetation on the refuge, and is farmed using no-till soil management techniques by a single farmer. There remains an unmet need to understand whether the disproportionate benefits associated with prairie strips also holds at the scale of commercial farm fields, located on different landforms, situated in different landscape contexts, and under different farm management regimes. **The new commercial farm-based experiment (STRIPS Phase II) we are currently implementing is designed to fill these knowledge gaps.**

OBJECTIVES

Our **overall goal** is to test the disproportionate benefits hypothesis by quantifying the impacts of prairie strips integrated within the fields of commercial corn-soybean farms. We are working with cooperators to establish prairie strips at 22 sites in Iowa. At six of these sites we are implementing a paired experimental design, in which each corn-soybean field with prairie strips is paired with an adjacent control field. At the remaining 16 sites, prairie strips have been or are being implemented on farmers' fields without a corresponding control. The broader STRIPS project seeks to quantify the impacts of prairie strips on *provisioning* (crop production), *regulating* (water infiltration, pollution control), and *supporting* (soil structure development and sequestration of carbon and nitrogen, biodiversity preservation, pollination, pest regulation) services at these sites, and additionally estimate the *economic value* of all ecosystem service outcomes using market and non-market valuation techniques. **The current proposal is focused on biotic integrity and specifically seeks to quantify the provision of habitat for birds and pollinators through prairie strips. We propose three interlinked objectives, as detailed below.**

The **first research objective** of this proposal is to quantify how native birds respond to prairie strips on commercial farm fields. We propose to test the following specific hypotheses using the methods detailed in the *Strategies and Methods* section below:

> *H_1:* Bird species richness, abundance, and nest success are higher on commercial farm fields with prairie strips than those without; and

H_2: Bird species richness, abundance, and nest success vary with landscape context surrounding the row-cropped field with prairie strips.

The **second research objective** of this proposal is to quantify how native pollinators respond to prairie strips and ground nesting sites on commercial farm fields. We propose to test the following specific hypotheses using the methods detailed in the *Strategies and Methods* section below:

H_1: Native bee species richness and abundance are higher on commercial farm fields with prairie strips than those without; and

H_2: Native bee species richness and abundance are higher on commercial farm fields with ground nesting sites than those without.

A **third objective** of this proposal is to disseminate our research results to a large and diverse group of knowledge users. Broad dissemination is warranted by the potentially extensive spatial, agronomic, and ecological impacts prairie strips could have if it were implemented over across the Corn Belt region. Given that row-cropped agriculture is predominant in Iowa, the STRIPS project impacts nearly all Iowans. Initial results suggest that impacts are likely to be positive from the standpoint of conserving soil quality, water quality, and attenuating hydrological flows (Helmers et al. 2010, Zhou et al. 2012, Helmers et al. 2014, Hernandez-Santana et al. 2013), benefiting rural and urban stakeholders alike. Given the location of Iowa in the Mississippi River basin, the prairie strips practice, if widely deployed, would also impact people and organisms living downstream. The bird and pollinator biodiversity component of the project, however, broadens its relevance to the continental scale. Initial research at NSNWR suggests prairie strips could provide habitat for birds and pollinators; however, the location of initial experiment on a National Wildlife Refuge compromised broader understanding of the performance of prairie strips in more typical agricultural landscapes. A fuller understanding of the quality of this habitat needs to be developed to determine whether the novel and economically practical prairie strips practice can meet continental biodiversity conservation goals (Fitzgerald and Pashley 2000). The biodiversity conservation component of the STRIPS project, and specifically the bird biodiversity component, also expands the value of the prairie strips practice to include (1) nature enthusiasts, many of whom appreciate prairie for its wildlife-viewing opportunities, and whom have a substantial economic impact on the state of Iowa through their activities (USFWS 2014) and (2) the growing pollinator conservation community that now includes President Obama (Presidential memorandum issued June 20, 2014) and the economic impact of native pollinators in crop production (Kremen et al. 2004). We intend to reach a large and diverse audience through a suite of activities, as outlined in the *Strategies and Methods* section of this proposal. This objective has no clear endpoint, but key midpoints are discussed in the *Evaluation* section of this proposal.

Strategies and Methods

Study Sites and Experimental Design – The proposed work is part of STRIPS Phase II activities and will be located on farmers' fields throughout Iowa. By November 2014, prairie strips are expected to be sown on 22 fields: six of these fields have corresponding controls and comprise a paired experiment; the remaining 16 fields do not have a paired control (Fig. 3). Agricultural portions of the fields are farmed for corn or soybean by local farmers, either the farmland owner or a contracted individual. The prairie strips are composed of reconstructed tallgrass prairie established by the farmer or farmland owner, usually with guidance from the STRIPS team. Plant species composition is variable among locations, but generally includes a diverse mix of cool-season grasses, warm-season grasses, and forbs. The extent of prairie strips is also variable among locations and is based on the site-specific factors.

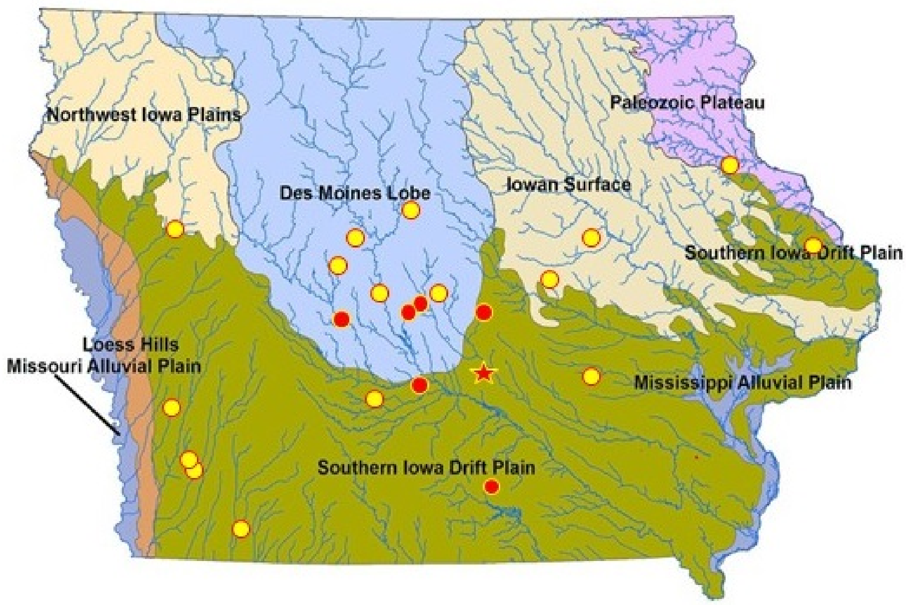

Fig. 3. Location of study sites in relation to landforms in Iowa. Our original STRIPS Phase I study site located at NSNWR is marked with the red star. Our new STRIPS Phase II study sites located on commercial farms are marked with the red (depth research) and yellow (basic monitoring) dots.

Integrating prairie strips into commercial corn-soybean farming operations in Phase II requires a different design than that used for Phase I of our project due to a variable level of experimental control posed by working on private farms and the widespread distribution of study sites. **To overcome these challenges and maintain scientific rigor, we have adopted a two-pronged approach to experimentation: paired "depth research sites" and unpaired "basic monitoring sites."** At six paired depth research sites located more proximal to ISU, we expect to collect data on the full suite of environmental measures investigated in our Phase I research at NSNWR, including crop and prairie productivity; soil erosion, chemistry, and structure; soil water chemistry; ground water chemistry; surface water runoff timing, amount, and chemistry; plant community composition; insect richness and abundance; and bird richness, abundance, and nest success. Additional components will be added with additional funding. At the remaining 16 distributed monitoring sites, we will be collect data on a subset of measures, including soil erosion and chemistry, ground water chemistry, plant community composition, and bird richness.

The paired study design—with treatment and control fields—associated with our depth research sites was based on consultation with statistician Dr. Jarad Niemi (Department of Statistics, ISU). A paired design is appropriate when a high level of background variation impedes the ability to detect treatment responses if treatments were randomly distributed among all study units and has the advantage of being able to simultaneously evaluate multiple factors. We will be investigating or controlling for multiple factors in our depth research experiment: (1) treatment, which is prairie strips or no prairie strips; (2) crop phase, which is corn or soybean; (3) farms, which are located in different geographic settings and managed by different operators; and (4) year effects, which reflect regional-scale weather variation. Farm-level management and environmental characteristics cannot be controlled and will be confounded with site for the duration of this experiment. Local variation in weather will be confounded with site until a long-term time series of data has been collected, but will eventually be factored into our analyses. In statistical analyses, treatment and crop will be fixed effects, whereas farm and year effects will be treated as random. We also will assess a linear year trend for climate change effects. Because implementing our design requires substantial negotiation with multiple entities, including farm owners, managers, farmers, and partners, full randomization of treatments was not possible. We were able to randomize treatment and control fields on four of the six depth research farms, providing us with greater power to detect treatment effects and causal inference with this subset. In statistical analysis of data from our 16 basic monitoring sites, all factors listed above will be accounted for except for treatment, since these sites will not have a paired control.

