NRE 540 GIS Poster Symposium

Friday, December 14, 2007
2:00pm – 6:00pm
Room 1024, Dana Building

<table>
<thead>
<tr>
<th>Time</th>
<th>Student</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>2:12</td>
<td>Jennifer Johnson</td>
<td>Mapping the Socioeconomic and Ecological Determinants of Water Borne Disease in Mwanza, Tanzania</td>
</tr>
<tr>
<td>2:24</td>
<td>Vicki Kalkirtz</td>
<td>Environmental Justice and Fish Advisories on the Detroit River Area of Concern</td>
</tr>
<tr>
<td>2:36</td>
<td>Hugh Stimson</td>
<td>Hyper-spectral Mapping of Water-Limited Vegetation</td>
</tr>
<tr>
<td>2:48</td>
<td>Joe Nohner</td>
<td>Muskellunge Spawning Habitat in Northern Wisconsin Inland Lakes</td>
</tr>
<tr>
<td>3:00</td>
<td>Diego F. Alvarado-Serrano</td>
<td>Evaluating the relative importance of environmental variables in the distribution of genetic variants: a case study in the Soft Grass Mouse (<em>Akodon mollis</em>) in Ecuador</td>
</tr>
<tr>
<td>3:12</td>
<td>Sean Ledwin</td>
<td>Assessing the Environmental Impacts of Belize Aquaculture Ltd on Placencia Lagoon</td>
</tr>
<tr>
<td>3:24</td>
<td>Dianne Dietrich</td>
<td>What can communities know about their neighborhoods? Analyzing Freedom of Information Act Requests and access to Public Library resources in southeast Michigan</td>
</tr>
<tr>
<td>3:36</td>
<td>Jennifer Doty</td>
<td>Mapping the Mercantile Liverpool Project: A Spatial Analysis of Historical Census Data</td>
</tr>
<tr>
<td>3:48</td>
<td>Leah Long</td>
<td>Roman Marble Quarries in the territory of Aphrodisias, Turkey: Volume Estimations, Transportation Routes, and Associated Landscapes</td>
</tr>
<tr>
<td>4:00</td>
<td><strong>Break</strong></td>
<td><strong>Room open to public for poster viewing – Students available for questions</strong></td>
</tr>
<tr>
<td>4:24</td>
<td>Adela Sobotkova</td>
<td>GIS and Satellite Image Analysis for Archaeological Survey Planning at Kabile, Bulgaria</td>
</tr>
<tr>
<td>4:48</td>
<td>Elizabeth Nellums</td>
<td>Prioritizing Areas for Conservation in the Blue and John Crow Mountains National Park, Jamaica.</td>
</tr>
<tr>
<td>5:00</td>
<td>Han Zhang</td>
<td>Enhancing Pavement Management System Using GIS</td>
</tr>
<tr>
<td>5:12</td>
<td>Michael Billmire</td>
<td>Mapping Biological Vulnerability to Climate Change in El Yunque National Forest, Puerto Rico</td>
</tr>
<tr>
<td>5:24</td>
<td>Michael Guterbock</td>
<td>Travel Behaviors and Malaria Risk in Western Kenya</td>
</tr>
<tr>
<td>5:36</td>
<td>Simeon Caskey</td>
<td>Predicting Distribution of Subalpine Fir (<em>Abies lasiocarpa</em>) and Big Mountain Sagebrush (<em>Artemisia tridentata</em>) in Wyoming</td>
</tr>
<tr>
<td>5:48</td>
<td>Michael Yun</td>
<td>Alternative uses for city-owned vacant property in Detroit, MI</td>
</tr>
</tbody>
</table>

Abstracts available online at <http://esa.snre.umich.edu/classes/nre540/index.html>
Mapping the Socioeconomic and Ecological Determinants of Water Borne Disease in Mwanza, Tanzania

Jennifer Lee Johnson (ferfina@umich.edu)

