

**Research Grants for Graduate Students**  
Departmental Evaluation Sheet

Please fill out an evaluation form for each RGGGS application submitted by your department. The completed evaluation forms and RGGGS proposals are due in the Graduate School by 4:30 PM, October 1, 2008, or February 4, 2009. Proposals should be evaluated according to the three primary criteria for the RGGGS program:

1. The originality/creativity and significance of the student's proposed research.
2. The clarity and appropriateness of the student's research design and procedure.
3. The feasibility of the student's proposed research.

Also note that the RGGGS research projects should be for work that is to be conducted. Proposals that describe projects where significant work has already been completed are ordinarily not funded. Please pay particular attention to the timeline of the proposal to see that it accurately reflects the status of the project. Please note that RGGGS funds cannot be used to reimburse money spent prior to the award. If you have questions about the evaluation of proposals, please contact the Graduate School.

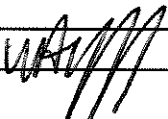
Student Name: \_\_\_\_\_

Project Title: Predictors of the diversity of the ...

This proposal was ranked \_\_\_\_ out of \_\_\_\_ proposals submitted by the department

In the space below, please provide your departmental evaluation of this proposal. If more than one proposal is submitted from your department, clearly explain the reasons for the relative ranking of this proposal. Attach additional sheet, if necessary.

Department: Biological Sciences

Signature of Chair: \_\_\_\_\_  


<b>RESEARCH GRANTS FOR GRADUATE STUDENTS</b>		2009-2010	
Application Cover Sheet		Deadlines 10/5/2009 OR 2/8/2010	
NAME	Student Number	Date:	Email Address
Home Town	Mailing Address		
Department Name	Dept. Campus Box	Requested Amount	
Biological Sciences	1651	\$500.00	
Project Title			
Predictors of the Diversity of the Spring Ephemeral Community in a Fragmented Landscape			
Nature of Project (check one)		Is this a resubmission? (Check one)	
<input checked="" type="checkbox"/> Thesis <input type="checkbox"/> Other Research Project		<input type="checkbox"/> Yes. If yes, previous app: _____ <input checked="" type="checkbox"/> No	
Expected Date of Graduation:		Student's Signature:	
May 2011			

**Compliances (Please check if your project involves any of the following):**

Animal Care  
  Biosafety  
  Hazardous Waste  
  Human Subjects  
  Radiological Safety

**Project Summary (No more than 300 words)**

See attached proposal.

<b>APPROVALS</b>		
Dr. Peter Minchin		2-3-2010
Major Advisor (Printed Name)	Major Advisor Signature	Date
Dr. William Retzlaff		2/4/10
Department Chair (Printed Name)	Department Chair Signature	Date

**FOR GRADUATE SCHOOL USE**

GPA: \_\_\_\_\_ Earned Hours: \_\_\_\_\_ Reviewed \_\_\_\_\_

Approved: \_\_\_\_\_ Not Recommended: \_\_\_\_\_

RPAB Chair Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Project Begin Date: \_\_\_\_\_ Final Report Due: \_\_\_\_\_

# **Predictors of Diversity of the Spring Ephemeral Community in a Fragmented Landscape**

Faculty advisor: Dr. Peter Minchin

## **Abstract**

The spring ephemeral community is distinctive in the forests of the Midwest. However, this community has been reduced as a majority of the forests have been converted to agriculture and urbanization. The aim of this research is to find predictors of the diversity of the spring ephemeral community in forest fragments. I hypothesize that diversity in the spring ephemeral community will increase as the age of the forest, distance from the edge zone, and canopy cover increases. Also, spring ephemeral diversity should decrease as invasive species become more abundant and/or the disturbance frequency of the forest increases. The effects of forest maturity, distance from edge, invasive species abundance, canopy structure, and disturbance history on spring ephemeral community diversity will be studied in Sweet William Wood, Bluebell Woods, and Bohm Woods using 129 previously established 750-m<sup>2</sup> sampling plots. Percent cover and counts of individuals will be recorded for spring ephemeral species in randomly selected subplots within the sampling plots. Species will be identified using a portable herbarium which I will make specifically for this study. Data will be used to construct multiple regression models to find the best predictive model that uses the fewest variables. The results of this study will aid in the conservation management of the spring ephemeral community. Managers can identify which factors improve or decrease diversity and where conservation efforts should be focused.

