Research Grants for Graduate Students

Departmental Evaluation Sheet

Please fill out an evaluation form for each RGGS application submitted by your department. The completed evaluation forms and RGGS 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 RGGS 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 RGGS 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 RGGS 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: Examining the effect of algal epibionts on ...

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: ______________________

Print Form

RESEARCH GRANTS FOR GRADUATE STUDENTS Application Cover Sheet		2009-2010 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
Biology		1651	$490.00

Project Title

Examining the effect of algal epibionts on hydrodynamic drag experienced by the freshwater snail Elimia potosiensis.

Nature of Project (check one)	Is this a resubmission? (Check one)
☑ Thesis	☐ Yes. If yes, previous app: ______
☐ Other Research Project	☑ 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)

Project summary is less than 300 words, but will not fit in the box provided. See next page for project summary.

APPROVALS

		2/3/10
Major Advisor (Printed Name)	Major Advisor Signature	Date
Dr. 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:** ____________

Project Summary

The health of local stream and river systems is dependent on the abundance and diversity of algae and snail populations. The freshwater snail *Elimia potosiensis* is abundant in streams and rivers of the Saint Louis region and experiences variable degrees of algal growth on its shell through the spring and summer months. The presence of algae on the shells could increase energy the snail devotes to locomotion, which is already higher than any other animal. This relationship is crucial to study due to the potential for anthropogenic impacts to freshwater systems to increase water velocities and densities of filamentous algae, therefore influencing drag experienced by snails. The proposed study seeks to determine the effect of algal growth on hydrodynamic drag experienced by shells of the freshwater snail *E. potosiensis* through the use of a modified terminal velocity assay. Due to the absence of scientific literature on this relationship, it is expected that the results from the proposed research will provide valuable insight into the energetic ecology of freshwater snail populations and result in a publication in a peer-reviewed journal.

Background and Significance

The health of any natural ecosystem is often measured by the abundance and diversity of plant and animal communities. Two important components of these communities in North American streams and rivers are populations of freshwater snails and algae. Snails feed on algae and decaying organic matter and act as an important food source for numerous aquatic and terrestrial species (Johnson 2003; Thorp and Covich 1991). For locomotion, they use a single, muscular foot to slowly move across the substrate. Movements of the foot are facilitated by the secretion of a thin layer of adhesive mucus, which allows the snail to maintain its position on the substrate. While effective for movement and in preventing dislodgement, this adhesive locomotion is one of the most energetically expensive forms of locomotion in the animal kingdom (Denny 1980). Considering that snails can be found in densities as high as 1700 per m^2, with each having this high energetic component to locomotion, snails serve as a critical energetic link in stream ecosystems (Thorp and Covich 1991).

Algae serve as primary producers in aquatic communities and are highly dependent on adequate light exposure and the correct balance of nutrients in the stream. In flowing waters, algae must be attached to a fixed object, and one substrate on which they often grow is the shells of snails (Figure 1). This epibiotic relationship is important for some algae as it provides the algae with a stable living environment. The algae benefit because as long as the snail is living, the algae are provided ideal growing conditions through exposure to the sun and flowing water, even if the snail is temporarily dislodged.

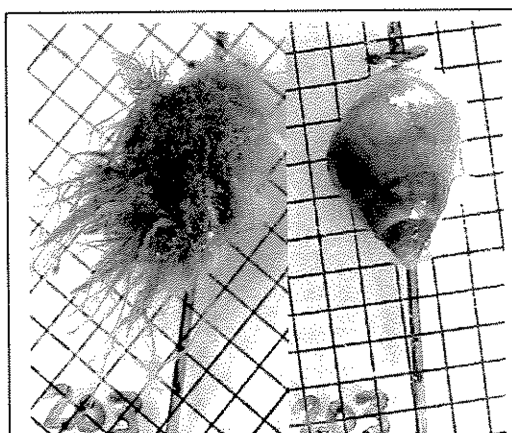

Figure 1: *E. potosiensis* with and without algae cover

Effects of this epibiotic relationship on freshwater snails are not known. Algae can sometimes grow to very high densities on snail shells (Figure 1), making it likely that algal growth could significantly alter drag characteristics of the snail as it tries to maintain its position in flowing water. In marine snails, epibiotic algae can double the amount of hydrodynamic drag experienced by snails and can significantly decrease snail growth rate (Wahl 1996). It is hypothesized that the decrease in growth may be a result of the increased energy that must be devoted to foot tenacity to prevent dislodgement (Wahl 1997). Wahl also discovered that drag was more than three times greater for filamentous algae than the slender, unbranched species (Wahl 1996). To date, however, we know of no research examining effects of epibiotic filamentous algae on freshwater snails.

