Undergraduate Research at the Firestone Center for Restoration Ecology, Costa Rica:
Tree Demography and Stand Characteristics in a Recovering Tropical Secondary Rainforest

Tropical secondary forests are often touted as having immense potential for carbon sequestration, yet little is known about how the carbon storage potential might vary across landscapes or what factors control the carbon storage potential. Working with my advisor, Dr. Diane Thomson, I studied tree demography and biomass accumulation in a recovering tropical secondary rainforest. I received training in forest survey skills and tree identification from my advisor and a Costa Rican botanist. Following my training, I worked independently for nine weeks to permanently tag, map, and measure over 1000 trees, including more than 50 different species. Using this data along with data from a previous survey, I estimated mortality, growth and recruitment rates, as well as total biomass and basal area.

After analyzing the data and performing an extensive literature review, I discovered that our plots were significantly less developed (smaller size distribution, higher proportion of pioneer species, lower basal area, and higher mortality rate) than similarly aged stands in other tropical secondary forests. Identifying substantial landscape-level variation is an important first step in understanding the processes that affect the recovery rate and carbon storage potential of tropical secondary forests. Thus far we believe that abiotic factors, land-use history, and proximity to seed sources may be the most important factors controlling the recovery of tropical secondary forests. This work was presented at an Ecological Society of America annual meeting and at the Southern California Conference for Undergraduate Research.

Undergraduate Senior Thesis Research:
Examining the Impact of Changes in Regional Precipitation Regime of the Population Viability of the Threatened Coachella Valley Fringe-toed Lizard

I initially planned to pursue a senior honors thesis that combined my strong interests in GIS, climate change, and conservation biology by constructing a bioclimatic envelope model to predict species range contractions under climate change scenarios. However, through my initial research I became acutely aware of the limitations of species distribution modeling. With the guidance of my advisor, Dr. Thomson, I decided to pursue a new alternative method for answering the question of how a species might respond to climate change. By combining population viability analysis with multiple regression techniques I developed a population model linked to rainfall that more accurately captured the biological complexities of the system. To complete this project, I expanded my skill-set and learned new statistical techniques and programming using MATLAB software.

Based on my model, I found that remarkably small changes in either the mean or the variance of future rainfall regimes could dramatically alter the risk of extinction for the threatened Coachella Valley Fringe-toed Lizard. For example, an increase of only 5% in the inter-annual variance of rainfall caused a two-fold increase in extinction risk. My study was the first to simultaneously consider changes in both the mean and variance of the future climate variables, and my results demonstrate that changes in the variance of climate can have effects that are not only substantial but equal in magnitude to those caused by changes in mean conditions. I presented my findings at the Joint Science Dept. Senior Thesis Symposium, and for my written thesis I was awarded for the "Best Senior Thesis in the Biological Sciences" at Claremont McKenna College. I will apply this model to analyze additional data sets before submitting my work for publication.

Employment as a Wildlife Technician for UC Berkeley: *Carrizo National Monument Exclosure Experiment*

While I am interested primarily in plant community ecology and restoration, I sought to use my summer research position at the Carrizo Plains to add direct work with animals to my modeling experiences, to become more familiar with the ecosystem, and to develop partnerships with the managing agencies. This work also helped me to further appreciate the strengths and weaknesses of ecological modeling compared to "on the ground" research, and allowed me to learn new skills that I will apply in my current research—studying how plant-herbivore interactions affect grassland restoration. During my first week I trapped San Joaquin Antelope Squirrels (*Ammospermophilus nelson*), used PIT (passive integrated transponder) tags to identify individuals, and recorded their demographic information. Later in the season I used a variation of the same techniques to monitor populations of federally endangered Giant Kangaroo Rats (*Dipodomys ingens*). Other skills I learned during the field season included radio telemetry, reptile surveys, and pit-fall trapping for invertebrates.

I also gained valuable insights into the plant community dynamics by measuring biomass on clip plots, identifying seeds in kangaroo rat pit caches, and performing Giant Kangaroo Rat feeding trials. For the feeding trials, 50g of seed from ten common plant species, including five natives and five exotics, were placed in a random order along a trench. We recorded visitation rates using motion-activated cameras and calculated the amount of seed removed. Our results indicated that seeds of the invasive annual grass red brome (*Bromus madritensis rubens*) were most preferred, while seeds of the native bluegrass (*Poa secunda*), were least preferred by Giant Kangaroo Rats.

Based on these results and the results of a previous study, we believe an interesting paradox exists whereby the Giant Kangaroo Rats promote the invasion of red brome through soil disturbance but simultaneously suppress its abundance by preferentially eating its seeds. This hypothesis has provided the inspiration for part of my current research—determining the net effect of Giant Kangaroo Rats on grassland restoration efforts.

Publications:

Gurney, C.M. "Examining the Impact of Changes in Regional Precipitation Regime of the Population Viability of the Threatened Coachella Valley Fringe-toed Lizard." Undergraduate Senior Thesis. Claremont McKenna College. 2009.

Gurney, C.M. "Shifting Agricultural Patterns and Productivity." Global Climate Change, Summaries of the 2007–2008 Scientific Literature. Ed. J. Emil Morhardt. Roberts Environmental Center Press, 2007. 271–288.

Presentations:

Gurney, C.M. "Changes in Regional Precipitation Regime Affect Persistence of the Threatened Coachella Valley Fringe-toed Lizard at Thousand Palms Preserve" Joint Science Department Senior Thesis Poster Session, Claremont, CA (4/09)

Thomson, D. M., Gurney, C.M., Cummings, K., and Scott, A. "Tree Demography and Stand Characteristics in a Recovering Tropical Secondary Rain Forest" Southern California Conference for Undergraduate Research, Pomona, CA (11/08)

Thomson, D. M., Cummings, K., Gurney, C.M., Scott, A. "Tree Demography and Stand Characteristics in a Recovering Tropical Secondary Rain Forest" Ecological Society of America Annual Meeting, Milwaukee, WI (8/08)