Depth research sites were purposively chosen from a pool of 22 candidate sites based on institutional ownership; the ability to accommodate environmentally comparable treatment and control fields directly adjacent to one another (Fig. 4); and proximity to ISU. Institutional owners were preferred over private owners due to the higher level of temporal stability they provide, given that we expect to maintain this set of experimental sites for 10 years, pending further funding. Proximity to ISU was favored for logistical reasons related to the timeliness of sample collection. All six farms proposed for this experiment are managed commercially by the institutional owners or through leases with neighboring commercial farmers. Only six sites can be investigated at the present time due to financial and logistical challenges associated with running an experiment of this size and complexity. Efforts were made to have three farms in each phase of the corn-soybean rotation in each year so that crop and year effects could be isolated. Field characteristics, crop management, landscape context, and prairie strip designs vary at each study site based on local biophysical conditions and farming operations (Table 1; Fig. 4).

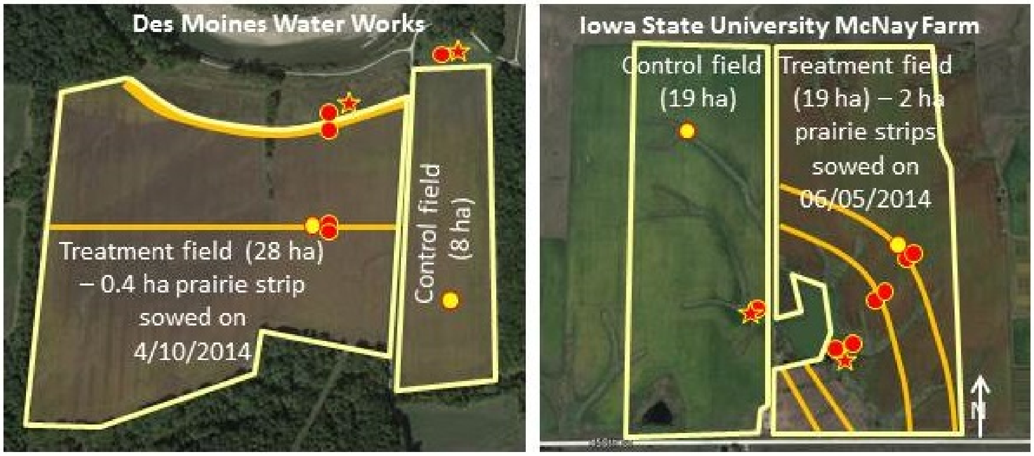

Fig. 4. Two of the six STRIPS Phase II depth research locations with prairie strips in place shown; prairie strips are being implemented at the remaining four depth research sites in November 2014. Locations of prairie strips shown in orange. Approximate location of ARUs associated with bird monitoring are shown with yellow dots; approximate locations of hydrological flumes and ground water wells are shown with red stars and dots, respectively. Fields not drawn to scale.

The specific management history of our depth research sites is unknown, but all fields have been in a corn/soybean rotation for several decades. Per agreements with farm managers (*see letters of support from Scott Atzen, Des Moines Water Works; Mark Honeyman, ISU Research and Demonstration Farms; and Conrad Kramer, Whiterock Conservancy*), crop identity and management on both the strip integrated treatment and row-crop control fields at each study location will be the same. Data on the management history at our 16 distributed monitoring sites is currently being collected and summarized by STRIPS farmer liaison, Mr. Tim Youngquist.

Table 1. Basic characteristics of commercial farms comprising STRIPS Phase II depth research sites.

Farm	Average Annual Rainfall (1984-2013) (mm)	Major Soil Series	Average Slope	Crop in 2014
DMWW	894	Wiota silt loam	1%	Corn
ISU McNay	945	Arispe silty clay loam	6%	Corn
ISU Rhodes	926	Downs silt loam	8%	Corn
ISU Sundberg	891	Clarion loam	3%	Soybean
ISU Worle	891	Clarion loam	2%	Soybean
WRC	917	Marshall silty clay loam	9%	Soybean

Approximately 10% of the area within treated fields will be converted to prairie strips, although the exact percentage will vary with site conditions; sites that are relatively flat and less prone to erosion will have less area converted (e.g., DMWW, ISU Worle, ISU Sundberg), whereas sites that have steeper slopes and more erodible soils will have more area converted (e.g., ISU McNay, ISU Rhodes, WRC; Table 1, Fig. 4). The species composition of prairie seed mixtures will vary by site, depending on cost and availability of prairie seed. In all cases, however, a diverse mixture—containing multiple native cool-season grass, warm-season grass, and forb species—will be planted. Prairie strips have been designed based on topography and modeled erosion potential; visual signs of erosion based on field reconnaissance; the location of existing patches of perennial vegetation; and the size of farming equipment. Each site generally follows the 10% prairie strip treatment from our STRIPS Phase I study at NSNWR: multiple prairie strips distributed from the footslope position to the top of each watershed.

Bird Data Collection – In partial evaluation of *H1: Bird species richness, abundance, and nest success are higher on commercial farm fields with prairie strips than those without, bird species presence* at all sites—both **depth research** and **basic monitoring sites**—will be collected with Automated Recording Units (ARUs; Wildlife Acoustics Song Meter SM3 Acoustic Recorder), which digitally record and store bird and other sounds. ARUs will be deployed in each of the row-crop fields planted with prairie strips beginning in April 2015 and data will be collected monthly thereafter for the duration of the grant period; additional ARUs will be placed in adjacent control row-crop fields at paired depth research sites. Associated control sites will be covered by an equal number of monitoring stations that do not overlap treatment areas. ARUs have an approximate detection radius of 125 m. At the paired depth research sites, ARUs will be placed in treatment and control fields so the detect radii do not overlap. Data captured by the ARUs will first be digitally analyzed for bird and other sounds using computer algorithms associated with Cornell Lab of Ornithology's Raven Interactive Song Analysis Pro Software (http://www.birds.cornell.edu/brp/raven/RavenOverview.html); the accuracy of the algorithms will be assessed for 0.01% of recordings using the human ear and identification.

For full evaluation of H_1, bird habitat use in terms of *species presence, abundance, and nest success* will be fully evaluated at our **depth research sites** using point counts and nest searching and monitoring. A trained observer using unlimited-distance 10-minute point counts, and by nest searching and monitoring (Ralph et al. 1993, Thomas et al. 2010). Three point-count stations will be located at least 100-m apart and 150 m from any field edge, but otherwise randomly, on paired treated and control fields. All birds seen or heard during the point-count period will be recorded and their spatial position will be estimated within 10-m bins, especially in relation to prairie patches. The activity of birds observed will be recorded (e.g., singing, foraging, perching, flying), along with sex, if possible. Surveys will be conducted between one-half hour before sunrise to no later than four hours after sunrise on days with suitable weather conditions (i.e., adequate temperature, no rain, little wind; Blake et al. 1991). Point counts will be performed at least five times during the breeding season (mid-May through July). Density estimates will be derived using the program Distance (Thomas et al. 2010). Data will be analyzed using univariate and multivariate statistical techniques. Covariates such as weather, observer, start time, day of breeding season, and site characteristics will be recorded for inclusion in an *a priori* model of bird site usage. Upland game birds such as Ring-necked Pheasant (*Phasianus colchicus*) and Northern Bobwhite (*Collinus virginianus*) will be analyzed both with and separately from all birds during bird. Brood and covey counts will also be conducted during the month of August to determine population demographic data. Data will be stored in a Microsoft Access database and will be available upon request by all research partners.

Nest searching will be conducted at six paired study sites throughout the breeding season (May-July) each year of the study (Ralph et al. 1993). Nests will be located via rope dragging or by disturbing vegetation with a 1 m pole where rope dragging is not appropriate. One to three people will walk through prairie to cover the entire area watching for flushed birds and conducting a more thorough visual investigation of the area immediately surrounding the flush point; an equal area of cropland will be sampled within treatment fields. A similar total area (summed prairie and cropland areas from treated fields) will be searched within control fields, such that the same amount of area is sampled in treated and control fields. Nests may also be found incidentally during bird point counts, spot-mapping or other field activities. Once a nest is located, location data will be collected via a handheld GPS unit, and the nest will be marked by placing a flag or attaching flagging to vegetation 2-5 m directly north and south of the nest, in order to aid in relocation of the nest without increasing visibility to potential nest predators. Nest age will be determined via visual estimation, and nests will be monitored every 2-4 days until fledging or nest failure. After nest termination, habitat data including litter depth, species composition, visual obstruction, and nest visibility will be collected. Daily nest survival will be estimated using the nest survival model in program MARK (White and Burnham 1999, Dinsmore et al. 2002), which incorporates nest variables (e.g., location, nest age, etc.) in the analyses. If possible, constant (Mayfield) daily survival rates will be calculated to allow for comparison to other studies.

Spatial data on land cover surrounding research sites will also be collected and analyzed in evaluation of *H_2: Bird species richness, abundance, and nest success vary with landscape context surrounding the row-cropped field with prairie strips*. Species lists will be assembled by month and variability in the composition among research sites will be analyzed using time-series and multivariate statistics.

Pollinator Data Collection – Pollinator assessment will begin with the selection of 10 study sites identified among the 16 private and ISU operated farms with prairie strips by November 2014. Additional sites without prairie strips will be identified for the pollinator portion of this study.

The paired sites will not be considered due to the flight ranges of native bees being greater than the distance between the pair members. The identified study sites will be comprised of four fields with prairie strips augmented with ground nesting bee plots, four with prairie strips without nesting plots, two sites in 100% rowcrop with nesting plots and two sites in 100% rowcrop without nesting plots.

Plots of bare soil suitable for colonization by ground nesting bees will be added to each field. Two 5 m x 10 m plots will have vegetation removed by backpack sprayer application(s) of herbicide and with subsequent removed of plant debris with subsequent manual weed removal as needed. Nesting plots will be built adjacent to study fields and placement determined using soil survey maps to identify areas of suitable soil type (Cane 1991) as well as consideration of constraints due to field-specific farming practices. Assessments of plot use will begin in year 2 when emergence holes and active excavations will be counted every 2 weeks throughout the season (Cane 2008).