Given the high cost of mucus production in snails, the potential for algal epibionts to increase drag experienced by snails is of particular interest. Furthermore, anthropogenic impacts on stream ecosystems may be modifying the relationship between snails and algae. Repeated increases in nutrient inputs and sedimentation caused by human activities have been shown to decrease algal taxonomic richness in streams and increase the density of filamentous algae (Riddle, et al. 2009). In addition, physical modification of rivers and streams increases sedimentation and water velocity. The response of snails to these changes in flow parameters is dependent on their drag characteristics including shell shape and size (Holomuzki and Biggs 1999), which themselves may be affected by algal growth. Increase in algal growth may result in more energy being devoted to adhesive mucus production or ultimately result in dislodgement and the decline of snail populations (Dussart 1987; Johnson 2003).

The proposed study seeks to determine the effect of algal growth on hydrodynamic drag experienced by shells of the freshwater snail *Elimia potosiensis*. *E. potosiensis* is locally abundant in streams and rivers of the Saint Louis region and experiences variable degrees of algal growth through the spring and summer months. The null hypothesis to be tested is that the presence of algal growth on the snail shells does not affect the amount of drag experienced by the snail.

Procedure/ Methodology

Study Design

Collection of snails will be focused on small streams and rivers through east-central Missouri, mostly in the vicinity of Meramec State Park. Efforts will be focused on collecting *Elimia potosiensis*, a snail that is locally abundant and distributed throughout streams and rivers in the east-central Ozarks (Wu, et al. 1997). Individuals representing a broad range of sizes and degree of algal cover will be collected. My advisor, Dr. Paul Brunkow, currently possesses state collecting permits and has extensive knowledge of local streams and snail populations. The snails will be returned to the laboratory where they will be narcotized with clove oil, which has been shown to be a safe, humane method of relaxing snails so that they may be removed from the shells (Venarsky and Wilhelm 2006). This method of narcotizing will also have minimal to no effect on the algal epibionts (personal observation), whereas traditional euthanasia techniques would kill algae as well as the snail. After the bodies are removed, shells will be measured and photographed to maintain a record database. Shells will be mounted on a small plastic disk and maintained in an aquarium to keep the algae alive until they are measured for drag.

In this study, hydrodynamic drag will be measured with a modified terminal velocity assay (Donovan et al. 2003; Loudon and Zhang 2002). A drop tube constructed of a 40 cm diameter, 1.7 m long PVC pipe, closed at the bottom, will hold a column of water through which shells will be dropped to determine terminal, free-fall velocity. Terminal velocity is reached when the force of gravity on the object and the forces of buoyancy and drag are perfectly balanced. The drag coefficient of the snail shell can be calculated by knowing the density of the shell, the density of the fluid through which it is falling, and its terminal velocity in that fluid (Loudon and Zhang 2002; Vogel 1994). As shells fall through the tank, each will pass by two sets of infrared LED/phototransistors mounted a fixed distance apart near the top and bottom of the tank, which act as light sensitive timing gates. Voltage output from the phototransistors, digitized at 1200 Hz, allows for timing a shell's transit between these timing gates to the nearest 0.0002 sec.

To ensure that shells encounter the same force of water flow as they would in nature, each shell will be mounted facing forward to a thin plastic sled. Sleds will be constructed out of 0.8 mm thick acrylic with chambers cut out of each end and the shell mounted in the middle. The aft chamber will be sealed to create an air chamber and the forward chamber will be filled with varying amounts of weight to create a series of sleds with different densities. This allows algae-covered shells to be dropped through the tank at velocities ranging from 12 cm/s to 60 cm/s, representing the range of flows they would experience in nature.

The drag force contributed solely by the sled will be determined by dropping the unloaded sleds and regressing terminal velocity of unloaded sleds against the drag coefficient of unloaded sleds (calculated as above). Subtracting the drag of the sled from the total drag acting on the snail/sled composite object will yield drag for the shell in each trial. After each shell is dropped at each velocity, the algae will be scraped off of each shell, dried and weighed. The clean shell will also be photographed and weighed. Terminal velocity measurements will be repeated for each shell and compared to the results from the shell with algae.

