

Sam Taylor Fellowship Proposal PART A: 1-page vitae

PERSONAL Dr. Romi Lynn Burks

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Position: Assistant Professor of Biology (2003 - current)
 Beginning 5th year at Southwestern; untenured

EDUCATION

University of Notre Dame (UND) Ph.D. Ecology, Evolution & Env't Biology, 2000

Loyola University Chicago (LUC) B.S. Biology with honors, *magna cum laude*, 1995
 B.A. English with honors, *magna cum laude*, 1995

MAJOR PUBLICATIONS (representative; * = undergraduate student)

1. Youens, A. K.* and R. L. Burks. 2007. Comparing applesnails to oranges: the impact of different measuring techniques on the study of *Pomacea*. Accepted in *Aquatic Ecology*.
2. Burks, Romi L. and L. Boles. 2007. Evolution of the Chocolate Bar: A creative approach to teaching phylogenetic relationships within evolutionary biology. *The American Biology Teacher* 69(4): 229-237.
3. Burks, R. L., G. Mulderij, E. Gross, I. Jones, L. Jacobsen, E. Van Donk, and E. Jeppesen. 2006. Chapter 3 - Center stage: The Crucial Role of Macrophytes in Regulating Trophic Interactions in Shallow Lake Wetlands. Pages 37-59 in R. Bobbink, B. Beltman, J. T. A. Verhoeven, and D. F. Whigham (eds) *Wetlands: Functioning, Biodiversity Conservation, and Restoration*. Ecological Studies, Volume 191, Springer-Verlag Berlin Heidelberg.
4. R. G. Howells, L. E. Burlakova, A. Y. Karatayev, R K. Marfurt*, and R. L. Burks. 2006. Chapter 5 - Native and introduced Ampullaridae in North America: History, Status and Ecology. Pages 73-112 in R. C Joshi (ed) *Global Advances in Ecology and Management of Golden Apple Snails*. Philippine Rice Research Institute (PhilRice), Philippines.
5. Tuchman, N. C., R. L. Burks, C. A. Call, and J. J. Smarrelli. 2004. Flow rate and vertical position influence ingestion rates of colonial zebra mussels (*Dreissena polymorpha*). *Freshwater Biology* 49: 191-198. (*revisions completed at SU*)
6. Burks, R. L. and D. M. Lodge. 2002. Cued in: advances and opportunities in freshwater chemical ecology. *Journal of Chemical Ecology*. 28(10): 1881- 1897.
7. Burks, R. L., N. C. Tuchman, C. A. Call, and J. E. Marsden. 2002. Colonial aggregations: the effect of spatial position on zebra mussel responses to interstitial water quality. *Journal of the North American Benthological Society* 21(1): 64-75.
8. Burks, R. L., D. M. Lodge, E. Jeppesen and T. L. Lauridsen. 2002. Diel horizontal migration of zooplankton: costs and benefits of inhabiting littoral zones. *Freshwater Biology* 47: 343-366.

MENTORING UNDERGRADUATE RESEARCH

Colin Kyle '09, James McDonough '09, Sarah Hensley '08, Brandon Boland '07, Abby Youens '07, Matt Barnes '06, Austin Hill '05, Becca Marfurt '05

Sam Taylor Fellowship Proposal **PART B: Project Description****Objectives:**

General: To increase our knowledge about reproduction and survival of a novel exotic species in Texas (applesnail, *Pomacea insularum*), which may possibly help to deter its spread. In addition, I want to continue to involve undergraduates in research opportunities.

Specific: To establish long-term laboratory cohorts of applesnails (i.e. groups of similarly aged individuals) to clearly determine age-specific fecundity.

Background:

In 2000, a new molluscan invader established reproducing populations in Houston, Texas, within a large urban wildlife refuge (i.e. 2500-acre Armand Bayou Nature Center). This snail was like nothing biologists had ever seen before. Adults have the capacity to reach 150-g in weight (top photo), lay thousands of eggs in one clutch and aestivate through short drought periods. Brilliantly-colored pink egg clutches (bottom photo), which females lay above the water, quickly sprouted up everywhere. Economic and ecological concerns flared immediately after this new invader became known as a 'channeled applesnail' with a reputation of global invasion and negative impacts on rice fields and ecosystems (Carlsson et al. 2004). Conservationists pointed to the potential for these plant-eating snails to damage wetlands and restoration efforts.



Texas Parks and Wildlife Department moved swiftly to list these new invaders as prohibited and identified them as '*Pomacea canaliculata*' or 'golden applesnails (GAS; Joshi & Sebastian 2006).