Ground-nesting bee use of soil within row-cropped fields will be assessed by scouting for bees flying near the soil surface and for presence of tumuli (small hills of excavated soil). Once a potential ground nest site is located the bees will be sampled using supported 6 m x 1.8 m floating rowcovers (Kim et al. 2006) equipped with funnel traps. Areas will be covered after nightfall to insure nesting females will have returned to their entrance holes and funnel traps will be retrieved the following morning and the sites uncovered. In addition to sampling suspected areas of nest activity, each field also will be sampled with 4 rowcovers located randomly within the field. Randomized nest sampling will coincide with bee trapping/sweeping collection (see below) dates for a total of 4 samples from late May to August.

Bee species richness and diversity data will be collected using three sampling methods; pan traps, blue vane traps and sweep netting. Within each prairie strip or within the control field without strips, a 50 meter line transect will be established with one blue vane trap placed at each end. Twelve pan traps (Solo®), four white, four fluorescent yellow and four fluorescent blue (Guerra Paint®, Droege 2012) containing a dilute soap solution will be placed every 5 m in random color order at vegetation height along the transect. Trapping will be initiated by 7 am on sunny, calm (wind speeds less than 15 mph) and warm (ambient temperatures greater than 18^{o}C) and remain in place for 6 hours. Blue vane traps will be deployed for 24 hours.

Sweep netting will be conducted for 12 minutes (6 minutes per 25 meters) at a 5 m distance from the midline along each 50 meter transect. Sweeping will be executed 2 sweepers for a total of 24 minutes per transect. The 12-minute sweeping bouts will be repeated 3 times, once in early morning, mid-morning and early afternoon. Trap and sweep sampling will be completed once each month from late May to August for a total of 4 sampling dates over the growing season. All collected bee specimens will be prepared (pinned with mouthparts pulled and labeled) and identified in the Harris lab where a substantial (>4,000 identified specimens) reference collection is available. Identifications will be confirmed by Sam Droege (USGS Bee Inventory and Monitoring Lab).

We will use analysis of covariance (ANCOVA) to determine how variation in bee species richness and diversity is influenced by one continuous predictor variable: floral resource availability (% cover); and three categorical predictor variables: time (May, June, July, August), prairie strips or no prairie strips treatments, and nesting plots or no nesting plots treatments. We also will employ nonmetric multidimensional scaling (NMDS) to cluster sites with respect to the abundances (counts) of all identified bee species and to visualize the relationship between this clustering and the above three categorical variables (Borcard et al. 2011).

Vegetation Data Collection – Prairie strips as bird and pollinator habitat will be evaluated through annual plant surveys conducted in late June to early August at both **depth research** and **basic monitoring sites** using the methods of Hirsh et al. (2013). Quadrats will be placed along transect lines within both prairie conservation strips and row-crop areas and ground cover will be estimated by species using seven cover classes: 0–1%; >1–5%; >5–25%; >25–50%; >50–75%; >75–95%; or >95–100%. Equal total numbers of quadrats will be used in strip-treatment and control fields, with total sample areas dependent on the size of experimental areas. Statistical analyses of plant species cover will be conducted using the midpoints of each cover class (Bonham 2013).

At **depth research sites**, additional vegetation data will be collected at nest sites after nest fate has been determined. Plant species and cover estimates will be collected using a 0.5-m^2 quadrat, centered on the nest site, to understand nest site selection by birds and its impact on nest success. Vegetation height will be surveyed with a visual obstruction reading from 4 m using a Robel pole placed at the nest site (Robel et al. 1970). We will also measure litter depth at nest sites. For comparative purposes, each nest site will be paired with a random site, located within 10 m of the nest site in the same habitat type (rowcrop or reconstructed prairie); the same vegetation measures will be collected at the nearby random site.

Floral resources for pollinators will be assessed in prairie strips and rowcrops by estimating percent cover of each species in bloom within meter square quadrates along a 50 meter transect. The percent cover of each species in flower will be estimated within 10 1 meter square quadrates along each transect. Species in bloom within the strips or control fields but not encountered with the quadrates will be recorded for each sampling date.

Outreach – We propose a suite of outreach activities to reach a large and diverse group of knowledge users. Results will be disseminated to (*a*) the public through the project website (www.prairiestrips.org) and through social media (@prairiestrips on Twitter); (*b*) diverse Iowa agricultural and environmental stakeholder groups (e.g., Iowa Department of Agriculture and Land Stewardship, Iowa Farm Bureau, Iowa Soybean Association, Pheasants Forever, Practical

Farmers of Iowa, The Nature Conservancy) through annual STRIPS project stakeholder meetings; (*c*) through updates of STRIPS project printed material; and (d) through periodic press releases. We will further communicate our findings to relevant audiences through field days held in conjunction with Iowa Learning Farms; presentations through ISU Extension and other local meetings, such as with Conservation Districts of Iowa; and presentations at least one regional and one national professional conference.

RESULTS

This project addresses the **biotic integrity focus area** and **landscape subject portal** within LCSA's current RFP. **By quantifying the impacts of strategically integrating small amounts of reconstructed tallgrass prairie into farmers' fields on two components of biotic integrity—native birds and pollinators—this proposal will assist LCSA in meeting its goal of developing diversified agricultural systems and practices that result in the management of farm, ecosystem, and societal benefits.**

This project specifically **guides the development of strategically integrated prairie strips as a novel, effective, and economically practical conservation practice for landscapes dominated by row-crop agriculture.** This practice responds to the need to blur the distinction between working lands and conservation lands identified by regional leaders in agriculture, natural resources, and policy in Iowa (see final report from Leopold Project E2006-20 by Schulte, Atwell, and Westphal). Results enhance the biotic integrity component of STRIPS (E2004-14), an ongoing LCSA research team. Other services addressed by STRIPS include soil formation and stability, water purification and attenuation, carbon sequestration, and insect pest suppression, among others. The proposed work will contribute to filling a key knowledge gap articulated by the STRIPS team, which is to understand the impacts of prairie strips on biodiversity at the scale of farmers' fields and within landscapes more typical of Corn Belt agriculture than that of the team's initial research location at NSNWR.

Key outputs of this work include two Master's theses and resulting publications in peer-reviewed scientific journals. In addition, the results from this proposed work will be integrated into existing STRIPS outreach and extension activities to reach a large and diverse group of knowledge users. Results will be disseminated through (1) a project website and social media, (2) annual stakeholder meetings, (c) field days held in conjunction with Iowa Learning Farms, and (3) periodic news releases. We will further communicate our findings to relevant audiences through discussions with extension specialists at ISU, presentations at regional and national meetings, and publications in peer-reviewed scientific journals. Ultimately, the new knowledge on the habitat benefits of prairie strips will contribute to a broader understanding of their environmental benefits, potentially broadening the stakeholder support base for this novel and cost-effective conservation practice. In addition, the new knowledge gained in this study will improve our ability to properly siting prairie strips for biodiversity benefits in addition to soil and water conservation benefits for increased agroecosystem functioning in Iowa and beyond.

PARTNERS

Project investigators on this proposal are housed in the Departments of Natural Resource Ecology and Management (NREM) and Agricultural and Biosystems Engineering (ABE) at ISU. Drs. Schulte and Mary Harris are respectively an Associate Professor and an Adjunct Assistant Professor in this department and together are responsible for overseeing work on this grant. Graduate research assistants in their labs will be responsible for conducting the field portion of the research; interfacing with other field crews working on the STRIPS project; analyzing project data; communicating project results at stakeholder group meetings, field days, and professional meetings; and writing initial drafts of project reports. We expect this project to form the basis of at least two Master's theses. All project investigators will facilitate communication among personnel on the overall STRIPS project; assist the graduate research assistants with data analysis, preparing presentations, and preparing final project reports; communicate project results to key stakeholders in the state; and integrate research results into teaching, outreach, and extension programs. Dr. Schulte will furthermore disseminate research results through the STRIPS project website (www.prairiestrips.org) and Twitter account (@prairiestrips), which she maintains.

The STRIPS project has historically represented a partnership among LCSA, five Iowa State University departments (ABE, Agronomy, Entomology, NREM, and Sociology), Neal Smith National Wildlife Refuge, the US Forest Service Northern Research Station, and USDA Agricultural Research Service National Laboratory for Agriculture and the Environment. LCSA has supported the STRIPS project by providing funding and outreach support (e.g., http://www.leopold.iastate.edu/strips-research-team). In the last two years, however, STRIPS has expanded substantially in scope to include on-farm installations and monitoring of prairie strips. The team is currently working with four institutional farmland owners and 16 private farmland owners to establish and monitor prairie strips. Partners in the current research include Des Moines Water Works, which established prairie strips on two fields in March 2014 (*see letter of support from Mr. Scott Atzen*); Iowa State University Research and Demonstration Farms, which will have prairie strips established on five farm fields by December 2014 (*see letter of support from Dr. Mark Honeyman*); Whiterock Conservancy, which will have prairie strips established on one farm field by December 2014 (*see letter of support from Mr. Conrad Kramer*); and 16 private landowners who have established prairie strips or will have established prairie strips by April 2015. USDA Farm Service Agency (FSA) is another new partner (*see letter of support from Dr. Skip Hyberg*). FSA is providing funds to partially offset the costs associated with monitoring prairie strips implementations and also has provided access to Iowa locations where contour buffer strips have previously been implemented under the Conservation Reserve Program.

