APPLICATION CHECKLIST
Research, Scholarship, and Creativity Grant

Application Deadline: March 11, ~~2004~~ 2005

Please print and complete this checklist and attach it as the cover page of your grant application. For more information about RSC grants, please see <www.gustavus.edu/oncampus/facdev/grants/RSC.cfm>.

FACULTY INFORMATION

Name:	Jon Grinnell	Dept.:	Biology
Email:	grinnell	Rank:	Asst. Prof.

CHECKLIST

☑ **Description of previous projects (and outcomes) funded by RSC grants**

☑ **Complete project description, including separate statements of:**

1. **Purpose.** What are the intellectual, conceptual, or artistic issues? How does your work fit into other endeavors being done in this field?
2. **Feasibility.** What qualifications do you bring to this project? What have you done/will you do to prepare for this project? What is the time period, i.e. summer, summer and academic year, academic year only? Is the work's scope commensurate with the time period of the project?
3. **Project Design.** This should include a specific description of the project design and activities, including location, staff, schedules or itineraries, and desired outcomes.

☑ **RSC Budget Proposal Form attached as last page of application**

☑ **Eight copies of complete application (including this checklist) to be submitted to the Faculty Development Resource Center (SSC 119)**

☑ **If successful, my proposal can be used as an example to assist future faculty applicants. This decision will not in any way influence the evaluation of my application.**
(Yes) / No (please circle one)

X

Bellowing and Assessment by Bison Bulls

A proposal to the Research, Scholarship and Creativity Fund

Jon Grinnell
Biology

1. Statement of previous support

I have received no prior funding from the Research, Scholarship and Creativity Fund.

2. Description

Purpose

Success at reproduction is the only outcome of any value in evolution. Whether and how well an organism passes on its genes will determine the genetic makeup of the next generation, and by extension the physical and behavioral traits present in the population. Animals go to great lengths to succeed at reproduction, and this success can come either through attracting a mate (intersexual selection) or through winning competition for access to mates (intrasexual selection), the two fields in the study of sexual selection. Some modes of advertisement, such as vocal communication, can effectively serve both functions simultaneously: the roar of a lion (Grinnell & McComb 2001) or the song of a bird (Catchpole & Slater 1995) can both attract females (the sex often doing the choosing) and keep rival males at bay. In both cases, the listeners must be able to tell something about the quality, desirability, or formidability of the signaler simply by listening to and/or watching it sing. We would predict, therefore, that in addition to the behavior of the animal, the structure of its vocalization may contain cues to ability or quality that an attentive listener could pick up on. The types of cues that are important will depend on the mode of vocal production.

Mammals produce sound by forcing air past two folds of tissue, the vocal cords, that vibrate in a periodicity that depends on their tension (derived from muscular action) and the rate of airflow past them (derived from the effort put into exhalation). This is the "source" of sound, and determines the basic pitch (measured as number of vibrations per second of the vocal cords). However as we humans well know, mammals can change the timbre of a sound by altering the vocal tract downstream from the vocal cords: the trachea and the mouth and nasal cavities. Together these act as a "filter" that allows humans, for example, to produce sounds of the same pitch but very different character. We make the different vowels, for instance, by changing the shape of our vocal tract. Other mammals typically do not alter the shape of their vocal tracts as much as we do, and can successfully be thought of as producing a single sound at variable intensities and durations. In such cases, physics tells us that the distribution of "resonances" (collections of adjacent frequencies at which sound energy is concentrated) enhanced by a vocal tract will depend on the length of the vocal tract. Modeling a mammal's vocal tract as a tube open at one end (the mouth) and closed at the source of a sound (the vocal cords), predicts these resonant frequencies to be at:

$F_i = \frac{(2i-1)c}{4L}$ where F_i = the Formant (resonant) frequency, i = the number of the formant, c = the speed of sound (about 350 m/s in warm vocal-tract air), and L = the length of the tube. By measuring where these "formants" occur in the vocal spectrum of a mammal, we can calculate an average spacing