Regional medical reports indicate that in 2001, diarrhea and intestinal worms were ranked the third and fifth cause of morbidity in the Mwanza region of Tanzania (National Bureau of Statistics, 2003). In Mwanza City, like many other cities in around Lake Victoria, fewer than 5% of inhabitants have access to municipal water and sanitation. Additionally, Mwanza lacks the infrastructure to adequately treat municipal and industrial wastes. Consequently, water receiving bodies such as Lake Victoria receive huge amounts of untreated wastes which are salient factors generating a rising risk of intestinal worms and diarrhea, particularly for those who rely on these water bodies for drinking, cooking, washing, etc. Rapid population growth, urbanization and the looming implications of climate change will continue to compromise human and ecosystem health around the lake, making necessary a comprehensive examination of the root causes of diarrheal diseases to plan for and adapt to climate change.

In the summer of 2007, a team of student researchers conducted 120 household interviews in Mwanza District, Tanzania. The team collaborated with the Mwanza Ministry of Health and the National Environmental Management Council to collect data on diarrhea prevalence, socioeconomic status and ecological conditions to assess the role that socioeconomics and ecological conditions have on diarrhea prevalence in the Mwanza region. Four specific sites were selected and sampled. Data on socioeconomic indicators, including income and highest level of education completed, sanitation practices, including use of water treatment and cooking practices, as well as ecological indicators, including distance from Lake Victoria and type of water source (well, borehole, tap, etc) was collected. Additionally, water quality data including, PH, turbidity and prevalence of fecal coliforms was collected for several water sources at each research site.

Over 100 data points taken during household surveys and water testing were overlaid on a GoogleEarth base map of the Mwanza region, which was then georeferenced in ESRI’s ArcGIS. Key health, behavioral, socioeconomic, and ecological indicators are shown for surveyed households, including; (1) diarrhea prevalence; (2) whether participants treated their water; (3) household income; (4) use of a contaminated well. This project maps these socioeconomic and ecological conditions to assist local health facilities and resource managers in assessing the prevalence and root causes of water borne diseases in Mwanza.
Environmental Justice and Fish Advisories on the Detroit River Area of Concern
Vicki Kalkirtz (vjmk@umich.edu)

This project investigates the fish consumption advisories issued for the Detroit River in both Detroit and Canada and whether the anglers receive and heed this information. Detroit residents are predominantly African American and of low income, while the suburban areas south of the city are predominantly Caucasian and middle class as are the residents of Ontario. Significantly different mechanisms for distributing information about toxins in fish and fish consumption advisories are employed by Canada and the United States. For this study, we conducted creel surveys of anglers fishing at several popular spots on the Detroit River in both Michigan and Ontario. Several differences in information access, contaminant awareness and fish consumption were observed between the anglers from Michigan and the anglers from Ontario. Using GIS analysis, demographic information was compared to the survey responses to determine if this is indeed an Environmental Justice issue and to spatially represent our data. We found that the residents of Detroit, MI who are people of color are less aware of the fish consumption advisory than their Canadian counterparts, and consume fish from the Detroit River more often. We also found that people of color in Michigan have a more positive perception of the Detroit River’s water quality than Caucasian residents of Ontario.

Hyper-spectral Mapping of Water-Limited Vegetation
Hugh Stimson (hstimson@umich.edu)

Understanding how plants mitigate water-stress through landscape growth pattern has implications for predicting complex landscape response to climate change in water-limited regions of the US and other countries. Spatial growth patterns such as spotting, banding and mazing have been observed in the distribution of woody vegetation in diverse water-limited landscapes. These patterns are theorized to be the result of plant-to-plant mechanisms, and are demonstrated to be more rain-efficient than random distributions. Spatially patterned vegetation is also likely to respond to changes in precipitation in complicated and extreme ways. Predicting these changes requires better understanding of the underlying mechanisms driving patterning. My research couples remote sensing of vegetation with agent-based modeling to explore these mechanisms.

