Simpson College
Research, Scholarship and Creativity Fund
2013-2014

Submitted by: Clinton Meyer, Biology & Environmental Science
Phone: 961-1822, email: clinton.meyer@simpson.edu

1. Title of proposed project: Terrestrial Invertebrate Response to Planted Seed Diversity in Prairie Restoration

2. Description of project for which funding is being sought:
   a) Purpose:
   Tallgrass prairie is one of the most degraded and threatened ecosystems in the US. In the agricultural Midwest, the vast majority of native tallgrass prairie area has been converted to row-crop agriculture (Samson and Knopf 1994). Although the ecological value of prairies has been well-studied (Weaver 1954, 1968, Risser et al. 1981, Samson and Knopf 1996 and references therein), recent evidence confirms the value of prairies and suggests that their economic value (Costanza et al. 1997, Dodds et al. 2008) makes them important foci for restoration efforts.

   Restoration ecology, the branch of biology dedicated to increasing recovery of these imperiled habitats, is a relatively new field. Thus, there is incredible potential for answering basic and applied questions related to recovery. In particular, this project would focus on responses of invertebrates to restoration processes, specifically the reestablishment of native vegetation. Restoration efforts typically involve removing the disturbance (in this case, ceasing farming of sites), followed by introduction of seeds from locally-collected natural vegetation. Land stewards must decide which and how many plant species to introduce into restorations. Because seed collection, processing, and planting is time, labor, and money-intensive, restoration practitioners are interested in finding minimum thresholds for diversity that result in functional restorations. In other words, could seeding with a relatively low diversity of seeds still result in a prairie that is utilized as habitat by a high diversity of consumers such as birds and insects?

   The Nature Conservancy of Nebraska has been involved in restoration of wet meadow prairie habitats in south-central Nebraska for over 15 years. They and other conservation organizations (Plains Prairie Resource Institute, Platte River Trust) are pioneers in the
development of restoration practices in the Great Plains (see Steinauer 2003). In addition to several large-scale projects, they have established a research experiment in which replicate plots along a gradient of seed diversity (monoculture, low diversity, high diversity) have been established; the plots are designed to answer questions related to responses of other groups of organisms as well as soil and nutrient status. In particular, the objective of this study is to assess whether differences in plant diversity affect richness and diversity of ground-dwelling invertebrates. The project would include a combination of plant richness and diversity sampling and pitfall trapping for invertebrates within the established plots. The hypothesis is that invertebrate richness is highly correlated to plant richness, and plots with higher plant richness will have correspondingly high invertebrate richness.

b) Feasibility:
I have extensive research experience in both restoration and insect ecology (see attached CV). I hold a Master’s degree in Entomology from Kansas State University and a PhD in Zoology from Southern Illinois University Carbondale (SIUC). Following graduate school, I completed a one-year post-doctoral experience examining recovery following prairie restoration in the Department of Plant Biology at SIUC. My graduate and post-doctoral work has resulted in 9 publications in peer-reviewed scientific journals. Since that time, I have been involved in many research projects involving undergraduates related to invertebrate and/or restoration ecology. Additionally, I have been working with colleagues in the Platte River region of south central Nebraska for over a decade. My dissertation research focused on the region, and I am involved in several projects related to wetland and prairie restoration practices to track recovery of invertebrates. In fact, the proposed research project was designed in consultation with the Program Director of The Nature Conservancy’s Eastern Projects Office, Chris Helzer. Therefore, I am confident the results of this work are of great interest to Mr. Helzer and other restoration practitioners in the region.

3. Project Design and Justification.
The project will make use of plots that have been established by The Nature Conservancy of Nebraska (Hall County) to investigate responses to restoration based on differences in planted seed diversity. Replicated 60 x 60m plots were established in 2010. The design includes
replicates of the following 3 plant diversity types: monoculture, which was seeded with 100% big bluestem (*Andropogon gerardii*); low diversity, which was seeded with a low diversity mix of grasses and herbaceous plants; and high diversity, which was seeded with a high diversity mix of grasses and herbaceous plants (see Figure 1).