STRIPS also has an established a stakeholder group composed of individuals from the following organizations:

- Conservation Districts of Iowa
- Eastern Tallgrass Prairie and Big Rivers Landscape Conservation Cooperative
- Environmental Working Group
- Des Moines Water Works
- Iowa Corn Growers
- Iowa Department of Agriculture and Land Stewardship
- Iowa Department of Natural Resources
- Iowa Environmental Council
- Iowa Farm Bureau Federation
- Iowa Natural Heritage Foundation
- Iowa Natural Resources Conservation Service
- Iowa Soybean Association
- McKnight Foundation
- Practical Farmers of Iowa
- The Land Stewardship Project
- The Nature Conservancy
- Trees Forever
- USDA-ARS National Laboratory for Agriculture and the Environment
- USDA Farm Service Agency
- Walton Family Foundation
- Whiterock Conservancy

These partners provide input on the management of crops and prairie at our experimental sites, feedback on research results, communication project results to their staff and members, and introductions to additional farmers/farmland owners interested in adopting prairie strips. Their support can be viewed in STRIPS – The Movie: www.leopold.iastate.edu/STRIPSTheMovie. Letters of support from these groups are available upon request.

TIMELINE

A timeline for the LCSA-supported work follows. Activities occurring prior to the initiation of this grant are shown in gray.

	2014				2015				2016				2017				2018			
	Quarter																			
Components and activities	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Experimental Design																				
Design and establish prairie strips	x			x																
Prairie strip establishment management			x				x				x									
Hydrological instrumentation				x	x															
Objective 1: Bird Habitat																				
Presence/Absence monitoring with ARUs					←	—	—	—	—	—	—	—	—	—	—	→				
Point counts, nest searching, and monitoring						x	x			x	x			x	x					
Plant community surveys							x				x				x					
Objective 2: Pollinator Habitat																				
Insect community surveys						←	→			←	→			←	→					
Plant community surveys							x				x				x					
Objective 3: Outreach and Dissemination																				
Website and social media updates					←	—	—	—	—	—	—	—	—	—	—	→				
Annual stakeholder meetings		x					x				x				x					
Other field days and presentations							←	—	—	—	—	—	—	—	—	→				
Data Analysis, Project Management, & Reporting																				
Project team meetings & data evaluation					←	—	—	—	—	—	—	—	—	—	—	→				
Data analysis and writing					←	—	—	—	—	—	—	—	—	—	—	→				
Annual progress and final reports									x				x				x			
Submission of publications													←	—	—	—	—	—	—	→

The above strategies apply to the three years of support requested from LCSA; however, we plan to continue this experiment until at least 2025, for a total period of ten years post-treatment. Long-term experimentation is necessary given the length of time required to fully establish the prairie strips. Long-term study also will provide a more robust dataset on environmental performance, generally, and bird and pollinator response, specifically, given climate and population variability.

EVALUATION

We anticipate three outcomes from our research and engagement efforts: (1) an increase in the scientific knowledge underpinning the prairie strips conservation practice; (2) changes in the attitudes, beliefs, and behaviors of project partners to include biodiversity in addition to soil and water in their conservation goals; and (3) increased support for biodiversity conservation goals among the broader Iowa agricultural community. Evaluation of the scientific objective will be conducted by the peer-reviewers of the two-to-three manuscripts we will submit from this work to professional scientific journals, such as *Agriculture, Ecosystems and Environment*; *American Midland Naturalist*; *Conservation Biology*; or *Environmental Entomology*.

Engagement with participating farmers and farmland owners will be evaluated using a survey instrument currently under development by the STRIPS team. This survey instrument will establish baseline management history for farm parcels and changes in farmer/farmland owner attitudes, beliefs, and behaviors over time. Of particular interest to the current scope of work will be changes in attitudes, beliefs, and behaviors towards biodiversity. A positive change may include increased interest in bird or pollinator identification; an increase in support for biodiversity conservation issues; or planting high diversity species mixes in subsequent adoptions of prairie strips. We are working with STRIPS investigator and Extension Sociologist Dr. J. Arbuckle to design our survey instrument.

Measuring impact beyond direct project participants will occur through broader STRIPS field day and stakeholder meeting participant surveys. As we are able, we will incorporate participants' comments and suggestions into the research design and publications. We furthermore iteratively evaluate the extent and breadth of the audience we reach based on the number and spatial distribution of requests for information pertaining to our research.

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Woodcock, B.A., C. Harrower, J. Redhead, M. Edwards, A.J. Vanbergen, M.S. Hear, D.B. Roy, and R.F. Pywell. 2013. National patterns of functional diversity and redundancy in predatory ground beetles and bees associated with key UK arable crops. Journal of Applied Ecology. 51: 142-151.

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Zhou, X., M. J. Helmers, H. Asbjornsen, R. Kolka, and M. Tomer. 2010. Perennial filter strips reduce nitrate levels in soil and shallow groundwater after grassland-to-cropland conversion. Journal of Environmental Quality 39: 2006-2015.

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BUDGET JUSTIFICATION

We request $107,211 from LCSA over three years to support a portion of the total research and outreach costs of this project. Our yearly request includes $38,135 in Year 1, $34,112 in Year 2, and $34,964 in Year 3. Upon acceptance of our pre-proposals, the LCSA board asked us to reduce our funding request by $16,000. ***With this budget, we have reduced our overall request by $22,244.***

Additional funding has been leveraged to support this work. An additional $124,754 of funding in support of the bird habitat portion of this work is provided by USDA Farm Services Agency in the form of a ¼-time graduate research assistantship, undergraduate labor, and funding for travel. LCSA and ISU NREM special projects grants for respectively $9,990 and $31,000 awarded in 2014 support the purchase of Autonomous Recording Units for monitoring birds. For the pollinator portion of the work, additional support of the graduate student will be obtained through the availability of NREM and Biology teaching assistantships. During the first year of the proposed study transportation costs will be reduced by combining trips to research sites with those of an ongoing study funded by USDA Farm Services Agency. A further proposal pending with the USDA National Institute for Food and Agriculture for $499,930 in funding will further support this work if funded.

Our LCSA request for understanding the provision of ***bird habitat (Schulte)*** with on-farm installations of prairie strips totals $48,780 across the three years. Our ***pollinator habitat (Harris)*** request to totals $55,717 across the three years. Our specific request by budget categories follows.

- <u>Salary and wages:</u> We request funds to support two ¼-time research assistantships for all three years of the grant. One of the research assistants will work on bird habitat and the other will work on pollinator habitat assessment. Per ISU CALS' guidelines, this research assistant will be paid $1,700/mo between 02/01/2015 – 06/30/2015, $1,800/mo starting 07/01/2015, and incremented by 3% each year thereafter.

- Fringe benefits: For the graduate research assistants. Rates were calculated at 13.0%, per ISU guidelines (http://www.ospa.iastate.edu/proposal/preparation/benefits).

Travel: In Year 1, we request funds to support partial travel costs for the graduate research assistants to and from study sites. Distances and number of trips required have been estimated at 4,000 miles at $0.37 per mile ($1,480) as per ISU Transportation Services (http://www.transportation.iastate.edu/vehicles/seasonal-term.html). Also in Year 1, we request funds to support partial travel costs for a graduate research assistant to attend a sound-analysis training at the Cornell Laboratory of Ornithology. Costs include $1,040 for the training and $850 in associated travel (flight: $400; lodging: $300 for three nights; meals: $150 for four days). In Years 2 and 3 we request funds to support total travel costs to and from study sites: mileage estimated at $1,480 and vehicle rental $1,332 (for 4 months at $333 per month) as per ISU Transportation Services. Also in Year 2, we request partial funds for a graduate research assistant to attend and present at the 76th Midwest Fish and Wildlife Conference (location unknown); approximate total costs include $295 conference registration fee + $0.33/mi * 500 miles + $200 hotel for two nights + $50 meals = $710. In Year 3, we also request partial funds for a graduate research assistant to attend the 102nd Ecological Society of America meeting in Portland, OR; approximate total costs include $350 conference registration fee + $500 flight + $400 hotel for four nights + $100 meals = $1,350. We will use ISU vehicles for travel whenever available.

- Tuition: For the ¼-time Master's-level graduate research assistants supported by the grant for three years, per ISU guidelines (http://www.ospa.iastate.edu/proposal/preparation/tuition/).
- Supplies: We request funds for signage and 16 cattle panels at each of 5 ISU farms ($3,050) the first year and miscellaneous supplies associated with field data collection and storage.

- Other: In Year 1, we request funds for plot installation costs and user fees at each of five ISU farms ($3,125). In Years 2 and 3 we request funds for user fees at the ISU farms ($625 in each year).