I created fine-scale maps of real plant distributions using hyper-spectral imaging of a study site near Los Alamos, New Mexico, USA. I used data recorded in 2004 by the AVIRIS (Airborne Visible/Infrared Imaging Spectrometer) sensor over a series of mesas. That data was processed and filtered to create presence/absence maps of the co-dominant juniper (Juniperus monosperma) and pinon pine (Pinus edulis) vegetation. Several techniques for isolating the spectral signature of vegetation from the background soil are presented and compared. Exploratory analysis of moisture content in the resulting vegetation maps is also presented.
The muskellunge is an economically and ecologically important fish species in the Great Lakes Region. One of the most dense population centers occurs in Northern Wisconsin. These populations, as well as others, have been declining recently, and multiple hypotheses have been proposed. One strongly supported hypothesis is that muskellunge spawning habitat is being degraded through development. This project will seek to understand the muskellunge spawning habitat preferences. Data from twelve inland Wisconsin lakes with naturally reproducing muskellunge populations will be used to create a spawning habitat model. Model creation will be based on these unstocked populations to gain an understanding of the natural choices that muskellunge make in selecting spawning habitat.

The GIS-based model will utilize multiple data layers gained from the Wisconsin DNR and University of Michigan’s Institute for Fisheries Research (IFR). The IFR provided a raster file which is the application of the Darcy hydrology model across the state of Wisconsin. The Wisconsin DNR has provided landcover, lake and stream boundaries, aerial photography, and soil surrogate layers. According to the attached data flow model, these layers will be processed and refined to be used as inputs for the Spawning Habitat Model. Additionally, measures of fetch to the average wind direction, shoreline exposure, and littoral slope will be derived and included. Data from fieldwork in 2007 will locate muskellunge spawning sites, and serve as the basis for site characteristics. Spawning sites are those locations where a muskellunge was observed (over 24 inches) and eggs were found during separate surveys. A multiple regression model will combine these inputs at each spawning site in order to predict where muskellunge spawn.

At this point, a preliminary model will be created using the lakes for which data exist. However, after the 2008 field season, half of the lakes from 2007 and half from 2008 will be used to train the model. The remainder will be used to test the model, since variations in water levels, temperature regimes, and other stochastic factors may confuse data between years.
Evaluating the relative importance of environmental variables in the distribution of genetic variants: a case study in the Soft Grass Mouse (*Akodon mollis*)

Diego F. Alvarado-Serrano (dalvarad@umich.edu)

Despite growing interest in modeling geographic ranges of species and populations, few analytical tools exist to evaluate the relative importance of different environmental predictors in driving patterns of geographic distribution. The set of variables employed in generating predictive distribution models have traditionally been subjectively chosen given the lack of systematic procedures to estimate their significance. Yet, the set of predictors employed strongly determine the outcome and accuracy of the models. This project is a preliminary exploration of the possibility of using landscape-resistance models as an indirect approach to assess the role of different environmental variables in shaping the spatial distribution of intra-specific genetic variants. I generated landscape-resistance grids for populations of the Soft Grass Mouse (*Akodon mollis*) in Ecuador based on mean annual temperature, mean annual precipitation, vegetation type, elevation and slope. From these grids, I extracted the landscape-resistance values corresponding to the geographic location of genetically distinctive populations of *A. mollis*, and conducted simple and multiple linear regressions of these values on the inter-population genetic distance. The results indicate a high degree of correlation between all variables which hinders the utility of landscape-resistance models in understanding the importance of the different variables. Only the regression between the resistance values based on annual mean precipitation and genetic distance was statistically significant. Yet, this result should be interpreted with caution given the preliminary nature of the analysis. Further investigation is needed based on a greater population sample and extending the analysis to other species.
Assessing the Environmental Impacts of Belize Aquaculture Ltd on Placencia Lagoon

Sean Ledwin (sledwin@umich.edu)

Belize is promoting intensive shrimp culture as a major new industry. Shrimp farms use food and fertilizer to supplement diets of shrimp for better growth. Studies of nutrient retention from shrimp ponds have generally shown that less than half of the nitrogen applied to ponds (as protein feed) is retained by the target organism; the remainder is lost to pond sediments and surrounding water via flushing. In the past decade, serious concerns have arisen about the health of Placencia Lagoon and its ability to handle increasing effluent from shrimp farms and surrounding human development.