Sampling will focus on two major components of recovery. Firstly, plant richness and diversity will be measured at 9-12 locations in each of the twelve plots using a 0.25m$^2$ quadrat. All plant species found within the quadrat will be identified to species (Christiansen and Muller 1999, Stubbendieck 2003, Runkel and Roosa 2009), and aerial cover of each will be estimated to calculate plant species richness and diversity. This is important because it is not only the focus of the restoration methods, but also because the hope is that consumer groups (birds, invertebrates, mammals, etc.) will respond positively to restored plant communities. Secondly, ground-dwelling invertebrates will be measured by installing a series of pitfall traps (8 dram vials) within each plot. Pitfall traps are part of a passive sampling technique that makes use of invertebrate behavior and gravity such that invertebrates walking over a trap fall in and are collected. I am proposing to install 9-12 pitfall traps in each of 12 plots. The traps will be left in place for ~48 hours. The sampling would be done early (first week of June) and late (first week of August) during the season to account for temporal variability. Major groups of invertebrates will be separated and identified to genus (Arnett and Thomas 2000, Arnett et al. 2002, Fisher and Cover 2007) to estimate richness and diversity. A plant identification quadrat will be centered over each pitfall trap so that I can test for correlations between plant richness and species composition and invertebrate richness and composition.

This project was initially implemented during summer 2012 and was funded by the Bryan Summer Research Program in Mathematics. I worked with Heidi Berger, 3 math students, and 1 biology student to begin addressing this research question in an interdisciplinary way. We used field sampling to estimate plant and invertebrate richness in the plots. The students applied mathematical modeling to the data to investigate relationships between plants and inverts, as influenced by additional environmental variables. We were surprised to find that during 2012, although plant richness did indeed differ by planting treatment, there was no corresponding difference in invertebrate richness (Table 1). If this is true, it might suggest that ground-dwelling invertebrates are particularly resilient to agricultural disturbance, or perhaps more likely that richness of invertebrates is limited by factors in addition to plant richness. Also it is worth
noting that during 2012, south-central Nebraska experienced severe drought conditions. It is impossible to separate drought impacts from recovery patterns related to plant communities. Thus, adding another year of field data would help to further discern patterns of recovery in invertebrates, as well as help us measure inter-annual variability in richness. An additional factor to consider is that the plots are fairly young (established in 2010), so measuring biotic responses early in the recovery process would contribute valuable information to practitioners. The continuation of the data collection would be beneficial to land managers practicing restoration in the Platte region and beyond. Also, it would help Dr. Berger and I to continue building on a successful inter-disciplinary approach to research. Having another year of data would allow us to further fine-tune our mathematical model to assess the impact of plant diversity on ground-dwelling invertebrates in restored prairies in the central Platte River region.

4. **Budget for the project:** I am requesting funding for travel and salary. Funding would pay for 2 trips to field sites (using Environmental Science Truck; only gas reimbursement is requested). Additionally, the funding would pay for two students to work on processing samples and identifying invertebrates in samples during the fall semester. Finally, I am requesting salary for my time devoted to field sampling, invertebrate identification, and the mentoring of students. See attached form for details.

5. **Please indicate whether, if your proposal is funded, we may share your proposal with others:**

If the project is funded, you have my permission to share in part or in total any portion of this document.
Literature Cited


Weaver, J. E. 1968. Prairie plants and their environment. University of Nebraska Press, Lincoln, Nebraska.
Table 1. Average richness of plants and invertebrates, collected during summer 2012 at The Nature Conservancy Plots (Hall County, Nebraska). Data show averages from each of 4 plots per treatment and overall averages for each of the following three treatments: Mono plots= monoculture, LD= low diversity mix of grasses and forbs, and HD= high diversity mix of grasses and forbs. Initial data suggest that although plant richness is significantly different by treatment, invertebrates did not differ by treatment.