Leopold Center for Sustainable Agriculture

Proposed Budget for ISU Grants

__X__Project Budget ______Subcontract Budget (Check one)

	Schulte Requested Funds for 2015	Harris Requested Funds for 2015	Total Request for 2015
Salaries/Hourly	$ 10,550	$ 10,550	$ 21,100
Payroll Benefits	$ 1,372	$ 1,372	$ 2,744
Equipment > $5,000	$ 0	$ 0	$ 0
Travel - Domestic	$ 1,890	$ 740	$ 2,630
Travel – Foreign	$ 0	$ 0	$ 0
Student Tuition	$ 2,618	$ 2,618	$ 5,236
Supplies and Materials			
Ag & Vet Supplies	$ 0	$ 0	$ 0
Lab & Research Supplies	$ 0	$ 0	$ 0
Other Supplies	$ 250	$ 3,050	$ 3,300
Subcontracts/Consultants	$ 0	$ 0	$ 0
Other Direct Costs			
Telecommunication Charges	$ 0	$ 0	$ 0
Computer Usage	$ 0	$ 0	$ 0
Printing/Copying	$ 0	$ 0	$ 0
Honoraria/Services	$ 0	$ 0	$ 0
Postage	$ 0	$ 0	$ 0
Other	$ 0	$ 3,125	$ 3,125
Total Other Direct Costs:	$ 0	$ 0	$ 0
TOTAL DIRECT COSTS	$ 16,680	$ 21,455	$ 38,135

Leopold Center for Sustainable Agriculture

Proposed Budget for ISU Grants

__X___Project Budget ______Subcontract Budget (Check one)

	Schulte Requested Funds for 2016	Harris Requested Funds for 2016	Total Request for 2016
Salaries/Hourly	$ 10,827	$ 10,827	$ 21,654
Payroll Benefits	$ 1,408	$ 1,408	$ 2,816
Equipment > $5,000	$ 0	$ 0	$ 0
Travel - Domestic	$ 500	$ 2,812	$ 3,312
Travel – Foreign	$ 0	$ 0	$ 0
Student Tuition	$ 2,728	$ 2,728	$ 5,456
Supplies and Materials			
Ag & Vet Supplies	$ 0	$ 0	$ 0
Lab & Research Supplies	$ 0	$ 0	$ 0
Other Supplies	$ 250	$ 0	$ 250
Subcontracts/Consultants	$ 0	$ 0	$ 0
Other Direct Costs			
Telecommunication Charges	$ 0	$ 0	$ 0
Computer Usage	$ 0	$ 0	$ 0
Printing/Copying	$ 0	$ 0	$ 0
Honoraria/Services	$ 0	$ 0	$ 0
Postage	$ 0	$ 0	$ 0
Other	$ 0	$ 625	$ 625
Total Other Direct Costs:	$ 0	$ 0	$ 0
TOTAL DIRECT COSTS	$ 15,712	$ 18,400	$ 34,112

Leopold Center for Sustainable Agriculture

Proposed Budget for ISU Grants

__X___Project Budget ______Subcontract Budget (Check one)

	Schulte Requested Funds for 2017	Harris Requested Funds for 2017	Total Request for 2017
Salaries/Hourly	$ 10,881	$ 10,881	$ 21,762
Payroll Benefits	$ 1,415	$ 1,415	$ 2,830
Equipment > $5,000	$ 0	$ 0	$ 0
Travel - Domestic	$ 1,000	$ 2,812	$ 3,812
Travel – Foreign	$ 0	$ 0	$ 0
Student Tuition	$ 2,843	$ 2,843	$ 5,686
Supplies and Materials			
Ag & Vet Supplies	$ 0	$ 0	$ 0
Lab & Research Supplies	$ 0	$ 0	$ 0
Other Supplies	$ 250	$ 0	$ 250
Subcontracts/Consultants	$ 0	$ 0	$ 0
Other Direct Costs			
Telecommunication Charges	$ 0	$ 0	$ 0
Computer Usage	$ 0	$ 0	$ 0
Printing/Copying	$ 0	$ 0	$ 0
Honoraria/Services	$ 0	$ 0	$ 0
Postage	$ 0	$ 0	$ 0
Other	$ 0	$ 625	$ 625
Total Other Direct Costs:	$ 0	$ 0	$ 0
TOTAL DIRECT COSTS	$ 16,388	$ 18,576	$ 34,964

ATTACHMENTS

- Principal investigator and co-investigator information for:
  - Dr. Lisa A. Schulte
  - Dr. Mary Harris
  - Dr. Matt Helmers
  - Dr. Bob Klaver

- Letters of support from:
  - Mr. Scott Atzen, Supervisor of Grounds and Facility Security, Des Moines Water Works
  - Dr. Mark Honeyman, Director, Iowa State University Research and Demonstration Farms
  - Dr. Skip Hyberg, Economist and Scientist, USDA Farm Service Agency
  - Mr. Conrad Kramer, Executive Director, Whiterock Conservancy

Lisa A. Schulte – Brief resume (15 October 2014)
Associate Professor of Natural Resource Ecology & Management
Iowa State University, 339 Science II, Ames, IA 50011
Phone: 515-294-7339; Email: lschulte@iastate.edu; Web: www.nrem.iastate.edu/landscape

<u>*Education*</u>

Ph.D. in Forestry (emphasis in landscape ecology), University of Wisconsin-Madison, 2002
M.S. in Biology (emphasis in avian ecology), University of Minnesota-Duluth, 1996
B.S. in Biology (minors in chemistry, environmental science), University of Wisconsin-Eau Claire, 1993

<u>*Positions*</u>

Associate Professor, 2009 – present, Iowa State University, Department of Natural Resource Ecology and Management, Ames, IA

Visiting Associate Professor, 2010-2011, University of Minnesota, Department of Bioproducts and Biosystems Engineering and Institute on the Environment, St. Paul, MN

Assistant Professor, 2003 – 2009, Iowa State University, Department of Natural Resource Ecology and Management, Ames, IA

Postdoctoral Associate, 2002 – 2003, USDA Forest Service Northern Research Station, Grand Rapids, MN

Associate Lecturer of Biology, 1997 – 1998, University of Wisconsin – Eau Claire, Eau Claire, WI

Biology Instructor, 1997, Western Michigan University, St. Joseph, MI

<u>*Selected Publications*</u> *(75 publications total; 22 as lead author; 53 peer-reviewed)*

Cox, R., M. O'Neal, R. Hessel, L.A. **Schulte**, and M. Helmers. 2014. The impact of prairie strips on aphidophagous predator abundance and soybean aphid predation in agricultural catchments. Environmental Entomology 43:1185-1197

Asbjornsen, H., V. Hernandez-Santana, M. Liebman, J. Bayala, J. Chen, M. Helmers, C.K. Ong, and L.A. **Schulte**. 2014. Targeting perennial vegetation in agricultural landscapes for enhancing ecosystem services. Renewable Agriculture and Food Systems 29:101-125.

Enloe, S., L.A. Schulte, and J.C. Tyndall. 2014. Fostering collaborative watershed management: lessons learned from the Boone River Watershed, Iowa. Journal of Soil and Water Conservation 69:149A-53A.

Heaton, E., L.A. **Schulte**, M. Berti, H. Langeveld, W. Zegada-Lizarazu, D. Parrish, and A. Monti. 2013. Managing a second-generation crop portfolio through sustainable intensification: examples from the USA and the EU. Biofuels, Bioproducts & Biorefining 7:702-714.

Liebman, M.Z., M.J. Helmers, L.A. **Schulte**, and C.A. 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.

Manatt, R.K., A. Hallam, L.A. **Schulte**, E.A. Heaton, T. Gunther, R.B. Hall, and K.J. Moore. 2013. Farm-scale costs and returns for second-generation bioenergy cropping systems in the U.S. Corn Belt. Environmental Research Letters 8:035037.

Schulte, L.A., T.A. Ontl, and GL D. Larsen. 2013. Biofuels and biodiversity, Wildlife habitat restoration. Pages 540-551 in Levin, S.A., editor. Encyclopedia of Biodiversity, 2nd edition. Elsevier, London, UK.

Tyndall, J.C., L.A. **Schulte**, M. Liebman, and M.J. Helmers. 2013. Field-level financial assessment of contour prairie strips for enhancement of environmental quality. Environmental Management 52:736-747.

Atwell, R. C., L. A. **Schulte** and L. M. Westphal. 2011. Tweak, adapt, or transform: policy scenarios in response to emerging bioenergy markets in the U.S. Corn Belt. Ecology and Society 16: 10.

Atwell, R.C., L.A. **Schulte**, and L.M. Westphal. 2010. How to build multifunctional agricultural landscapes in the U.S. Corn Belt: add perennials and partnerships. Land Use Policy 27:1082-1090.

Selected Grants *($8,246,277 in total grants; $1,448,235 as lead-PI)*

USDA Farm Services Agency; 2014; Estimating the effect of the conservation reserve program (CRP) contour strips on grassland birds in Iowa; $124,754 (PI)

USDA Farm Services Agency; 2013; Evaluation of current USDA contour buffer and filter strip designs as resources for pollinators and for meeting water quality improvement goals in Iowa; $150,000 (co-PI)

Walton Family Foundation, 2013; Spreading prairie strips to Iowa farms for improved water quality, soil conservation, and biodiversity; $240,000 (co-PI)

McKnight Foundation, 2012; Developing the tools and knowledge base to strategically design agricultural landscapes to meet multifunctional goals; $70,000 (PI)

Iowa Soybean Association, 2012; Evaluation of Agriculture's Clean Water Alliance and Partners' Water Quality Monitoring Project in the Boone River Watershed, Iowa; $25,000 (PI)

Leopold Center for Sustainable Agriculture Ecology Initiative, 2011; Blurring the lines between working and conservation lands: bird use of prairie strips in row-cropped watersheds; $36,979 (PI)

USDA Agriculture and Food Research Initiative, 2009; Influence of alternative biomass cropping systems on short-term ecosystem processes; $499,250 (co-PI)

USDA Agriculture and Food Research Initiative, 2009; Learning and teaching with experimental watersheds: valuation of ecosystems services in mixed annual-perennial agroecosystems; $499,833 (co-PI)