This summer I collected data with the goals to 1) assess water quality in two tributaries of the Placencia Lagoon basin that receive shrimp farm effluent; 2) apply active and passive stable isotope tracking techniques to assess shrimp farm nitrogen and carbon in these two tributaries and beyond; and 3) investigate pond management and design alternatives that would both improve effluent quality and the financial integrity of shrimp farming operations in the Placencia basin. Samples collected this summer for stable isotope analysis included periphyton, seagrass, red mangrove leaves, mangrove oyster and manatee feces. Physical/Chemical water parameters and seagrass species/abundance were also measured. My project for this course will focus on effluents related to Belize Aquaculture Ltd (BAL), an ostensibly zero water exchange shrimp farm. Stable isotope data is currently being analyzed and was not available for this project. Maps were produced using GIS comparing spatial and temporal change of water quality parameters. Thiessen Polygons were employed to help illustrate seagrass change between 2003 and 2007. Samples collected during the summer of 2007 showed high levels of ammonia and orthophosphorus in an effluent stream (Silver Creek) of BAL on 5 occasions, low dissolved oxygen levels in that stream over the entire summer, and reduced seagrass abundance in the middle section of Placencia Lagoon adjacent to BAL (comparing seagrass data collected in 2003). Data will continue to be collected this spring and summer.
Public libraries serve an important function within communities, providing access to a range of resources and services. This can include access to specialized databases, guided research assistance, and opportunities to access Internet resources at little or no cost. Many public libraries include materials of specific local interest, which can include information about the local environment.

Superfund is a United States government program intended to address the cleanup and rehabilitation of toxic and hazardous waste sites. The Environmental Protection Agency has identified such sites as "Superfund sites" and maintains records pertaining to their history and cleanup efforts. There are fourteen "Superfund sites" in southeast Michigan, which includes Livingston, Macomb, Monroe, Saint Clair, Washtenaw and Wayne counties. The Environmental Protection Agency has also set up an office to handle Freedom of Information Act requests pertaining to these sites. Individuals or corporate entities can request copies of documentation pertaining to Superfund sites.

The purpose of this project is multifaceted: to examine public library resources in southeast Michigan to determine which areas are in greatest proximity to library and information services, and compare these areas with recent census data; to identify areas in southeast Michigan that are closest to, and are most likely to be affected by, Superfund sites; to analyze the origin of Freedom of Information Act requests for Superfund information in southeast Michigan.

A Freedom of Information Act request was placed to obtain copies of all requests for the fourteen Superfund sites in southeast Michigan. The information contained in these requests, including address of origin, information requested, reason for request (if available) was coded and entered into a geodatabase. Public library data was compiled using information provided by the Library Statistics program. The newest dataset, from 2004, was used to obtain names, addresses, branch locations, and information about collections and services for central public library systems. This data was also geocoded and included in a geodatabase. Analysis, including determination of proximity to Superfund sites, and density of information resources, was accomplished using functionality available in ArcGIS.

Possibilities for expanding this project include obtaining Freedom of Information Act requests for a broader range of environmental hazards, surveying libraries about the specific local information they offer, and possibly exploring other resources for obtaining environmental information.
Applications of GIS technology are growing in fields of historical academic research. There are challenges, however, that are unique to the situation of applying cutting edge technology to data collections from the past. The focus of this project is the application of spatial analysis techniques to the database from a historical research project undertaken at the Centre for Port & Maritime History as a joint collaboration between the University of Liverpool School of History and National Museums Liverpool.

From 2003 through 2006, the Mercantile Liverpool Project (MLP) research team collected data from original trade directories and census records in the local records archives of the City of Liverpool library. This was compiled in a database of over 100,000 records of merchants’ names, home and business addresses, and other personal or business-related information from the years 1851-1912.

