My goal as a researcher is to explain how species and landscapes interact to form ecosystems and communities. I want to apply this knowledge to help preserve and improve the way these systems produce the life-supporting services on which humans rely. I have been investigating these interactions since my undergraduate freshman year, primarily focusing on ant communities, a fantastic study system because of their high diversity and wide geographic range. I have taken advantage of comparative and experimental methods, involving field manipulations and utilization of natural experiments across a range of sites: the islands of Boston Harbor (BHI), the Dominican Republic (DR), and most recently the LTER site at Cedar Creek, Minnesota (CDR). I have developed skills including ant taxonomy, spatial analysis and mapping using GIS, and mathematical and statistical modeling in the R programming language.

I was fortunate enough to discover a course of research that excited me very early in the course of my studies, which gave me an opportunity to extensity follow a complex project from conception to completion. I joined the Farrell entomology lab at the Harvard University Museum of Comparative Zoology in the fall of my freshman year, and remained there until my senior graduation. Though the lab's primary research focus was insect phylogenetics, I was enticed by a small biodiversity inventory project on the BHI. I initially volunteered as a field assistant, databased specimen data, and prepared collections for identification by taxonomic experts. My mentors taught me the basics of field work, data management, and insect taxonomy. I soon found ants to be a fascinating and powerful study system. I began to study ant taxonomy at the university's ant laboratory and was subsequently hired to identify ants from a four-year backlog of the inventory's specimens.

I became curious about how ant species on the BHI's had been affected by the region's history of human disturbance. I obtained funds from Harvard to buy a sea kayak, and spent a summer camping on the islands and navigating terrifyingly crowded shipping lanes to collect specimens from across habitat and land-use gradients. Since no one in my lab studied contemporary biogeography, most of my work was independent. Reading through decades of literature on biogeography, I taught myself the statistics and theory behind island species distributions. Soon, I had cataloged enough of the BHI to analyze basic trends, and found that ant species diversity did indeed correlate with island land-use. I was invited to present these initial findings at a regional NPS conference [7-8] and at a regional student research conference [1].

Based on my taxonomic work, I was awarded a research grant by Harvard to travel to the DR and investigate an ant invasion reported in a recent string of newspaper articles. These declared that an exotic pest species, *Paratrechina longicornis*, was ravaging the country's hinterlands, but the academic community was skeptical. I took advantage of my lab's relations with the state university in Santo Domingo, UASD, to secure collecting permits and design my own field study. Traveling to museums across North America, I digitized museum records in a GIS database, which I used to identify potential field sites in the DR and analyze the ant's spatial distributions. I then worked with officials at UASD to organize transportation and lodging, find guides, secure permits, and gather the materials I needed to sample. After a month of field work, I found that the invasive ant was surprisingly rare, and that disturbed regions near roads and outside of conservation land actually harbored significantly higher ant diversity than undisturbed regions. I was delighted to discover that I could design a field study that answered a relevant ecological question. I presented these results at the Harvard Research Symposium [3], and wrote a news article for the journal that had originally reported on the plague [2].

Back in Cambridge, I became curious about similarities in the spatial distributions of ants that I had seen in the BHI and DR. To manage the enormous datasets that I had collected, I

taught myself to program in R and started compiling analysis methods from community ecology papers. I discovered much the same pattern on the BHI as in the DR: disturbance yielded a more diverse, but less stable ant community. However, some islands had far more species than was expected from theory, and several exotic species had strangely constrained distributions. I was invited to present my results during a regional conference on coastal diversity [4-6].

Though I wanted to explain the mechanisms behind these patterns, I quickly learned that my research approach had been somewhat backwards. I had not structured my field techniques around any specific question, but rather had collected whatever seemed interesting at the time. I had to teach myself Monte Carlo simulation techniques to analyze my non-parametric data, and threw out samples that couldn't be coerced into a useable form. Though I wasn't able to definitively identify mechanisms behind the patterns, I teased some preliminary results from my fieldwork, which suggested that there were predictable "cycles" of ant species occurrence both in the BHI and DR. With this in mind, I wondered if I could pick out the rules that governed these cycles, and predict ant community structure based just on sites' characteristics.

Fortunately, my department was interested by the results, and I received funding to continue collections at both sites. Over the following summers, I set up experimental plots across six of the BHI with different land use histories, replicating simulated patches of disturbance on each. Similarly, I returned to the DR to see how species responded to gradients across disturbed landscapes. These secondary studies allowed me to assign causality to the relationships I had previously observed. With the help of seasoned ecologists at the Harvard Forest LTER, I completed analysis of my field data, and formulated an elegantly simple explanation for ant species dynamics. As each species made small changes to the landscape around it, it paved the way for new species to invade in a continuous cycle of local colonization and extinction. An apparently chaotic system could be explained by a simple set of rules.

My work to date has led to six invitations to present my research at scientific meetings, and to the completion of an academic paper, which is in press at *PLoS ONE* [9]. Additionally, I translated a summary of my research in the DR into Spanish, which is percolating through the Dominican bureaucracy on its way to being published at *El Caribe*, the newspaper that originally documented invasive ants in the country [2]. My research has also resulted in practical benefits to society: I have worked as a director and educator for Boston public school students in Harvard's EnviroEd afterschool program, have collected species' inventory data and management plans for the BHI, which I was invited to present to the National Park Services on two occasions [7,8], and most recently have run field-technique and data-analysis clinics for local K-12 teachers and students at CDR through the Math and Science Teacher Partnership Program. Under the tutorage of Dr. David Tilman, I am now extending my research on species-environment interactions through graduate research at the University of Minnesota, working in a new field site at CDR.

Papers, Presentations, and Posters:

[1] *Boston Undergraduate Research Symposium*, poster: Predicting and Managing Species Diversity on the MCZ's Boston Harbor Island ATBI Site. 4/2009. **[2]** *El Caribe*, news article: El problema con las pestes. Promised by authorities to be released in 2011. **[3]** *Harvard Research Symposium*, poster: How do Landscape Factors Affect Community Structure? 11/2009. **[4]** *Nantucket Biodiversity Conference*, poster: What Landscape Factors Best Explain Ant Diversity? 9/2009. **[5]** ——, invited talk: Island-scale species richness: Where it came from or how it got there. 9/2010. **[6]** ——, poster: How can fifty-one ant species coexist on the Harbor Islands? 9/2010. **[7]** *National Park Service Boston Harbor Islands Science Symposium*, invited talk: Ants as an Indicator Species for Effects of Human Land Use. 9/2008. **[8]** ——, invited talk: Ant cycles, or how fifty-one ant species can coexist on the BOHA. 10/2011. **[9]** *PLoS ONE*, research article (in press): The effects of biogeography on ant diversity and activity on the BHI. 11/2011. Authors: Clark AT, Rykken JR, and Farrell BD.