## **Background and Significance**

Habitat fragmentation is a common occurrence in the Midwest of the US. According to Echeverria *et al.* (2007), habitat fragmentation is the process in which an area of continuous habitat within a landscape is reduced to smaller, more isolated patches. Fragmentation is a major threat to biodiversity. Smaller fragments support smaller populations of species that have a greater probability of going extinct through random events (Raatikainen *et al.* 2009). Also, smaller habitat patches have greater edge effects. An edge effect is the movement of energy and biotic and abiotic material from the surrounding environment into a habitat fragment. The edge zone is modified habitat near the edge of the fragment. It has different environmental conditions, such as more available sunlight, lower soil moisture, and higher air and soil temperatures, than habitat found deeper in the interior of a fragment (Honnay *et al.* 2005). Smaller patches have greater proportion of habitat within the edge zone, and therefore, the area of high quality interior habitat is either reduced or nonexistent. As viable natural ecosystems are degraded and replaced by agriculture or infrastructure, biological diversity decreases throughout the entire landscape, and natural diversity can only be found in habitat fragments (Laurence 2008).

The occurrence and abundance of particular plant species in the understory of a forest is greatly influenced by the composition of overstory vegetation (Berger and Puettmann 2000). Old growth forests have mature hardwood trees that shade the understory once their leaves expand in spring. Herbaceous plants which make up the spring ephemeral community must take advantage of available sunlight before the trees leaf out. Spring ephemerals survive as underground shoots, such as bulbs, corms or rhizomes, in the fall and winter. They complete their growth over several weeks to several months in spring, when the risk of frost is low and

light levels are relatively high. This acceleration in growth when spring arrives requires nutrient rich forest soils and sufficient moisture (Lapointe 2001, Rothstein and Zak 2001).

The spring ephemeral community is sensitive to fragmentation because most of the plant species that make up that community are poor dispersers and cannot replace locally extinct populations in distant patches or recolonize sites after frequent disturbance, such as plowing (Honday *et al.* 2005). However, the native diversity of the spring ephemeral community might be affected by different variables, such as tree maturity, distance from edge, invasive species abundance, canopy structure, disturbance history, and soil composition within a fragment. These factors will be studied in my research project.

This research study is significant to the preservation of herbaceous plant species, such as *Trillium flexipes*, found in the oak-hickory forest fragments of Illinois and Missouri. Fragmentation will likely increase as the human population continues to grow and move into undisturbed natural areas. This research will gather information on fragmentation effects on the spring ephemeral community and evaluate the level of threat that community faces of losing biodiversity. The data gathered in this study will help conservation managers make better decisions in setting up protected area systems that successfully preserve biodiversity.

### *Hypothesis and Objectives*

My objective is to build predictive models of the diversity of the spring ephemeral community based on the fewest factors that affect diversity. I hypothesize that spring ephemeral diversity will decline as invasive species become more abundant and if disturbances, such as clear cutting and plowing, have occurred in the past. Also, the diversity of the spring ephemeral

community will increase as the age of the forest, distance from the edge, and canopy structure all increase.

### *Discussion of the Related Literature*

The conditions that are necessary for spring ephemeral growth can only be met in high quality forest found in the core or interior of habitat fragments. Habitat within the edge of a fragment is unsuitable for some ephemerals because of the warmer and drier climate in the edge (Laurence 2008). The edge habitat also provides an entry point for nonnative plant species that can establish a population in the edge and disperse into the interior habitat, altering the community in the core. These invasive plants may compete for the same resources the native ephemerals use, and the competition for these resources could reduce the fitness of some individuals in the spring ephemeral community (Honnay *et al.* 2005).

The disturbance history of the forest fragment affects the diversity of the spring ephemeral community. Forest clearing changes the habitat the entire spring community depends on. If the forest is converted to agriculture, the soil is plowed and the spring ephemeral community is destroyed. If grazing is allowed, the spring ephemerals could be overgrazed by livestock and die off. If and when the forest is allowed to regrow, the spring ephemerals need to recolonize the area. However, most spring ephemerals are poor dispersers so colonizing the regrowth would be difficult. Therefore, younger regrowth forests would have lower diversity in the spring ephemeral community (Honnay *et al.* 2005).

### **Procedure/Methodology**

All sites will be oak-hickory forests found on or near the SIUE campus. Existing data for tree diameters, abundance of invasive species, and tree species richness will be included in a

diversity predicting model. Sites were utilized by a summer internship project for the National Great Rivers Research and Education Center. Looft and Minchin (2008) researched 129 randomly established circular plots within the two forest fragments on campus (Sweet William and Bluebell Woods) and in Bohm Woods, a state nature reserve near SIUE. All plots are 750 m<sup>2</sup> in area. Constraints for establishing the sample plots were that none of the plots could be within 20 m from the edge of the fragment and that all plots had to be at least 80 m apart from adjacent plots. Sampling for spring ephemerals will be restricted to a line transect across the 30 m diameter of the plot. The line transect will be divided into subplots of 0.25 m<sup>2</sup> every 2 m along the line. Subplots will be marked with flagging and navigated using GPS. Plants that emerge within a sample area will be identified using field guides and a portable herbarium which I will make specifically for this study. Number of individuals within a species will be counted and percent of land covered will be recorded in field notebooks. The entire plot will be searched for species not found in subplots. Historical aerial photos will be used to analyze past canopy composition. A GIS will be built to store existing data and data gathered from the study. It can then be used to analyze spatial variables and map the diversity of the community. Also, it can contour data to predict the diversity of different areas.