Selected Honors and Awards

Fellow, Aldo Leopold Leadership Program, Stanford Woods Institute for the Environment, 2013-present
Invited Member, Rapid-Response Team, Ecological Society of America, 2012-present
Trustee, The Nature Conservancy of Iowa, 2010-present
Coordinating Editor, *Landscape Ecology*, 2010-present
Team Achievement Award, Iowa State University Extension, 2009
Editor's Choice Award, *Journal of Soil and Water Conservation*, 2008
Elected Governing Board Member, U.S. Chapter – Internat'l Assoc'n for Landscape Ecology, 2006-2010
Teaching Award of Merit, North American Colleges and Teachers of Agriculture, 2007
Early Achievement in Teaching Award, Iowa State University's College of Agriculture, 2007
Most Beloved Professor, Iowa State University Fish and Wildlife Biology Club, 2006

Professional Memberships: Association for Women in Science, Ecological Society of America, International Association for Landscape Ecology, Society of American Foresters

Selected Collaborators: Cynthia Cambardella (USDA ARS), Glenn Guntenspergen (USGS), Rick Hall (Iowa State), Arne Hallam (Iowa State), Mary Harris (Iowa State), Emily Heaton (Iowa State), Matt Helmers (Iowa State), Tom Isenhart (Iowa State), Nick Jordan (U. Minnesota), Randy Kolka (US Forest Service), Matt Liebman (Iowa State), Matt O'Neal (Iowa State), Brian Palik (US Forest Service), Mark Tomer (USDA ARS), John Tyndall (Iowa State), Lynne Westphal (US Forest Service)

Graduate Students: Usman Anwar (MS 2014), Ryan Atwell (PhD 2008), Paul Brown (PhD 2008), Carrie Chennault (MS 2014, PhD X'18), Julia Dale (MS X'17), Stephanie Enloe (MS 2014), Rachael Cox Ohde (MS 2012), Katharyn (Derr) Lang (MS 2006), Dustin Farnsworth (MS 2009), Kumudan Grubh (MS 2010), Drake Larsen (MS 2011), Tricia Knoot (PhD 2008), Anna MacDonald (MS 2012), Erik Mottl (MS 2007), Todd Ontl (PhD 2013), Andrew Rayburn (MS 2006), Eddie Shea (MS 2013), Maeraj Sheikh (MS X'16), Emily Zimmerman (PhD X'16)

Websites: www.nrem.iastate.edu/landscape, www.nrem.iastate.edu/landscape/pewi
www.nrem.iastate.edu/landscapebiomass, www.prairiestrips.org

Mary A. Harris - Brief resume (October 2014)
Department of Natural Resource Ecology and Management
and Department of Entomology
Iowa State University, Ames, Iowa 50011
Phone: (515)294-2171 Email: maharris@iastate.edu

Education

Ph.D. Entomology, (emphasis in biological control) University of Georgia, 1995
MS Integrated Pest Management, University of California, Riverside, 1985
MS Wildlife Biology, (emphasis in avian ecology), University of Montana, 1982
BA Biology, University of California, Los Angeles, 1977

Positions

Adjunct Assistant Professor 2005 – present, Iowa State University Department of Entomology

Adjunct Assistant Professor 2007 – present, Iowa State University Department of Natural Resource Ecology & Management

Visiting Scholar 2010, University of New England Department of Ecosystem Management, New South Wales, Australia

Faculty Fellow Iowa State University Office of the EVP Provost/ADVANCE Program, 2008-2009

Insect Zoo Director and Educational Prog. Coordinator 2004, Iowa State University Department of Entomology

Founding Curator 2002 – 2004, Iowa State University Reiman Garden Christina Reiman Butterfly Wing

Temporary Assistant Professor 2000 –2001, Iowa State University Department of Botany

Adjunct Assistant Professor 1996 –2000, University of Iowa Department of Biological Sciences

Assistant Research Scientist 1995 – 1996, University of Georgia Entomology Department

Staff Research Associate II 1988 – 1990, University of California Entomology Department

Head 1986 – 1988, Biological Control Division Technical Business Group, Yoder Brothers, Inc., Alva, Florida.

Staff Research Associate I 1985 – 1986 University of California Entomology Department

Selected Grants

USDA Farm Services Agency; 2013; Evaluation of current USDA contour buffer and filter strip designs as resources for pollinators and for meeting water quality improvement goals in Iowa; $150,000 (lead-PI).

Pollinator Partnership Corn Dust Research Consortium 2013; Use by Honey Bees of Flowering Resources In and Around Cornfields. M. Harris, R. Palmer, J. Coats., $133,413, (lead-PI).

ISU Entomology/Virus-insect interactions at ISU Phase II Year 3 funding 2013. Understanding landscape impacts on the incidence of viruses-of-concern to pollinator health in honey bees and wild bees. A. Toth, M. O'Neal, M. Harris, S. Hendrix. $38,939, (co-PI).

Prairie Biotic Research, Inc. Small Grants Program 2012. Iowa Native Bee-Biodiversity Assessment. M. Harris, $1,000 (PI).

Iowa Department of Agriculture and Land Stewardship, Division of Soil Conservation 2011. Facilitation of Multipurpose Prairie STRIPs Adoption by Iowa Farmers. M. Harris, M. Helmers, $52,511(co-PI).

Hermon Slade Foundation, NSW, Australia 2010. Can the fig-fig wasp pollination mutualism persist in a fragmented landscape? J. Nason, C. Gross, M. Harris. $87,306 (co-PI).

USDA, AFRI, Managed Ecosystems Program, Area: Agriculture and Food Research Initiative 2009. Learning And Teaching With Experimental Watersheds: Evaluation of Ecosystem Services In Mixed Annual-Perennial Agroecosystems., $499,833, (co-PI).

Pertinent Publications

Harris, M. and Iyer, G. 2014. Small Changes, Big Impacts: Prairie Conservation STRIPS. Leopold Center. http://www.nrem.iastate.edu/research/STRIPS/files /Small_Changes_Big_Impacts_STRIPS.pdf

Harris, M. and J. Neal. 2014. Prairie conservation strips on my land: frequently asked questions. Leopold Center.

Leanne M. Martin, H. Wayne Polley, Pedram P. Daneshgar, Mary A. Harris, Brian J. Wilsey. Biodiversity, photosynthetic mode, and ecosystem services differ between native and novel ecosystems. Oecologia DOI 10.1007/s00442-014-2911-0.

Lisa Schulte Moore, Matt Helmers, J. Arbuckle, Pauline Drobney, Mary Harris, Matt Liebman, Randall Kolka, Jeri Neal, Matt O'Neal and John Tyndall. Agroecology that Harnesses the Power of Prairie to Achieve Landscape Conservation Goals. The National Workshop on Large Landscape Conservation.

Mary A. Harris, Lisa A. Schulte, Matthew J. Helmers, J. Gordon Arbuckle, Pauline Drobney, Randall K. Kolka, Matt Liebman, Matthew E. O'NealJohn C. Tyndall. Bridging the conservation lands – working lands divide with a cost-effective strategy to enhance ecosystem services. Abstracts of the 2013 Ecological Society of America 98th Annual Meeting. http://eco.confex.com/eco/2013/webprogram/Session8841.html

Gardner, C. A. C., M. A. Harris, R. W. Hellmich, H. T. Horner, J. C. Nason, R. G. Palmer, J. J. Tabke, R. W. Thornburg and M. P. Widrlechner, eds. 2007. 9th International Pollination Symposium on Plant-Pollinator Relationships- Diversity in Action: Program and Abstracts. Iowa State University, Ames, IA.

Pertinent Presentations

Prairie strips integrated with row crops: biodiversity, soil conservation and income opportunities. Mary A. Harris, Lisa A. Schulte, Matthew J. Helmers, J. Gordon Arbuckle, Pauline Drobney, Randall K. Kolka, Matt Liebman, Matthew E. O'Neal, John C. Tyndall. Society of Ecological Restoration, March 28-29, 2014, St. Paul, MN.

"Bridging the conservation lands – working lands divide with a cost-effective strategy to enhance ecosystem services." Harris, M.A., L.A. Schulte, M.J. Helmers, J.G. Arbuckle, P. Drobney, R. Kolka, M. Liebman, M.E. O'Neal, and J.C. Tyndall. Ecological Society of America, Minneapolis, MN. August 8, 2013.

Current Collaborators: Joel Coats (ISU), Adam Dolezal (ISU), Caroline Gross (UNE-AU), Matt Helmers (ISU), Randy Kolka (US Forest Service), Matt Liebman (ISU), John Nason (ISU), Matt O'Neal (ISU), Lisa Schulte Moore (ISU), Mark Tomer (USDA ARS), Amy Toth (ISU), John Tyndall (ISU)

Biographical Sketch – Matthew J. Helmers

Professional preparation

Iowa State University, Civil Engineering, B.S. (1995)
Virginia Polytechnic Institute and State University, Civil Engineering, M.S. (1997)
University of Nebraska-Lincoln, Agricultural and Biological Systems Engineering, Ph.D. (2003)

Appointments

2014-Present	Professor, Agricultural and Biosystems Engineering Department, Iowa State University – 60% extension, 40% research
2009-2014	Associate Professor, Agricultural and Biosystems Engineering Department, Iowa State University – 60% extension, 40% research
2003-2009	Assistant Professor, Agricultural and Biosystems Engineering Department, Iowa State University – 60% extension, 40% research
1999-2003	USDA National Needs Graduate Fellow, Agricultural and Biological Systems Engineering Department, University of Nebraska-Lincoln
1997-1999	Staff Engineer, URS Greiner Woodward-Clyde, Santa Ana, CA, and Denver, CO
1995-1997	Eisenhower Graduate Research Fellow, Civil Engineering Department, Virginia Polytechnic Institute and State University

Selected Recent Peer-reviewed publications

Iqbal, J. M. Castellano, **M.J. Helmers**, T. Parkin, and X. Zhou. In press. Denitrifcation and N2O emissions in annual croplands, perennial grass buffers and restored perennial grasslands. Accepted October 2014 to *Soil Science Society of America Journal*.