There would be immense value in being able to present map visualizations of the merchant data through the application of GIS techniques to the spatial elements already present in the MLP database. The methodology for this project initially included geocoding of the historic addresses; however, this technique will not be possible due to copyright restrictions on postcode data by the Ordnance Survey of the United Kingdom. However, there are additional possibilities for this project to serve as an example of the process and methodology for combining historical census data with spatial analysis to develop digital maps that can be used for additional analysis of the historical data in question.

Through collaboration with colleagues at the University of Liverpool who have access to the EDINA repository of digital data, I have acquired copies of historical census vector layers for the years 1871, 1881, and 1891. Relationships were created between these layers and tables of census and directory data queried from the merchant database for the corresponding years.

Based on geographic locations of home addresses for merchants across multiple decades, and covering multiple types of trades (brokers and merchants of cotton, corn, and ships), it is possible to analyze the related data for spatial patterns in merchants’ places of birth, primary trades, and affluence (based on existence and number of servants in the households). A geodatabase has been created that includes the layers of historic Liverpool census areas for 1871-1891, joined with the tables of related merchant data from the original MLP database. The spatial data produced may be used to create map layers in ArcGIS for possible use as static images to accompany related publications about the MLP database, and/or dynamic maps to be presented on a website related to the original MLP research.
Roman Marble Quarries in the territory of Aphrodisias, Turkey: Volume Estimations, Transportation Routes, and Associated Landscapes.
Leah Long (leahel@umich.edu)

Marble was the lifeblood, the literal building blocks, of ancient Roman cities. Aphrodisias, in the ancient region of Caria, in southwestern Turkey, is an unusually well-preserved archaeological site. Founded in the 1st c. B.C., it prospered through the Roman and Late Roman periods. The focus of intensive public building projects, the urban infrastructure included a Temple of Aphrodite, Sebasteion (Sanctuary of the Emperor), Hadrianic Baths, a theater, a stadium, and a council meeting house and became famous as a center for producing high quality marble sculpture. Aphrodisias is a city of marble, yet little is known about the origin of marble used to build the city or the dynamics of supply. Nine quarries have been discovered in the Aphrodisias Regional Survey from 2005-2007, many of which are quite large in size and at a considerable distance from the city center. This project aims to reconstruct marble quarries in their natural and archaeological landscapes through three different applications.

The first aim is to estimate the volume removed from one of the largest known marble quarries, located 2 km. north of Aphrodisias. In 2005, points were taken in ArcPad and interpolated to simulate current land surface, after the marble was removed. In order to recreate the original topography prior to quarrying, elevation points were estimated and re-entered into an attribute table. Such a process allowed for visualization in ArcScene of the quarries before and after marble extraction. It was discovered that a volume of approximately 35,000 cubic meters was removed, enough stone to supply over half of the buildings in the city center.

The second application involves locating the most cost efficient routes of transportation from two different marble quarries through a least cost path analysis. The quarries, both located in remote, mountainous locations, were set as the origin, while Aphrodisias served as the destination point. Slope, obtained from 5 meter digitized contours, hydrology (research in quarries elsewhere in the Roman World has shown that when moving stone downhill, transporters followed the natural contours cut by seasonal riverine channels), ancient roads leading out from the city center (discovered through archaeological documentation of tombs, which traditionally lined the roads of Greco-Roman cities) formed the three criteria for determining the routes. Sub-meter resolution QuickBird imagery was checked for the suitability of the paths, which were found to be plausible. Analysis shows that transportation of marble was a dangerous undertaking. Workers using, who used ox-pulled wooden carts, were forced to proceed downhill at dangerous angles of 17 degrees.

Distance analyses were performed on nine quarries to assess whether recurring types of archaeological sites occurred near quarries, with a meaningful distance of correlation set at 2 km. from each quarry. The main aim of this exercise was to identify worker communities and activities associated with quarrying. Many different categories of Roman archaeological sites, such as farmsteads, settlements, agricultural processing areas, the presence of miscellaneous architectural elements and tombs were well represented, yet the variability of sites revealed no pattern of association. The analysis revealed the tendency for the products made in the marble quarries to remain close to their origin of production. Marble items, such as columns, floor slabs, agricultural olive pressing blocks, and ashlar masonry were distributed to the rural inhabitants, suggesting that these quarries served local needs in addition to sources for the city.
This project explores the potential of GIS and high-resolution satellite image analysis for planning archaeological survey and detecting the location of unknown sites in the environs of the ancient city of Kabile in the Yambol District of southeastern Bulgaria.