<table>
<thead>
<tr>
<th>Plant Richness</th>
<th>Invertebrate Richness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mono</td>
<td>LD</td>
</tr>
<tr>
<td>4.56</td>
<td>4.56</td>
</tr>
<tr>
<td>3.44</td>
<td>5.56</td>
</tr>
<tr>
<td>5.22</td>
<td>4.78</td>
</tr>
<tr>
<td>4.78</td>
<td>5.33</td>
</tr>
<tr>
<td>Ave: 4.50</td>
<td>5.06</td>
</tr>
</tbody>
</table>

Significantly different (F=16.1, P=0.001) Not significantly different (F=1.05, P=0.39)
Figure 1. Aerial photograph of research plots established by the Nature Conservancy of Nebraska in Hall County. Proposed sampling would take place in the twelve 60 x 60m research plots which include 4 replicates each of the following treatments: Mono plots= monoculture, LD= low diversity mix of grasses and forbs, and HD= high diversity mix of grasses and forbs.
## Budget Proposal Form
**Research, Scholarship, and Creativity Grant**
*2013-2014*

<table>
<thead>
<tr>
<th>ITEM</th>
<th>AMOUNT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Equipment</strong></td>
<td>$</td>
</tr>
<tr>
<td>1: Cost:</td>
<td></td>
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<tr>
<td>2: Cost:</td>
<td></td>
</tr>
<tr>
<td>3: Cost:</td>
<td></td>
</tr>
<tr>
<td><strong>Materials</strong></td>
<td>$</td>
</tr>
<tr>
<td>1: Cost:</td>
<td></td>
</tr>
<tr>
<td>2: Cost:</td>
<td></td>
</tr>
<tr>
<td>3: Cost:</td>
<td></td>
</tr>
<tr>
<td><strong>Personnel</strong></td>
<td>$714</td>
</tr>
<tr>
<td>1. Student worker 1</td>
<td></td>
</tr>
<tr>
<td>2. Student worker 2</td>
<td></td>
</tr>
<tr>
<td>14 weeks in Fall semester, 3 hrs each @ $8.50/hour = $714</td>
<td></td>
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<tr>
<td><strong>Travel Costs</strong></td>
<td>$584</td>
</tr>
<tr>
<td>Airfare:</td>
<td>$</td>
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<tr>
<td>Mileage: Number of miles _______ @ .565/mile</td>
<td></td>
</tr>
<tr>
<td>600 miles each way, 2 trips = 2400 miles. 15 mpg with Environmental Science truck = 160 gallons @ $3.65/gallon = $584</td>
<td></td>
</tr>
<tr>
<td>Lodging</td>
<td>$</td>
</tr>
<tr>
<td>Number of days _____ @ $ ____/day</td>
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<tr>
<td><strong>Other Expenses</strong></td>
<td>$</td>
</tr>
<tr>
<td>1: Cost:</td>
<td></td>
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<td>2: Cost:</td>
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<td>3: Cost:</td>
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<tr>
<td><strong>Taxable Faculty Stipend</strong></td>
<td>$700</td>
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<tr>
<td>($500 professor; $600 associate professor; $700 instructor/assistant professor)</td>
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</tbody>
</table>
| TOTAL EXPENSES  
| (incurred between 6-1-10 and 5-31-11) | $  |
| AMOUNT REQUESTED  
| (Not to exceed $2000 including stipend commensurate with rank) | $ 1998 |
CLINTON K. MEYER
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Phone: 515-961-1822, Email: clinton.meyer@simpson.edu

EDUCATION
Ph.D. 2007  Zoology, Southern Illinois University Carbondale, Carbondale, IL. Ecosystem structure and function in restored and natural slough wetlands: evaluation of restoration practices in the central Platte River valley
M.S. 2000  Entomology, Kansas State University, Manhattan, KS. Life history and secondary production of grasshoppers (Orthoptera: Acrididae) in a Kansas tallgrass prairie
B.S. 1997  Biology, Wayne State College, Wayne, NE.