Mitchell, D. X. Zhou, T. Parkin, **M.J. Helmers**, and M. Castellano. In press. Comparing nitrate sink strength in perennial filter strips at toeslope of cropland watersheds. Accepted September 2014 to *Journal of Environmental Quality.*

Daigh, A.L., **M.J. Helmers**, E. Kladivko, X. Zhou, R. Goeken, J. Cavadini, D. Barker, and J. Sawyer. In press. Soil water during the drought of 2012 as affected by rye cover crop in fields in Iowa and Indiana. Accepted March 2014 to *Journal of Soil and Water Conservation.*

Smith, T.W., R.K. Kolka, X. Zhou, **M.J. Helmers**, R.M. Cruse, and M.D. Tomer. 2014. Effects of native perennial vegetation buffer strips on dissolved organic carbon in surface runoff from an agricultural landscape. *Biogeochemistry* 120(1-3):121-132.

Perez-Suarez, M., M. Castellano, R. Kolka, H. Asbjornsen, and **M.J. Helmers**. 2014. Nitrogen and carbon dynamics in prairie vegetation strips across topographic gradients in mixed Central Iowa agroecosystems. *Agriculture, Ecosystems and Environment* 188:1-11.

Daigh, A.L., X. Zhou, **M.J. Helmers**, R. Horton, and R. Ewing. 2014. Subsurface drainage flow and soil water dynamics of reconstructed prairies and corn rotations for biofuel production. *Vadose Zone Journal* doi:10.2136/vzj2013.10.0177.

Zhou, X., **M.J. Helmers**, H. Asbjornsen, R. Kolka, M. Tomer, and R. Cruse. 2014. Nutrient removal by prairie filter strips in agricultural landscape. *Journal of Soil and Water Conservation* 69(1): 54-64.

Christianson, L., J. Tyndall, and **M.J. Helmers**. 2013. Financial comparison of seven nitrate reduction strategies for Midwestern agricultural drainage. *Water Resources and Economics* 2-3: 30-56.

Zhou, X., **M.J. Helmers**, and Z. Qi. 2013. Field scale modeling of subsurface tile drainage using MIKE SHE. *Applied Engineering in Agriculture* 29(6): 865-873.

Tyndall J.C., L. Schulte, M. Liebman, and **M.J. Helmers.** 2013. Field-level financial assessment of contour prairie strips for environmental quality enhancement. *Environmental Management* 52(3):736-747.

Christianson, L.*, R. Christianson, **M.J. Helmers**, C. Pederson, and A. Bhandari. 2013. Modeling and calibration of drainage denitrification bioreactor design criteria. *Journal of Irrigation and Drainage Engineering* 139: 699-709.

Synergistic activities

Dr. Helmers is actively involved in research and extension and outreach activities in the areas of water management and water quality. One focus area is subsurface drainage and the impacts of agricultural management on nutrient export from subsurface drained lands. This includes work on how future agricultural management impacts drainage water quality. Another focus area is surface runoff from agricultural areas. This includes studies on strategic placement and design of buffer systems.

Collaborators and Co-Editors (past 48 months)

J. Arbuckle (Iowa State University), Kapil Arora (Iowa State University), Heidi Asbjornsen (University of New Hampshire), Alok Bhandari (Kansas State University), Greg Brenneman (Iowa State University), Laura Bowling (Purdue University), Michael Castellano (Iowa State University), Jackie Comito (Iowa State University), Rick Cruse (Iowa State University), Craig Chase (Iowa State University),William Crumpton (Iowa State University), Michael Dosskey (National Agroforestry Center), Pauline Drobney (U.S. Fish and Wildlife Service), Mike Duffy (Iowa State University), Dean Eisenhauer (University of Nebraska), Norm Fausey (USDA-ARS), Jane Frankenberger (Purdue University), Brian Gelder (Iowa State University), Mary Harris (Iowa State University), Kirsten Hofmockel (Iowa State University), Robert Horton (Iowa State University), Tom Isenhart (Iowa State University), Dan Jaynes (USDA-ARS), Amy Kaleita (Iowa State University), Eileen Kladivko (Purdue University), Randy Kolka (U.S. Forest Service), Rattan Lal (Ohio State University), John Lawrence (Iowa State University), Dean Lemke (Iowa Department of Agriculture and Land Stewardship), Matt Liebman (Iowa State University), Antonio Mallarino (Iowa State University), Steve Mickelson (Iowa State University), Tom Moorman (USDA-ARS), Emerson Nafziger (University of Illinois), Matt O'Neal (Iowa State University), Gary Sands (University of Minnesota), Tom Sauer (USDA-ARS), John Sawyer (Iowa State University), Lisa Schulte-Moore (Iowa State University), Keith Schilling (Iowa Department of Natural Resources), William Simpkins (Iowa State University), Michelle Soupir (Iowa State University), Jeff Strock (University of Minnesota), Mark Tomer (USDA-ARS), John Tyndall Iowa State University, Lois Wright Morton (Iowa State University)

Graduate Advisor

Dr. J. Michael Duncan (M.S. Advisor) (Virginia Tech) and Dr. Dean Eisenhauer (Ph.D. Advisor) (University of Nebraska)

Thesis Advisor and Postgraduate-Scholar Sponsors (15 total)

Linda Geiger (M.S. current). Emily Waring (current), Kristina Craft (current), Ryan Goeken (M.S. '13), Dan Andersen (Ph.D. '12), Andrew Frana (M.S. '12), Wade Welsh (M.S. '12), Delise Lockett (M.S. '12), Jose Guiterez-Lopez (M.S. '12), Laura Christianson (Ph.D. '11), Qi Zhiming (Ph.D. '09), Emily Hancheck (M.S. X'12), Melissa Cheatham (M.S. 2007), Mario Perez-Bidegain (Ph.D. '07), Greg Shepherd (M.S. '06), Kyle Riley (M.S. '06), Dr. Ranvir Singh (Post-doc. 05-07), Dr. Xiaobo Zhou (Post-doc. 07-09), and Dr. Aaron Daigh ('13)

ROBERT W. KLAVER

U.S. Geological Survey
Iowa Cooperative Fish and Wildlife Research Unit
Department of Natural Resources Ecology and Management
Iowa State University
Ames, IA 50011
Telephone: (515) 294-7639
E-mail: bklaver@iastate.edu

EDUCATION

PhD Wildlife Biology – South Dakota State University, Brookings, SD - 2001
MS Wildlife Biology - University of Montana, Missoula, MT - 1977
BS (with honors) Wildlife Biology - University of Montana, Missoula, MT - 1974
Graduate Studies Biochemistry - Brandeis University, Waltham, MA - 1971-1972
BS (with honors and distinction) Biochemistry - Iowa State University, Ames, IA - 1971
Minor in Mathematics, Statistics and Computer Science.

EXPERIENCE

Throughout my career I have combined my academic skills and professional experience in of wildlife biology, forestry, wildland fires, atmospheric science, hydrology, mathematics, statistics, geostatistical and geospatial analysis, computer programming languages, and hardware configuration to manage and research wildlife issues. Have expert knowledge of geospatial and geostatistical analysis for natural resource applications. I have gained an understanding of the strengths and limitations of these tools for wildlife management.

Highly experienced in analyzing wildlife-habitat relationships and interpreting wildlife surveys using statistical, GIS, and remote sensing techniques. Ability to program in several computer languages.

Training in fire ecology and fire effects. Use satellite imagery to understand fire effects. Developed fire prescriptions to enhance wildlife habitat.

Developed and taught graduate and undergraduate college courses and agency training classes. Trained field assistants and colleagues.

Academic and Professional Honors and Awards

Phi Kappa Phi, National Scholastic Society; Phi Mu Epsilon, National Mathematics Honor Society; Phi Lambda Upsilon, National Chemistry Honor Society; Gamma Sigma

Delta, The Honor Society Of Agriculture; PhD Student of the Year (2001), Department of Wildlife and Fisheries Science, South Dakota State University

Professional Societies

Certified Wildlife Biologist, 1981; The Wildlife Society; Society for Conservation Biology; Ecological Society of America; International Association for Landscape Ecology; American Society of Mammalogists

RECENT PUBLICATIONS AND PRESENTATIONS

(out of 42 total publications)

Grovenburg, R.W. Klaver, and J.A. Jenks. **In Press**. Spatial Ecology of White-Tailed Deer Fawns in the Northern Great Plains: Implications of Loss of Conservation Reserve Program Grasslands. Journal of Wildlife Management.

Klaver, R.W., D. Backlund, P.E. Bartelt, M.G. Erickson, C.J. Knowles, P.R. Knowles, and M.C. Wimberly. **In Press**. Spatial analysis of northern Goshawk territories in the Black Hills, South Dakota. Condor.

Grovenburg, T. W., R. W. Klaver, and J. A. Jenks. **In Press**. Survival of white-tailed deer fawns in the grasslands of the Northern Great Plains. Journal of Wildlife Management.

Ceccato, P., C. Vancutsem, R. Klaver, J. Rowland, and S.J. Connor. A vectorial capacity product to monitor changing malaria transmission potential in epidemic regions of Africa. Journal of Tropical Medicine 2012:1-6.