The 2007 field season at Kabile focused on the construction of a Geographic Information System (GIS) and relational database (based on a 100 sq km QuickBird multi-spectral satellite image centered on the site). Agricultural information for over 500 fields was recorded, and features of archaeological interest were identified through the manipulation of multi-spectral information in the satellite image using PCI Geomatica and ERDAS respectively.

The GIS analysis of the suspect features and their agricultural and environmental context is useful for the planning of archaeological surface survey, since areas for survey can be prioritized according to:

- presence of suspect features
- accessibility
- agricultural usage
- surface visibility (and likely surface visibility at the planned time of survey)

Overall feasibility was determined by overlaying features and fields, and linking fields to information in the database. Not only were individual fields assessed in this manner, but a buffer zone of 100 m surrounding each feature was also analyzed. Such an analysis saves time and manpower by flagging areas of the highest potential for archaeological survey. It also facilitates constant monitoring of sample size (the area any given field being surveyed) and assessment of statistical significance (of artifact counts) during survey.

The Satellite Image analysis comprised of the following procedures.

- Spectral Analysis through band manipulation
- Generation of an NDVI (Normalized Difference Vegetation Index)

In the past, high resolution imagery such as QuickBird has been applied to the analysis and management of relatively small areas ((Lasaponara and Masini 2006; Masini and Lasaponara 2006), while larger areas have been investigated using lower-resolution imagery like LANDSAT (Clark, Garrod et al. 1998; Harrower, McCorriston et al. 2002). Such lower-resolution imagery is extremely useful for producing detailed base maps and studying large-scale environmental and geological phenomena remotely, but only high resolution imagery can reveal the soil marks, crop marks, shadow marks, and structures associated with most archaeological features. In addition, indexes such as NDVI help delineate in the image environmental indicators of subsurface features. Stressed or vigorously growing vegetation can accompany archaeological remains such as buried walls and ditches respectively. With higher resolution and multispectral properties the satellite imagery not only presents the researchers with more powerful analytical capabilities, but opens a new horizon in time and cost effective large-scale archaeological investigation.

The feasibility of this methodology was tested against pre-existing archaeological survey data in the vicinity of the site of L’Amastuola, Italy.
State Wildlife Action Plans: GIS Collaboration Project
Sarah Levy (sarahlev@umich.edu)

The use of Geographic Information Systems (GIS) has become a crucial element of landscape ecology and conservation planning. The integrated nature of the State Wildlife Action Plans and their emphasis on stakeholder and interagency collaboration, has created a need for innovative approaches to creating dialogue opportunities. In particular, plan coordinators have expressed interest in using GIS to foster these opportunities.

The major obstacles that the coordinators have faced in achieving these goals amount to a significant lack of interoperability between state spatial data sets. Because each state has been tasked with developing its own GIS specific to its plan, coordinators have used conflicting spatial scales, classification systems, species/habitat prioritization methodology, and data model structures. These incompatible data models have nearly completely stifled discourse, data sharing, and collaborative planning between states.

While there are some efforts to develop regional or national classification systems and data models specific to the plans, there is a dearth of “bottom-up” approaches to fostering interstate GIS collaboration. To fill this gap, I have performed case studies of the New York and New Jersey GIS systems, gathered data from both states, and have put together a suite of datasets based on species location data, species densities, and habitat type. My goal is for the data sets to be suitable for use by both New York and New Jersey, and for the data models to be easily interchangeable between types of organization frameworks.

