

## Main Body of the 2000 REU Supplement Proposal

Dr. Scott Collins  
Long Term Ecological Research Program  
Division of Environmental Biology  
National Science Foundation  
4201 Wilson Boulevard  
Arlington, VA 22230

January 25, 2000

Dear Dr. Collins:

We are writing to request funding for a Research Experience for Undergraduates grant to be associated with the Shortgrass Steppe LTER project (**DEB-9632852**). Last year, we requested and received funding for two REU students. The program was an enormous success with respect to the experience for the REU students, the science that was accomplished, and the overall influence of the REU students on the LTER program.

### **Results from Previous REU Supplement**

In 1999 we received funding for two REU students, who have completed research projects at the Shortgrass Steppe LTER site.

An REU student from Earlham College, Richmond, Indiana, completed a project titled "Interactions of Land Use and Invasibility" that investigated the cover, density, and species richness of exotic plant species on three different land use types: undisturbed shortgrass steppe, 60-year old abandoned agricultural fields, and land entered into the Conservation Reserve Program and planted with introduced grasses. On all land use types, roadside and interior areas were compared to determine if roadside proximity increased weed cover, density, or species richness. She found that weed individuals and patches were absent from all undisturbed shortgrass steppe sites, and present on all Conservation Reserve Program sites.

A Colorado State University student developed a GIS database of active prairie dog towns the US Forest Service has been mapping on the Pawnee National

Grassland for 15 years. He took the information for each town in each year, digitized it, and anchored the resulting colony map to the larger map by going in to the field and using the GPS system to locate reference points from the hand-drawn maps. He summarized information that is being used to analyze factors associated with extinction and recolonization (e.g. town size, proximity to active towns or town extinction events, drainage distances between towns, soil type, etc.). From this, a metapopulation model that we can use to explore various scenarios for the persistence of the prairie dog metapopulation will be produced.

## **Nature of Student Activities**

### Philosophy:

Our highest priority for students in this project is not that they learn a large number of facts about the ecology of the shortgrass steppe, nor that they become expert in the field, laboratory, or computer analyses. Rather, our primary goal is that the students learn that science is an exciting process of discovery, and that they become interested in the field of ecology. They will be involved in the everyday process of research, but through this, we hope to infuse them with excitement about both science and ecology. Thus, although we focus below on the technical components of their activities, we will place a great deal of our effort with the students on the overall experience.

There are a number of components to the learning experience for the REU students. We subdivide these components into 1) basic ecology; 2) environmental issues; 3) hypothesis generation in the research process; 4) methods of field and laboratory analysis; 5) data analysis and synthesis; 6) the use of computers in research.

Below, we detail chronologically our plan for how the students will develop this knowledge base.

### 1. Pre-arrival orientation:

We will send both students a copy of James Michener's "Centennial" before they arrive. This book focuses on the history of European settlement of the northeastern Colorado-southeastern Wyoming region, and provides an excellent introduction to the area and its fascinating history of land use.

### 2. General Orientation:

The first 2 days of the summer will be spent with a field orientation. The students will accompany project scientists for 2 days in the Pawnee National Grasslands

and surrounding area. We will discuss the ecology of the shortgrass steppe, and the common land management practices. We will provide an overview of both the natural history and the human cultural context. We will introduce them to the issues that we are interested in, and work to engage the interest of the students in our research.

### 3. Field, Lab, and Data Analysis Assistance for Research Projects:

During the first 6 weeks of their time here, the students will assist project scientists in existing research projects. The purpose of this involvement is: 1) to introduce the students to the process of science, including question-generation and design phases; 2) to introduce students to field and laboratory methods in ecosystem ecology, and 3) to allow the students to work as part of a team in the field. We would like the students to get a strong sense of the interdisciplinary and cooperative nature of ecosystem ecology. Each student will be assigned a graduate student or postdoc mentor, with whom the student will work most closely. The mentor will be responsible for providing continuity among the field, lab, and data-analysis activities, and for helping to assure that the student feels connected to the science being conducted.

### 4. Independent Research Projects:

During week 5, we will begin to work with the students to develop their own research projects. The student research projects will necessarily be extremely well-focused and simple. During the 7th week of the summer, students will conduct their fieldwork, and during the subsequent weeks, they will complete their lab work.

### 5. Data analysis

When the students get close to completing their lab analyses (about week 10), we will begin to involve them in data analysis for an existing project. Each student will work closely with his or her mentor in this process, and will learn how the researcher is analyzing her or his data using simple graphical and statistical analysis. Further, the students will work with their mentor to plan their own data analysis.

### 6. Research Completion and Presentation

Students will complete their projects during the last weeks of the summer program. They will present their results to our research group in a special end-of-season symposium. We will invite members of our extended research group for the Shortgrass Steppe Long Term Ecological Research Project.

### 7. Ecological Society of America meetings

If funds permit, we plan to take both students to the ESA meetings in Snowbird, UT. In the six-year history of REU student involvement in the SGS-LTER, this trip has often been described as a program highlight. Past REU students attended the ESA meetings and commented on how these meetings helped to characterize many of the components of the science of ecology. This exposure to the current field of ecology is invaluable in providing the students with a sense of the discipline, as well as giving them the chance to make contacts for graduate school.

### **The Research Environment:**

The students will be associated with a large, well-equipped facility and a large group of interesting ecologists. The undergraduates will have access to some of the most sophisticated field, laboratory, and computer equipment available. This equipment includes:

- ? a new wet chemistry laboratory complete with some analytical equipment
- ? the Natural Resource Ecology Laboratory wet chemistry laboratory with a large number analytical instruments (probably most importantly an autoanalyzer and autotitrator)
- ? the LTER computer facility supported by the College of Natural Resources
- ? an extended group of graduate students and faculty (about 40 persons) who work closely together on the LTER project

### **Student Participants:**

We will target highly qualified students in the recruitment process for REU students. Our Honors program has had very successful recruitment of under-represented groups, with a current enrollment of 30% - more than twice that of the University at large. However, we will not limit our search to Honors students: we will advertise the REUs campus-wide, and, through an email network and the WWW, we will advertise these positions nationally. During the past five years, we have had at least one woman or minority student as an REU participant. We feel that this is an important component of our REU program and we plan to continue to recruit under-represented groups.

**Ethics Component:**

It is both important and appropriate to give the students a strong sense of the process of science as one that is dependent upon integrity at all stages of the process. We propose to introduce students to a collection of topics that relate to an "ethics component," through group discussions and through interactions with mentors. Our students, postdocs, and investigators regularly discuss issues related to our personal commitment to integrity in a competitive environment, such as quality control in research, and behavioral standards for scientists. We are also very interested in topics related to balancing a sense of professional accomplishment with a well-integrated life, particularly as members of under-represented groups in science. We have identified a number of short readings that elaborate upon these topics.

We will have weekly lunchtime discussions with our research group (postdocs and graduate students), as well as the REU students. Currently, we have such weekly meetings with our group, and we blend informal discussions with more formal ones, sometimes with readings as the focus. The informal atmosphere is very effective for focusing on issues that are philosophical yet have great importance to our daily activities. Past REU students have contributed a great deal to these discussions by introducing discussion topics that may not have otherwise been discussed. Some of the most interesting and provocative topics have dealt with the practicalities of a career in science.

In summary, we are very excited about the opportunity to continue an REU program. We are extremely enthusiastic about the program and the experiences it affords the students and our research group.

Thank you for your consideration. We look forward to hearing from you.

Sincerely,

Ingrid C. Burke  
Eugene F. Kelly