Montieth, K.L., V.C. Bleich, T.R. Stephenson, B.M. Pierce, M.M. Conner, R.W. Klaver, and R.T. Bowyer. 2011. Phenological patterns of season migration in mule deer: effects of climate, plant phenology, and life history. Ecosphere 2(4):1-34.

Bartelt, P.E., A.L. Gallant, R.W. Klaver, C.W. Wright, D.A. Patla, C.R. Peterson. 2011. Predicting breeding habitat for amphibians: a spatiotemporal analysis across Yellowstone National Park. Ecological Applications 21:2530-2547.

Kaczor, N.W., K. C. Jensen, R. W. Klaver, M. A. Rumble, K. M. Herman-Brunson, C. C. Swanson. 2011. Nesting success and resource selection of greater sage-grouse in South Dakota. Studies in Avian Biology 39:107-118.

Kaczor, N.W., K. M. Herman-Brunson, K. C. Jensen, M. A. Rumble, R. W. Klaver. 2011. Greater sage-grouse brood-rearing resource selection in the Dakotas. Studies in Avian Biology 39:169-177.

Grovenburg, T.W., C.C. Swanson, C.N. Jacques, R.W. Klaver, T.J. Brinkman, B.M. Burris, C.S. DePerno, and J.A. Jenks. 2011. Survival of white-tailed deer neonates in Minnesota and South Dakota. Journal of Wildlife Management. 75:213-220.

Grovenburg, T.W., C.C. Swanson, C.N. Jacques, C.S. DePerno, R.W. Klaver, and J.A. Jenks. 2011. Female white-tailed deer survival across ecoregions in Minnesota and South Dakota. American Midland Naturalist 165: 426-435.

Schulte-Moore, Lisa A [NREM]

From: Atzen, Scott <atzen@dmww.com>
Sent: Wednesday, May 28, 2014 2:31 PM
To: Schulte-Moore, Lisa A [NREM]
Subject: Maffitt

Hi Lisa,

We are excited about the partnership that we have started with ISU and your Prairie Strips team. We welcome the opportunity to have you install your monitoring equipment on site, in order to provide data on the strips that we installed this spring. Please know that this area is secured by gates, but DMWW cannot be held responsible for any damage that may occur to your equipment, either by vandalism or natural occurrences. This area is prone to flooding, but if installed on high enough ground – there probably won't be any issues. I will provide you a key for the gates that lead to the strips area, so that you can have access to the site.

Also, if possible, we would like you to share any of the data that is collected.

Please feel free to contact me at any time, should you have questions.

Thanks a lot,

Scott

SCOTT ATZEN | Supervisor of Grounds and Facility Security

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2201 George Flagg Parkway | Des Moines, Iowa 50321 | www.dmww.com

Phone: (515) 283-8702 | fax: (515) 283-8727 | e-mail: atzen@dmww.com

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

Research and Demonstration Farms
103 Curtiss Hall
Ames, Iowa 50011-1050
515 294-5045
FAX 515 294-6210

October 17, 2014

Lisa Schulte-Moore, Associate Professor
Natural Resource Ecology and Management
142 Science II
Iowa State University
Ames, IA 50011

Dr. Schulte-Moore:

I am writing in support of the project entitled "Blurring the lines between working and conservation lands: Enhancing bird and pollinator habitat using prairie strips" led by an interdisciplinary team of agricultural scientists at Iowa State University (ISU). The project is timely in its approach of addressing a broad spectrum of agricultural and environmental topics, particularly to reduce nutrient movement from agricultural fields.

The ISU Research Farms stand ready to assist with this project by providing appropriate sites for the next key phase of the work – field scale evaluation and demonstration at the farm level. The proposed side-by-side paired comparisons will generate practical information as well as sub-watershed demonstrations.

The Committee for Agricultural Development (CAD) owns and manages farmland in Iowa. CAD is a non-profit corporation affiliated with ISU College of Agriculture and Life Sciences. CAD and ISU Research Farms work jointly to meet field research and land needs of scientists at ISU.

ISU Research Farms and CAD operate some farms at a commercial scale that are suitable for the field scale phase of this project. Both groups are committed to the goals and strategies of the project, and have the experience and expertise to ensure successful selection and management of meaningful field sites.

Sincerely,

Mark S Honeyman

Mark S. Honeyman
Coordinator, ISU Research Farms
and Professor, Animal Science
Executive Director
Committee for Agricultural Development

AG ENGINEERING AND AGRONOMY RESEARCH FARMS:
1308 U Avenue, Boone, Iowa 50036;
AE: 515 296-4081; Agron: 515 296-4082
ALLEE RESEARCH AND DEMONSTRATION FARM:
2030 640th Street, Newell, Iowa 50568; 712 272-3512
ARMSTRONG RESEARCH AND DEMONSTRATION FARM:
53020 Hitchcock Ave., Lewis, Iowa 51544; 712 769-2402
HORTICULTURE RESEARCH STATION:
55519 170th Street, Ames, Iowa 50010; 515 232-4786
MCNAY RESEARCH AND DEMONSTRATION FARM:
45249 170th Avenue, Chariton, Iowa 50049; 641 766-6465
MUSCATINE ISLAND RESEARCH AND DEMONSTRATION FARM:
P.O. Box 40, Fruitland, Iowa 52749; 563 262-8787
NORTHEAST RESEARCH AND DEMONSTRATION FARM:
3321 290th Street, Nashua, Iowa 50658; 641 435-4864
NORTHERN RESEARCH AND DEMONSTRATION FARM:
310 S. Main Street, Kanawha, Iowa 50447; 641 762-3247
NORTHWEST RESEARCH AND DEMONSTRATION FARM:
6320 500th Street, Sutherland, Iowa 51058; 712 446-2526
SOUTHEAST RESEARCH AND DEMONSTRATION FARM:
3115 Louisa/Washington Road, Crawfordsville, Iowa 52621;
319 658-2353
WESTERN RESEARCH AND DEMONSTRATION FARM:
36515 County Hwy E34, Castana, Iowa 51010;
712 885-2802

October 24, 2014

Lisa A. Schulte
Natural Resource Ecology & Management
339 Science II
Iowa State University
Ames, IA 50011

Dear Dr. Schulte,

As leader of USDA Farm Service Agency's (FSA) CRP Monitoring, Assessment and Evaluation program, I'm pleased to support your proposal, *Blurring the lines between working and conservation lands: Enhancing bird and pollinator habitat using prairie strips*, to the Leopold Center for Sustainable Agriculture's grants program.

The Farm Service Agency is committed to identifying and encouraging cost-effective ways to implement conservation on private agricultural lands. Initial research by your STRIPS team suggests that prairie strips offers an effective way to protect fragile cropland while providing multiple environmental services such as pollination, wildlife habitat for grassland birds, erosion control, and enhanced water quality. The STRIPs project is working to quality these services, a mission FSA enthusiastically supports. We are pleased that your program is gaining the attention of a growing number of farmers and landowners.

As you know, however, significant knowledge gaps remain in how prairie strips function at the scale of farmers' fields and how they compare to more traditional conservation practices, such as buffers and filter strips composed of less diverse plant cover. For this reason, FSA is happy to support your monitoring efforts associated with on-farm implementations of prairie strips. Your current proposal would expand upon this research, and foster a more robust understanding of the prairie strips practice. I encourage the Leopold Center for Sustainable Agriculture to join FSA in supporting your proposal.

Sincerely,
Skip Hyberg

Whiterock
CONSERVANCY

1390 Highway 141
Coon Rapids, IA 50058
Ph: 712-684-2697
Fax: 712-684-2299
www.whiterockconservancy.org

May 30, 2014

Dr. Lisa Schulte-Moore
Iowa State University
Natural Resources Ecology Management Department
Ames, IA 50011

Dear Dr. Schulte-Moore:

With Whiterock Conservancy's mission to demonstrate and promote sustainable agriculture, we support your proposal titled, "Prairie Strips as an Innovative Agro Ecosystem Practice to Enhance Ecosystem Services from Farmers' Fields," to the USDA NIFA's program on Agriculture and Food Research Initiative (AFRI) Renewable Energy, Natural Resources, and Environment (Priority Area – A1451).

Whiterock sustainably grazes almost 1,000 acres of improved pasture and we are also developing warm season prairie pastures to also serve as wildlife habitat. Moreover, we sustainably crop 300 acres using no till, waterways, buffers, terraces, and multispecies cover crops. We are eager to test prairie strips on our land to understand the strategy's soil and water conservation effectiveness and habitat benefits. New knowledge from your team is critical to informing our management decisions.

The early results the STRIPS team obtained at the Neal Smith National Wildlife Refuge about the impacts of prairie strips on soil, water, and wildlife conservation has caught my attention. I'm concerned about maintaining these important resources both at Whiterock Conservancy and within Iowa's agricultural landscapes into the future.

I understand that the prairie strips practice is a new and innovative conservation practice and you are not yet sure if similar results will be obtained in an operational farm setting, nor how the practice might conflict with our goals. I know further research is needed.

I write this letter to certify that Whiterock Conservancy is willing to work with you and your team on implementing prairie strips on our farm as a part of your grant proposal and in an effort to fill knowledge gaps. Specifically, we will work with your team to use a portion of our farm as a part of your experiment. I also grant you my permission to use Whiterock's crop land as a demonstration and evaluation site as a part of the STRIPS project.

Sincerely,

Conrad Kramer
Executive Director