Species richness is the number of species within a given area, and species evenness is the degree at which species abundance is equal within a community. A diversity index combines species richness and species evenness to produce a more comprehensive measurement of a community's biodiversity. Richness and evenness will be graphed for each site, and a Shannon's diversity index will be calculated for each site. Using the data gathered, multiple regression models will be created to predict richness and diversity using the factors researched. All computing resources and software needed for the study are available in Dr. Minchin's lab.

*Timetable*

January 2010 – March 2010: Establish subplots.

April 2010 – September 2010: Survey subplots at each site.

September 2010 – March 2011: Analyze data and prepare results for presentations at the Illinois State Academy of Science.

April 2011: Defend master's thesis.

May 2011-August 2011: Write up results for publication in a conservation journal.

August 2011: Present research at ESA annual meeting in Austin, Texas.

*Anticipated Results*

The data gathered for this study will be used to build a GIS to store data and that can incorporate other fragments. Also, building a portable herbarium of spring ephemerals can be used for future research projects. The results of my study will be used in presentations at the Illinois State Academy of Science and the Ecological Society of America annual meeting in 2011. The data will defend my master's thesis and be written for publication. The data gathered by this research will provide good information about biodiversity changes as predictive factors increase or decrease. Conservation managers can use the information to predict the diversity within their management areas and make decisions on where conservation efforts should be made.



## **Budget Justification**

The field guides and the portable herbarium will be used to identify plant species in the field. The portable herbarium will require a field plant press, cardboard separators, and mounting paper. Field notebooks are needed to record data and flagging is needed to mark subplots. A GPS is needed to navigate back to plots and collect spatial data for mapping and calculation of variables such as distance to forest edge.

## **References**

**Berger, A. L., and K. J. Puettmann. 2000.** Overstory composition and stand structure influence herbaceous plant diversity in the mixed aspen forest of northern Minnesota. *American Midland Naturalist* 143: 111-125.

**Echeverria, C., A. C. Newton, A. Lara, J. M. R. Benayas, and D. A. Commes. 2007.** Impacts of forest fragmentation on species composition and forest structure in the temperate landscape of southern Chile. *Global Ecology and Biogeography* 16: 426-439.

**Honnay, O., H. Jacquemyn, B. Bossuyt, and M. Hermy. 2005.** Forest fragmentation effects on patch occupancy and population viability of herbaceous plant species. *New Phytologist* 166: 723-736.

**Lapointe, L. 2001.** How phenology influences physiology in deciduous forest spring ephemerals. *Physiologia Plantarum* 113: 151-157.

**Laurence, W. F. 2008.** Theory meets reality: how habitat fragmentation research has transcended island biogeography theory. *Biological Conservation* 141: 1731-1744.

**Looft, J. and P. Minchin. 2008.** Patterns of native and exotic plant diversity in fragmented bluff forests: A test of the biotic resistance hypothesis. Unpublished Internship Report. National Great Rivers Research and Education Center, Godfrey, IL.

**Raatikainen, K. M., R. K. Heikkinen, and M. Luoto. 2009.** Relative importance of habitat area, connectivity, management and local factors for vascular plants: spring ephemerals in boreal semi-natural grasslands. *Biodiversity Conservation* 18: 1067-1085.

**Rothstein, D. E., and D. R. Zak. 2001.** Photosynthetic adaptation and acclimation to exploit seasonal periods of direct irradiance in three temperate, deciduous-forest herbs. *Functional Ecology* 15: 722-731.

**RESEARCH GRANTS FOR GRADUATE STUDENTS (RGGGS)  
BUDGET REQUEST**

	<u>Requested Amount</u>	<u>Department Recommendation</u>
<b>COMMODITIES</b> ( <i>Supplies, etc.</i> ):		
1. Field Guides (x3)	\$75.00	
2. Portable Herbarium (binders, pressing materials, plant press, etc.)	\$103.00	
3. Field Notebooks (x4)	\$75.80	
4. Historical Aerial Photos (x3)	\$90.00	
5. Flagging (x5)	\$6.20	
<b>Commodities Sub-Total:</b>	\$350.00	
<b>TRAVEL:</b>		
1.		
2.		
3.		
4.		
<b>Travel Sub-Total:</b>	\$0.00	
<b>CONTRACTUAL SERVICES</b> ( <i>Postage, photocopying, etc.</i> )		
1.		
2.		
3.		
4.		
<b>Contractual Services Sub-Total:</b>	\$0.00	
<b>EQUIPMENT:</b>		
Garmin eTrex Legend GPS	\$150.00	
<b>Equipment Sub-Total:</b>	\$150.00	
<b>TOTAL REQUEST:</b>	\$500.00	