Prioritizing Areas for Conservation in the Blue and John Crow Mountains National Park, Jamaica.
Elizabeth Nellums (ekayn@umich.edu)

The Blue and John Crow Mountains National Park (BJCMNP), located in western Jamaica, is a rainforest expanse jointly managed by several non-profit and government agencies. There are many threats to forest quality within the park, particularly the clearing of slopes for coffee farming. However, resources to protect the park are stretched thin, and conservation efforts must be targeted and prioritized. As part of a School of Natural Resources and Environment Masters project, five University of Michigan students visited the BJCMNP in the summer of 2007 to explore the interaction of conservation and community in the park. This aspect of that project presents a map of one area of the park and its surrounding buffer zone, Penlyne, examining three criteria of land quality in order to prioritize land conservation projects. Data was collected at GPS points throughout the region to report 1) canopy cover, 2) percent of invasive species, and 3) an on-site evaluation of forest health. These factors were extrapolated into grids through kriging and the creation of Theissen polygons, which were overlaid in ArcGIS. When projected over satellite imagery of the region, these map overlays allow decision-makers to select for areas of high canopy cover, low invasive species, and intact forest status. Such areas are considered high-priority for conservation. ‘Green corridors’ that connect such habitats can also be identified and prioritized for restoration and protection.
Pavement management systems (PMS) are useful tools for highway agencies in quantifying the overall maintenance needs of pavements and presenting the alternative maintenance strategies under budget constraints. The most important aspect of development of a PMS is to collect, manage and analyze the pavement condition data in a considerably detailed format. Since geographical information systems (GIS), with their spatial analysis capabilities, match the geographical nature of the road network, they are considered to be the most appropriate tools to enhance pavement management operations, with features such as graphical display of pavement condition.

A case study in which the PMS model connects a GIS platform for Washtenaw County, Michigan, is described. The first stage of the study entailed the collection of all necessary information available from the pavement network. AADT, control section, pavement type, lane numbers, and pavement conditions were collected and inputted into the attribute table. Secondly, the pavements are divided into segments using uniform sectioning methodology. Then, the GIS model was interacted with VBA optimization model which predicts the future pavement condition changes and returns the optimal maintenance schedule. Finally, the pavement condition changes and maintenance activities were visualized in the GIS model.

The use of GIS for pavement management purposes can be helpful in quick and precise decision-making. The graphical presentation of results may prove to be very useful in presenting the case to the decision-makers for fund allocation for maintenance management of the highway network. The result shows that the optimal maintenance schedule can significantly improve pavement condition compared to original MDOT’s schedule.
Global Climate Change is predicted have significant effects that will alter the most resilient natural systems. Consequently, the chronically under-funded USDA Forest Service is faced with the difficult task of planning for changes that are uncertain in scope and weight. El Yunque National Forest (EYNF) in Puerto Rico is thought to be particularly susceptible to climate change due to the specific temperature and moisture requirements of species along the elevation gradients in the mountainous terrain. This purpose of this project is to provide a map of the forest displaying biological vulnerability to climate change for usage in long-term planning.

Mapping biological vulnerability will be achieved by: creating habitat models of the most sensitive vertebrate species inhabiting the forest; weighting these models according to each species’ global rarity, endemism to the forest and predicted sensitivity to climate change; and combining these models into a single map. Spatial data used to create the habitat models includes a land cover dataset derived from a 2005 Landsat TM image and classified by the International Institute of Tropical Forestry (IITF), a 10m digital elevation model, a basic roads/trails layer manually modified to reflect size and type, a streams layer, and a forest boundary layer. All data was provided by IITF.

Over the summer, field data was collected from 35 points across the forest for the purpose of indirectly groundtruthing the biological vulnerability map. Regression analysis performed on a preliminary map that was produced shows a significant correlation between total biomass and biological vulnerability indicator, normalized by elevation. This result helps to validate the map as usable for management/planning purposes. Once the updated biological vulnerability map is completed, similar analysis will be conducted to further validate the map.

