It's hard to see the environmental impact of our activities from the ground. Only from a satellite image can we really see human civilization, appearing like a bad case of smallpox across the verdant skin of the earth. As global warming proceeds and precipitation patterns change, plants and animals are being forced to migrate to more hospitable areas. However, human alterations to the landscape such as homes, buildings, and open fields will make the migration more difficult in some places than others.

My research interests lie in studying this migration of species due to climate change. After inputting existing landscape and species distribution data for a study region into a GIS, I want to use it to develop a model that accounts for dispersal patterns, available food, urban development, and other factors affecting migration. The model would then be used to try to forecast areas where species might migrate most easily, so these areas can be targeted for conservation.

Dean Urban has been working on a graph-theoretic approach to predicting migration hotspots, which parallels my interests nicely. I met with him and Pat Halpin in October, and was encouraged to apply to the Ecology program. This lab is ideal because when I begin to develop my model, graphs might prove to be very useful. Also, Dean has been involved in a range of projects where my broad background in the biological, physical, and computational sciences would be of good use.

Background

I've had some experience with remote sensing, though from the ground up, literally. In 2003, besides being a TA for Paula Lemons' introductory biology class at Duke, I also worked in Sonke Johnsen's visual ecology/biophysics lab. My field research involved heavy use of a spectrometry system I put together to measure daily variations in natural skylight color, as well as computer analysis back in the lab of the resulting irradiance spectra. This was done so I could later investigate the effects of light pollution on nocturnal insect ecology, for conservation and pest management purposes. I earned an NSF Graduate Fellowship for a research proposal based on my work. However, I'm not limited to this work in graduate school. Unfortunately, I received this news only after learning I hadn't been admitted to Duke's Biology program.

I was likely not admitted because my research experiences were mostly in the physical and computer sciences instead of molecular biology, which was important to the Biology program. While at the NC School of Science and Math, I was on the US team to Vienna for the 12th International Young Physicists' Tournament. Just before college, I used photoelastic materials to study the stress distribution beneath sandpiles in Robert Behringer's physics lab at Duke. This work resulted in a paper published in Physical Review E. Duke granted me a full-tuition Reginaldo Howard Scholarship so I could continue my studies in physics. However, I later decided to take advantage of Duke's strengths in ecology and environmental science.

I majored in biology, but kept a strong focus in areas pertaining to global change. Despite my 3.4 GPA that was due to first semester roommate troubles, I earned A's and A+'s in geology, global change, and climate change, as well as in biomechanics, trees and shrubs of NC, computer science, and photobiology/visual ecology. I first became familiar with GIS outside of class by exploring the interactive GIS maps on the USGS and Durham, NC web sites. Recently I've been familiarizing myself with ArcGIS, installed in a computer lab at Duke's EOS department. My map and navigational skills are strong, though I frequently take a GPS and topographical software with me on field excursions. I've also been doing web/graphics design for Duke and NCSSM for the past 6 years (portfolio: www.realizen.com). It's helped to sharpen my facility with computers, graphics software, and programming.

In retrospect, I probably should have applied to the Ecology program last year instead of Biology, but I previously believed I couldn't because of my major. Before discovering Dean's lab this fall, I tried getting more molecular biology experience so I might be able to apply to Biology again. I worked as a research technician for David Pickup's virology lab at Duke. I really enjoyed looking up and analyzing DNA sequences from genomics databases, but I also learned the wet lab wasn't meant to be my laboratory as

much as computers and nature have been. After this brief position, I began doing more independent study in GIS, remote sensing, and ecology, along with investigating prospective graduate labs.

One of my best EOS classes had been Paul Baker's, on global change. Recently we discussed his research with John Terborgh on climate change and the tropical ecology of Bolivian rainforests. I considered what a good graduate project it would be to report how varying precipitation levels over previous millennia have caused a vertical shift in vegetation distributions in the forest canopy. The data could then be used to develop a model to predict future changes in vegetation and wildlife distribution.

However, I can do the same kind of research in Dean's lab, while still remaining on the continent of the world's #1 greenhouse gas producer. I would love to travel the world, but if I can help the people responsible for most of global warming to see its consequences right here in their own backyards, they might be more inclined to take action. Instead of focusing on an altitudinal shift of rainforest vegetation, I would study the general northward shift of temperate forest communities. There are many more man-made obstructions to be encountered in such a large scale migration, which will mean more declines in species that aren't broad dispersers. Declines in plant and songbird populations, along with increases in many pest populations, are just some of the changes we've already seen in America.

Unfortunately, regardless of what action we take against global warming, it will be irreversible over the next century. Therefore, it will be necessary to identify and protect crucial species migration pathways. By earning my Ph.D I could work toward this goal, as well as to provide a better understanding of the ecological effects of climate change. Since I want my research to ultimately be used for environmental protection, the proximity of the Nicholas School is ideal. Undoubtedly there will be others in Ecology as well as Environmental Policy and Management whom I can work with so the migration hotspots I identify might be conserved.

Publications:

Clark D, Johnsen S. Natural color changes in visible skylight over a 24-hour period. In progress.

Vanel L, Howell D, Clark D, Behringer RP, Clement E. Memories in sand: Experimental tests of construction history on stress distributions under sandpiles. PHYSICAL REVIEW E 60 (5): R5040-R5043 Part A NOV 1999

NSF Research Proposal:

The effects of light pollution on nocturnal insect ecology. www.realizen.com/about/NSFproposal.pdf