EMPLOYMENT HISTORY
2008-present  Assistant Professor
Biology & Environmental Science, Simpson College
2007-2008  Andrew Mellon Foundation Post-Doctoral Fellow
Plant Biology, Southern Illinois University Carbondale, Mentor: Sara G. Baer
Plant and environmental drivers of C₄ grassland development
2002-2007  Graduate Teaching and Research Assistant
Zoology, Southern Illinois University Carbondale, Advisor: Matt Whiles
2000-2002  Research Technologist I
Department of Agronomy and Horticulture, University of Nebraska Lincoln
1998-2000  Graduate Research Assistant
Entomology, Kansas State University, Advisors: Matt Whiles, Ralph Charlton

RESEARCH INTERESTS
The focus of my research is primarily on the effects of anthropogenic disturbance on insects, plants, and soil properties and subsequent recovery following restoration. I am most interested in restoration of wetland and prairie systems in the Great Plains.

REFEREEED PUBLICATIONS


MANUSCRIPTS IN PREPARATION


SUCCESSFUL FUNDING

External funding


Internal Funding


HONORS AND AWARDS

Trio Student Support Services Faculty of the Year Award- In appreciation of commitment to outstanding teaching and advising at Simpson College, 2011-2012
Dissertation Research Assistantship Award- Awarded to superior doctoral candidates at Southern Illinois University Carbondale, 2006-2007
Florence and Charles Foote Award- Awarded to the outstanding teaching assistant in the Department of Zoology, Southern Illinois University Carbondale, 2004-2005

TEACHING EXPERIENCE

Simpson College
Biol 103L: Environmental Issues, lab, Biol 110L: Principles of Biology I, lab, Biol 135: Biostatistics, online,
SC 101 LA: Ethnobiology, first-year student course

MEMBERSHIPS AND AFFILIATION

Iowa Academy of Science
Ecological Society of America
Lambda Delta Lambda, Honorary Society
Blue Key, Scholastic Honorary Society

ACADEMIC SERVICE, SIMPSON COLLEGE

Elected faculty committees
2010-2012 Multicultural and Minority Issues Committee, member
2009-2010 Teacher Education Committee, Secretary

Other institutional service
2009-present Undergraduate Research Working Group & Symposium Committee, co-chair
2010-present Tri-Beta Biological Student Honor Society, faculty advisor
2011-present Simpson Urban Studies Institute Advisory Committee, member
2011-present Biology and Environmental Science teaching assistant manager
2010-present Research Experience for Undergraduates information session, co-presenter
2010-2012 Coordinator for Moody and Orr Research Scholarships in Biology
2011 Presenter at SC Faculty Hour: Improving Students’ Speaking/Presentation Skills
2012  Guest lecturer for Upward Bounds Biology Summer Course
2010-2011  Curriculum Written Communication embedded skill, review panel member
2010, 2012  Writing Competency II portfolio reader
2010  Working Group for Learning Communities, member
2009-2010  CIVL Advising Group, Member
2009  Curriculum Working Group for Oral Communication embedded skill, member
2009  Science Fair, judge for 3 special awards
Continuous  Currently serving as academic advisor for 22 undergraduate advisees

PROFESSIONAL SERVICE AND DEVELOPMENT

2012-present:  Iowa Academy of Science Recognition and Awards Committee, member
2010-present  Reviewer for Weaver Grant Program, Nebraska TNC

2013  Reviewer for Northern Illinois University Intramural Opportunity Grants Program
2012  Reviewer for Iowa Academy of Science Grants Program
2011-2012  Reviewer for Maryland Sea Grant Omnibus 2011-12 RFP’s preproposals
2011-2012  Reviewer for Maryland Sea Grant 2011-12 Final Process
2009  Attended CUR Institute, Beginning a Research Program in the Natural Sciences at a Predominantly Undergraduate Institution, Grand Rapids, Michigan
2009  Reviewer for text book proposal: Entomology Taxonomic Key; Wiley-Blackwell
2009  Attended Grassland Restoration Network meeting in Aurora, Nebraska
2009  IOWATER volunteer water sampler training workshop, Marshalltown, Iowa

ORAL PRESENTATIONS SINCE 2008


**SELECTED POSTER PRESENTATIONS SINCE 2008**


Posters of undergraduate research mentees:


*indicates undergraduate collaborator