

Challenges Lead to Undergraduate Opportunities and Success in Biological Sciences

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I am a strong advocate of incorporating novel opportunities and challenges into undergraduate experiences at FHSU. We are redefining educational paradigms in the Department of Biological Sciences that allow us to continue to provide quality graduate experience, and expand that experience to an ever growing undergraduate population. Some of this innovation is the result of reevaluating the traditional professor/mentor interaction. But most significant is the proven success in student performance we observe that results from these experiences. A surprising benefit has been our improved ability to tackle increasingly complex, real-world problems in sustainability, natural resource management, conservation, biotechnology and health science disciplines.

There are various education models that facilitate student success. In the sciences, involvement in discovery-based scholarship is really tough to beat, not only as a conveyance of learning, but as an impressive resume building experience. In the Department of Biological Sciences, we are fortunate in having a foundation in a traditional high quality graduate research program. However, in the last decade we have expanded opportunities by using this program as an “umbrella” that augments the opportunities to provide undergraduate research experiences. This model provides a hierarchical-mentoring experience (professor



and graduate students) for these beginning students and a great deal more flexibility in our ability to provide novel academic challenges that match a student's program level (freshman to senior). In addition, the undergraduate - graduate student - professor collaboration allows the opportunity to tackle larger questions (securing larger extramural funds). Given the rather small age difference

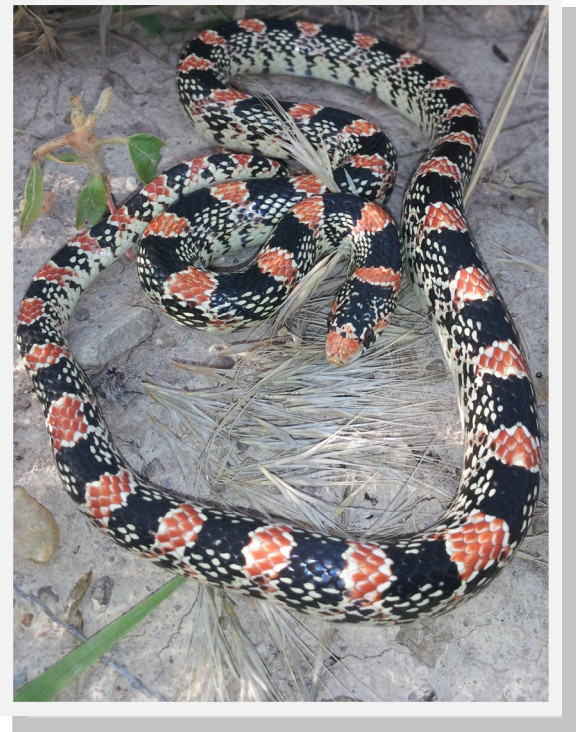
between the two student groups, it is easier for undergraduates to envision themselves at the next level of academic performance. Regardless of how we professors approach student interactions, the reality is that the experience and expertise gap can be intimidating. The graduate-student mentoring really seems to help bridge that gap and allow undergraduates to be confident more rapidly in the discovery process.

Let me provide a specific example from an exciting project that I have really enjoyed and which is typical within our department. Because we can support a vibrant graduate program, Dr. Rob Channell and I (and many others in the department) have developed successful collaborations over the years with natural resource agencies like the Kansas Department of Wildlife, Parks, and Tourism. We proposed a major investigation focused on reptiles and amphibians in southwestern Kansas, and how changes in land use and projected climate change might affect the occurrence and distribution of these native organisms. The project was initiated in July 2011 and ultimately would bring over \$400,000 in research funds to the university. The

size of the project was beyond what most contemporary investigators have attempted with regard to the scale of sampling, and well beyond what Rob and I



could undertake ourselves, even with a couple of graduate students. From the beginning one of the primary reasons we wanted to take on this challenge was because we could involve many students. Because much of the sampling would be done in the summer most of the students could be undergraduates. In actuality, over the two years of the study, 16 paid research positions and 30 students were able to participate either full-time, part-time, or as short-term volunteers.



Now, Rob and I have had a variety of professional experiences but brought different strengths to this large project. I have mentored a number of smaller field-ecology based projects focused on reptiles. In herpetology class, I have many opportunities to train students in proper methods of restraint and collection of life history attributes. Rob also has worked on a variety of problems with students, but brought superior spatial analytical skills and conceptual expertise in conservation biology to effectively model species responses to the projected changes. This made for an effective collaboration with regard to



accomplishing project objectives, but even more so from the perspective of student experiences. I was able to work closely with student groups in the field and took on the logistical support responsibilities through all of the empirical data collection. Rob then took the lion's share of responsibility in not only data analysis, imparting a measure of those techniques to students, but also mentored the

students in developing over a dozen posters and oral presentations at professional meetings. These additional professional experiences make a tremendous difference in the quality of student resumes as they compete for jobs and post-graduate fellowships.