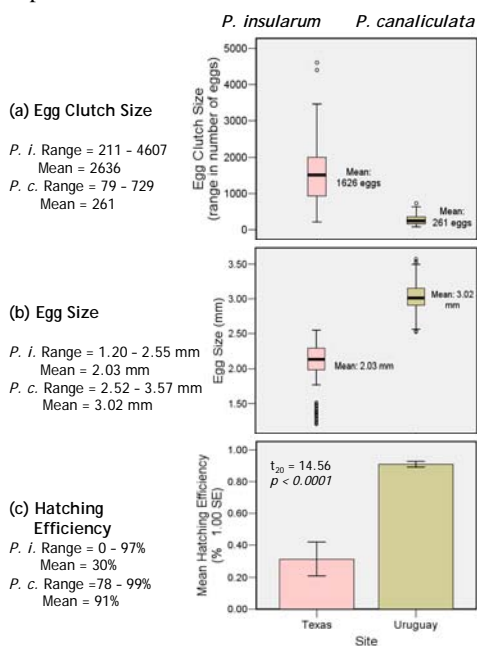
As confirmed introductions of snails increased and ecology of these snails began to garner more interest, phylogenetic studies (Cowie et al. 2006, Rawlings et al. 2007) of globally distributed populations of applesnails were occurring at the University of Hawaii by Robert Cowie & Ken Hayes and at Florida International University by Tim Collins and Tim Rawlings. In 2004-2005, researchers in Texas broadly identified exotic snails as part of the '*canaliculata*' complex (i.e. related to the global invasive). In December of 2005, I traveled with a student to Uruguay to work in a true, native population of *P. canaliculata*. Further scientific and genetic clarity recently arrived in May 2006. Although originally suggested to be *P. canaliculata*, the Texas species has been confirmed as *Pomacea insularum* (Cowie et al. 2006, Howells et al. 2006, Rawlings et al. 2007), although this information has not yet reached the management community. Both species find their origins in South America and fall within 'the complex' but diverge in mitochondrial DNA by ~9% compared to intraspecific variation of 2-3% (Hayes, personal communication).

Preliminary Data:

Alarmingly, preliminary investigations in my lab at Southwestern University (Barnes et al., in review) indicate that the egg output of exotic *P. insularum* can reach an order of magnitude higher than native *P. canaliculata* (Fig. 1). Alternate strategies

exist of a few hundred large eggs for *P. canaliculata* versus thousands of smaller eggs for *P. insularum* (Burks, unpublished data). Hatching rate varies considerably, although 30% of a large *P. insularum* clutch (i.e. 2500 eggs x 30% = 750 offspring) still results in nearly 3x as many offspring as a 90% hatching of a smaller clutch of *P. canaliculata* (i.e. 250 eggs x 90% = 225 offspring). Our early estimates of fecundity, the best risk assessment measure to date for invasiveness in mollusks (Keller et al. 2006), suggest that *P. insularum* may pose an equivalent threat to natural and agricultural systems as *P. canaliculata*.

Fig. 1: Preliminary data collected on (a) Number of eggs; (b) Size of eggs; and (c) Hatching efficiency for an exotic population of *P. insularum* at Armand Bayou and a native population of *P. canaliculata* from Uruguay. *P. insularum* exhibits much more variation in hatching efficiency and also with the number of eggs laid, which changes across the reproductive season (Burks, unpublished; results not pictured). Results for native *P. canaliculata* fall within reported literature values, but this data represents the first quantification of reproductive output for *P. insularum*.



Research Questions:

1. When do *Pomacea insularum* start to produce clutches?
2. Do predictable relationships exist between clutch size or hatching efficiency and snail size or age?

Details of the Research Plan:

- **Methods (Field):** I will need to travel with 2-4 students to Armand Bayou in Houston to collect adult snails that we can bring back to the lab. We will spend 2 days in canoes searching for snails and eggs. I have a cooperative agreement with Armand Bayou to borrow canoes, oars, life jackets and machetes as needed.
- **Methods (Lab):** We will maintain 4 cohorts (each housed in 1 of 4 tanks of above system) of an Armand Bayou population for 2 years. We will feed snails lettuce daily (Estoy et al. 2002). Water temperatures will fluctuate on seasonal cycles (versus room temperature) to simulate field conditions and produce the most realistic outcomes in fecundity (Estebenet & Cazzaniga 1992). Each cohort will be comprised of successful hatchlings from 5 clutches as pooled egg masses because hatchlings show higher survivorship, perhaps due to genetic variability. We will record number of live snails and operculum width of 30 random snails every 30 days (after Estebenet & Cazzaniga 1992).
- To calculate age-specific fecundity, each clutch produced by the cohort populations described above over 2-years will be removed carefully with a razor blade, measured (l & w & h to approximate volume) and weighed (to the nearest 0.01 g). The first 300 egg clutches from each population will be counted (after disassociation in sodium hydroxide) to establish a strong, predictive relationship ($R^2 > 0.80$) between clutch weight and egg number. Subsequent clutches will only be measured and weighed. Egg diameter (to calculate volume) and weight will be recorded for 10 eggs from every clutch.