Ideally, this map will aid in forest management decisions and target certain highly vulnerable areas for increased protection (i.e. Wilderness or Wild and Scenic River designation), decreased disturbance (avoidance of road/trail construction/demonstration logging), or land acquisition (for those areas within the forest “proclamation” but not owned by the forest).
From May 23rd through August 27th I worked with the Kenya Medical Research Institute (KEMRI) in Kisumu Kenya as part of the internship requirement for my Masters in Public Health. 188 interviews were administered, 94 in an “urban” neighborhood, and 94 in a “peri-urban” neighborhood. The interviews were conducted by two Kenyan employees of KEMRI fluent in both Luo and Swahili and sensitive to the cultural norms of Western Kenya. The culturally appropriate questionnaire included specific questions on frequency and method of travel outside of Kisumu, location of destination, length of stay, and malaria history over the previous 2 months. Data on malaria prevention behavior, such as the use of bed nets, insecticides, and the elimination of standing water was also obtained, and local environmental information relevant to mosquito breeding was assessed by the interviewers.

The research goal is to examine the effects of travel patterns on the occurrence of malaria between one urban and one peri-urban community. If a link in travel is established between rural and urban areas and an increased risk from malaria, it is hoped that the information gathered will help with malaria control. It is expected that targeting prevention measures to those who engage in behaviors (such as travel) that may increase the risk of malaria could considerably reduce malaria incidence among the local population.

The hypotheses for this project include:

- Frequent travelers are more susceptible to malaria infection than non-travelers.
- The geographic clustering of malaria cases is correlated to travel patterns.
- Malaria occurrence is higher in peri-urban communities than in urban communities.

Geographic data was gathered through the use of a global positioning device during the interviews. Geographic information on travel patterns was obtained during the interviews, and where possible, travel to the destinations in order to get the geo-referenced coordinates. The geographic data was entered into ArcGIS software and used to create various maps. Basic community maps showing individual households were created. An additional map specifically showing the destination and distance of travel of those interviewed was made. A third map showing the geographic clustering of malaria cases was created as well. The gathered geographical data is being used to analyze the relationship between travel patterns, malaria occurrence, and the geographic clustering of malaria cases. Statistical analysis on the data collected from the questionnaires is being conducted using the SAS statistical program.

The assessment of the role of travel as a risk factor for malaria combined with the use of GIS should contribute to existing knowledge and research on behavioral determinants of urban malaria, and help to focus interventions where they are most needed.
Flora species present in a locale are a result of many different, interacting environmental variables. The analysis begins with looking at two specific species of plant, *Abies lasiocarpa* and *Artemisia tridentata*, and determining their preferred habitat characteristics. The factors determining presence of a species were based upon climate conditions, soil types and elevation. Species specific habitat characteristics were determined using flora reference texts describing species traits and preferred conditions. Climate conditions will influence species presence based upon temperature and precipitation. Temperature ranges were crucial to understanding and predicting where species will exist. Precipitation greatly influences presence of *Abies lasiocarpa*, whereas *Artemisia tridentata* is more tolerant. Soil types will be integral to habitat because of different water retention capacities. The soil texture describes grain size and is indicative of how much water a soil can hold. Similar grain sizes were consolidated and grouped together from an original data set of 45 types. Elevation will allow a finite range for presence of species. These determining factors were standardized and then combined in a weighted average analysis. From these combined characteristics, a spatial model of favorable environments was generated and species presence can be predicted. The predicted distribution model is overlain on the actual distribution map of Wyoming to see how the model relates to the actual presence of a species, providing a good comparison and test of the model created.

The city of Detroit contains more vacant property than any other major US city. These properties are a significant challenge in the city’s attempt at revitalization. In order to successfully revitalize the city as a whole, this challenge must be addressed. This project quantitatively evaluates more than 33,000 city owned vacant parcels in Detroit, addressing their potential for urban restoration and urban agriculture. Raster based GIS methods were used to create an index of value, quantifying each parcels potential for both uses. The final analytical result was used to select a model neighborhood for which a management plan was created. This plan details a specific approach to transforming the abandon properties into community assets through organization, remediation, agriculture and development. This analysis and model may be utilized by individuals, community groups and the city of Detroit to invigorate discussion, spark dialogue and stimulate mobilization towards change.