Drag values for the shells will be regressed against shell size and shape, which will be evaluated using geometric morphometrics. The effect of algae on drag in *E. potosiensis* will be determined using repeated-measures analysis of covariance, with algal mass as the covariate (Whitlock and Schluter 2009).

Timetable for Conducting Research

Collection efforts for specimens from the Meramec River will begin in May 2010 and continue through the summer. Trial runs in the drop tank will begin immediately after snails are removed from shells to ensure that the algae are alive. Drops with the cleaned shells will occur in Fall 2010, with data analysis completed by the end of the term. I will begin writing my thesis in Spring 2011 and defend in May 2011.

Anticipated Results

The proposed research will quantify the relationship between algal epibionts and drag experienced by snails. I expect to find that the algae will increase the drag experienced by the snails; however this effect will likely vary depending on algal density and composition. Effects of algae growth on drag experienced by snails has not yet been systematically studied for any freshwater species. Information gained from this study will provide valuable insight into the energetic ecology of freshwater snail populations. This information is important due to the crucial role snails have in stream ecosystems coupled with the anthropogenic threats they currently face. Data gathered for the proposed research will be presented at regional and national scientific conferences through the next year. Also, since there is no existing literature on the effect of algal epibionts on freshwater snails, it is highly likely that this research can result in a publication in a peer-reviewed journal.

Literature Cited

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Donovan, D. A., B. L. Bingham, M. From, A. F. Fleisch, and E. S. Loomis. 2003. Effects of barnacle encrustation on the swimming behaviour, enregetics, morphometry, and drag coefficient of the scallop *Chlamys hastate. Journal of the Marine Biology Association.* 83: 1-7.

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Holomuzki, J. R. and B. J. F. Biggs. 1999. Distributional responses to flow disturbance by a stream-dwelling snail. *Oikos.* 87: 36-47.

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Thorp, J. H. and A. P. Covich. 1991. *Ecology and Classification of North American Freshwater Invertebrates.* Academic Press, Inc.

Venarsky, M. P. and F. M. Wilhelm. 2006. Use of clove oil to anaesthetize freshwater amphipods. *Hydrobiologia.* 568-425.

Vogel, S. 1994. *Life in Moving Fluids.* Princeton University Press.

Wahl, M. 1996. Fouled snails in flow: potential of epibionts on *Littorina littorea* to increase drag and reduce snail growth rates. *Marine Ecology Progress Series.* 138: 57-168.

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Whitlock, M. C. and D. Schluter. 2009. *The Analysis of Biological Data.* Roberts and Company Publishers.

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RESEARCH GRANTS FOR GRADUATE STUDENTS (RGGS)
BUDGET REQUEST

	Requested Amount	Department Recommendation
COMMODITIES *(Supplies, etc.):*		
1. Digital Camera Memory Card (x2)	$15.00	
2. Specimen Storage Vials	$20.00	
3. Acrylic Sheet (for sleds)	$15.00	
4.		
5.		
Commodities Sub-Total:	$50.00	
TRAVEL:		
1. 480 miles (3 round trips of 160 miles each)	$240.00	
2.		
3.		
4.		
Travel Sub-Total:	$240.00	
CONTRACTUAL SERVICES *(Postage, photocopying, etc.)*		
1.		
2.		
3.		
4.		
Contractual Services Sub-Total:	$0.00	
EQUIPMENT:		
Digital Camera	$200.00	
Equipment Sub-Total:	$200.00	
TOTAL REQUEST:	$490.00	

Budget Narrative

The necessary components for the drop tank and infrared timing system have already been acquired through a previous RGGS. The funds requested here are to allow for travel to collect specimens and to purchase a new digital camera for documenting the specimens.

Commodities

I am requesting higher capacity storage cards for the digital camera (requested below), containers for storing collected specimens, and a sheet of acrylic to construct additional sleds.

Travel

I am requesting $240 to travel witl to the Meramec River area in east-central Missouri to collect specimens of *Elimia.* I anticipate needing three trips to complete the necessary collections. Each round trip is 160 miles, and at the current SIUE mileage rate of $0.505 per mile, the total requested for the three trips is $240.

Equipment

I am requesting $200 to purchase a new digital camera for the lab. We are currently using my advisor's personal digital camera in the lab, which was purchased over five years ago. A new camera would give us a reliable way of taking and storing photographs for all projects. Camera models that meet our specifications include the Canon Powershot and Nikon Coolpix, which can be purchased through any of several online retailers for $200.