So what did we do? In collaboration with KDWPT, Rob and I outlined a study area that included four counties in Kansas: Barber, Comanche, Clark and Meade. There, we had the privilege of working with some of the nicest and most magnanimous ranchers that I have had the pleasure to meet. On seven large ranches we built arrays of funnel traps and fencing to capture passing reptiles and amphibians, and positioned coverboards to attract them. You can think about funnel traps as 3-foot mouse traps; the snake or lizard is guided through a narrowing funnel to a wire cage and then can't find its way back out. Coverboards are just big sheets of plywood that provide shelter and over time attract these types of animals as they pass through



the landscape. These capture devices were laid out in long lines of over 3.5 miles each in rugged rangeland. To effectively check and process the animals we had to work in 4-5 person teams and rotate the teams among ranches. Student investigators walked the trap-lines every day on one ranch or another, and searched much of the area within 400 yards of the trap-lines. Team leaders were graduate students, and I would rotate among the teams and tried to deal with the inevitable novel challenges, mechanical, organisational, data related, etc., that arose periodically. It is difficult to convey the amount of just “plain old work” that it takes to set-up a project of this scale and in this ruggedly beautiful terrain. Conservatively, we deployed 2.5 tons of wire fencing and coverboard material on each of the seven ranches (total = 17.5 tons);



hauling it some of the distance by ATV, and much of it by hand. Nobody can tell me that this generation (X'ers, millennials, whatever name you want to hang on them) is afraid of work, won't do anything, or can't get away from a computer screen! I think everyone just needs a novel challenge, an opportunity to grow to their potential, and to demonstrate what they are capable of accomplishing.

After the installation of capture devices, we began to collect information about the reptiles and amphibians in the region, over the course of two active seasons. We captured animals and collected careful measurements related to size, maturity, sex and a battery of habitat characteristics that defined the plant communities and soil characteristics. Students learned how to use contemporary field equipment, GPS ori-



enteering, organizing large amounts of information, safely handled target organisms, and generally thrived in harsh conditions (2012 was a horrific drought year in that area). This was a serious commitment of time, sweat, blood, and mental tenacity. Students had many unique experiences with charismatic species like the Texas Horned Lizard or "Horny Toad" (I mean who doesn't like these passive little creatures), secretive species

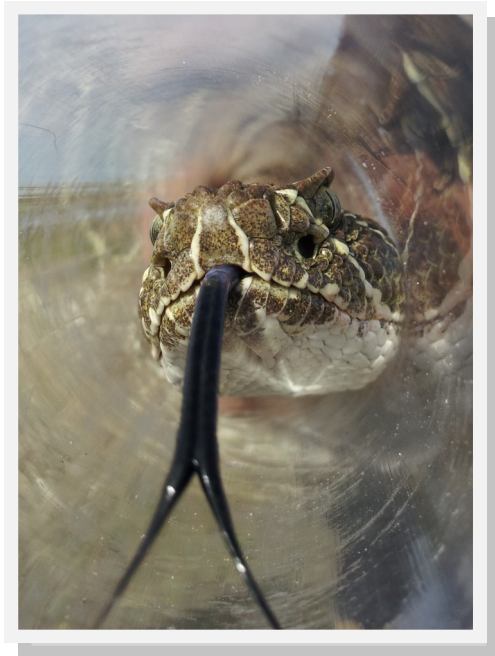
like the tiny New Mexico Blind Snake, and the truly beautiful Longnose Snake, all within some of the most breathtaking rangelands in Kansas.



Our students captured over 3100 individuals representing 48 species of reptiles and amphibians. They lived and worked together for 3 months each summer and were focused on collecting data; then worked together during the academic year to summarize information and present it at regional and international meetings of natural resource professionals. This is hands-on, immersive, education



at its best. As a mentor, I had the good fortune to witness the growth in academic maturity of both gradu-



ate and undergraduate students as they assumed ownership of more and more aspects of the project in their respective roles, and embraced the responsibilities associated with them. Perhaps as it should be, I became increasingly less relevant to many aspects of daily operations. As such, Rob and I were able to work more closely with individual undergraduates as they began to develop and design investigations of their own that we could incorporate in the project. This may be the greatest success of the project – to witness the level of growth and independence these students achieved. It certainly

makes all the effort more worthwhile in my mind.

I am confident students took a lot away from this experience. More than half the students that participated full-time in one or both seasons had successful applications to graduate and professional programs (not just in herpetology) both at FHSU and elsewhere. Here are a few of the comments they had regarding their experiences:

"It was great to have the opportunity to work with so many people who all have such different emphases. Two summers of learning, immersion, and quality research are irreplaceable in my memory. They afforded

me the opportunity to develop my own research questions, present my own projects, and to learn and be surrounded by those who aim to make a difference in the field of biology. Working on this survey and gaining valuable field experience was a key factor in being awarded the Presidential Merit Scholarship for my graduate program.” Adam Rusk, 2012



“The herp survey has encouraged me to continue with my academic career. Before the survey, I had planned on getting a job right after I had graduated. Fortunately, I had positive experiences with people I had met on the project that encouraged me to go to graduate school. I always enjoyed reptiles and amphibians, but being able to work with them every day made me appreciate them even more. I am now working on my graduate degree in Conservation Biology with a focus on reptiles and amphibians. After working two years on the project, it is now easier to formulate a plan of action on my own thesis project. Without this project, I don’t think I’d be anywhere near where I am today. Having a job that actually pertains to what you’d like to do in the future is a priceless experience that every student should have the opportunity to pursue.” Kasandra Brown, 2012

In closing, I would be remiss if I left you with the impression that Rob and I were the only faculty in the Department of Biological Sciences that provide this type of experience. Quite the contrary; as I mentioned earlier, this is the primary mode of research within the department. Students can easily follow their interests because we have faculty actively recruiting students to investigate projects in biotechnology, reproductive physiology, ecophysiology and plant stress, microbiology and antibiotic resistance, animal biolo-

gy, rangeland and conservation biology to name just a few. We see a bright future for FHSU students that upholds traditional quality in graduate education and expands challenges and opportunities that will provide the best undergraduate experience and credentials in the state.