Outcomes: Based on my recent success in establishing this line of research in the lab, I have the following expectations for outcomes:

1. Two student presentations in 2008 at a national scientific meeting
2. At least one publication quantifying age-specific fecundity (please note that this will take nearly 3 years to gather all of the data and write).
3. Undergraduate research experiences for at least 2 Southwestern students

Timeline:

January 2008: Receive notification of grant
 June 2008: Travel to Armand Bayou
 July 2008: Set up tanks for cohorts
 July 2008: Resubmit National Science Foundation grant
 July 08 - July 2010: Record data of growth and fecundity
 August 2010: Analyze data and begin presentations and publications

Fit with Professional Goals:

A Sam Taylor Fellowship would allow me to continue the research momentum I have established at Southwestern and help me maintain my commitment to being a "teacher-scholar" through further mentoring of undergraduates. I recently submitted a National Science Foundation grant that did not get funded (9% rate). Conducting this project would help me obtain more data that could be added to my grant revision. As I have started this new research program from scratch, I feel that I am at a crucial stage and that I could investigate more questions regarding this exotic snail in Texas. Understanding how many offspring may result from these egg clutches could give us insight into how to slow down the invasion (i.e. with possible active removal of clutches or larger snails that may produce larger clutches). Furthermore, I expect that the products from this work would enhance my case for tenure and provide more building blocks for work that could eventually contribute to further promotion.

References:

1. Barnes*, M. A., A. K. Youens*, B. B. Boland*, J. A. Hand, R. K. Marfurt* & R. L. Burks. 2007. The Big Applesnail: growth and fecundity of established *Pomacea insularum* in Texas. In review.
2. Carlsson, N. O. L., C. Brönmark & L. A. Hansson. 2004. Invading herbivory: the golden apple snail alters ecosystem functioning in Asian wetlands. *Ecology* 85(6): 1575-1580.
3. Cowie, R. H., K. A. Hayes & C. Thiengo. 2006. What are apple snails? Confused taxonomy and some preliminary resolution. Pages 3-24 in: R. C. Joshi & L.S. Sebastian (ed) *Global Advances in Ecology and Management of Golden Apple Snails*. Philippine Rice Research Institute (PhilRice), Philippines.
4. Estebenet, A. L. & Cazzaniga, N. J. 1992. Growth and demography of *Pomacea canaliculata* (Gastropoda: Ampullariidae) under laboratory conditions. *Malacological Review* 25: 1-12.
5. Estoy, G. F., Jr., Y. Yusa, T. Wada, H. Sakurai & K. Tsuchida. 2002. Size and age at first copulation and spawning of the apple snail, *Pomacea canaliculata* (Gastropoda: Ampullariidae). *Applied Entomology & Zoology* 37(1): 199-205.
6. Howells, R. G., L. E. Burlakova, A. Y. Karatayev, R. K. Marfurt*, and R. L. Burks. 2006. Native and introduced Ampullariidae in North America: History, Status and Ecology. Pages 73-112 in: R. C. Joshi (ed) *Global Advances in Ecology and Management of Golden Apple Snails*. Philippine Rice Research Institute (PhilRice), Philippines.

7. Joshi, R. C. & L. S. Sebastian (eds). 2006. *Global Advances in the Ecology and Management of Golden Apple Snails*. Philippine Rice Research Institute (PhilRice), Philippines, 600 pages.
8. Keller, R. P., J. M. Drake & D. M. Lodge. 2006. Fecundity as a basis for risk assessment of nonindigenous freshwater molluscs. *Conservation Biology* on-line DOI: 10.1111/J.1523-17.39.2006.00563x.
9. Rawlings, T. A., K. A. Hayes, R. H. Cowie & T. M. Collins. 2007. The identity, distribution, and impacts of non-native apple snails in the Continental United States. *BMC Evolutionary Biology* 2007, 7:97; doi:10.1186/1471-2148-7-97.

Sam Taylor Fellowship Proposal PART C: Budget

Budget Requests:

1. One trip to Houston **\$528.00**
 - Mileage (450 * \$0.485) = \$218.25
 - 1 night hotel (\$80 * 2 rooms) = \$160.00
 - Food (\$25 per diem per day * 2 days * 3 people) = \$150.00

2. Lab Supplies for Tank Experiment (Aquatic Ecosystems) **\$1422.00**
 - *P. insularum* design = \$200 x 4 fiberglass 170-L [45 gal] tanks = \$800
 - \$150 x 2 canister filters = \$300
 - \$322 x 1 heater = \$322

Photograph illustrates the main design of new tanks for cohorts. A new system is necessary so that they can be properly monitored and not used for other experiments.

3. Lettuce to feed new snails **\$50.00**
 - 1 head x \$2.00 romaine x 25 weeks = \$50



Total: \$2000.00

Other sources of funding:

I have a small amount (~\$500) of funds within the Department of Biology to purchase Ozarka water and additional food as needed to maintain the snails.