NRE 540 GIS Poster Symposium

Friday, December 6, 2002
8:00am – 12:00pm
Room 2003, Nat Sci Bldg

Sean Maher	8:00am	Analysis of Different Methods of Geographic Range (in Michigan) Determination of Two Species of Mice
Baku Takahashi	8:20am	Risk Analysis of Air Pollution on Low Income Populations and People of Color in Washtenaw County, Michigan
Deborah B. Maylie	8:40am	Alternative Future Landscape Scenarios: A Means To Consider Conservation Policy, Loudoun County, Virginia
Damon Hearne	9:00am	Assessing Gray Wolf Range Conversion in Northern Wisconsin and Upper Peninsula, Michigan: Determining Land Use Change Using LUDA and NLCD Datasets
Laura J. Kearns	9:20am	Quantifying Balsam Fir Understory Through Remote Sensing to Determine the Black-throated Blue Warbler's Best Habitat
Break	*9:40am – 10:40am*	
Stephanie Hitztaler	10:40am	Patterns of Forest Use in the Central Kamchatka River Valley
Aneetha Jayaraman	11:00am	Preparing Raster Data for Vector Analysis of Patch Patterns in Gunung Palung National Park, Indonesia
Tingting Zhao	11:20am	Land-cover Change in Siberian Forest: A Case Study Site in Krasnoyarsk, Russia
Amy Gilboy	11:40am	Effects of Surrounding Vegetation on Pine Warbler (*Dendroica pinus*) and Red-eyed Vireo (*Vireo olivaceus*) Presence in the Hiawatha National Forest: A Comparison Between Field Data, the Northwoods Database, and a Classified Landsat Image

Posters will be available for review after the symposium in the SNRE ESA Lab

Analysis of Different Methods of Geographic Range (in Michigan) Determination of Two Species of Mice

Sean Maher (mahers@umich.edu)

Two species of mice, *Peromyscus leucopus* and *P. maniculatus gracilis* share similar preferences in habitat and co-occur in various sites in Michigan and throughout the United States. The estimated geographic ranges within Michigan of both species have changed, and identification of current areas of habitat and likely areas of inhabitancy are key in understanding why this change occurred. Methods within Geographic Information Systems are available to estimate probability of occurrence and identify locations where suitable habitat exists. Using Weight of Evidence techniques within ArcView and Idrisi software, results of the methodology are compared to highlight areas of interest. Analysis of shortcomings of the methodologies is given by comparing presence/absence data to the outputs. Environmental layers include habitat and temperature data, while positive locations are from the University of Michigan Museum of Zoology specimens and live trappings over the past thirty years.

Risk Analysis of Air Pollution on Low Income Populations and People of Color in Washtenaw County, Michigan

Baku Takahashi (btakahas@umich.edu)

This study tests if low-income populations or certain racial groups are disproportionately located within high-risk air pollution areas in Washtenaw County. The EPA's Toxic Release Inventory (TRI) facility data was geocoded to TIGER/Line street network, and income and racial group data were assigned to the TIGER/Line block group polygons. With the help of a chemical dispersion model, the extent of a chemical plume was also defined and buffered with an assumption that each facility is keeping considerably more chemicals than they actually report to EPA (hypothetical risk factor). With the above data, the observed number of people was compared with a randomly assigned number of people within chemical plumes. The analysis discovered that a significantly higher proportion of low-income population (< $30,000 household income/yr) is located within high-risk air pollution areas. The study, on the other hand, could not find statistically significant differences between the observed number of people of color and the expected number of those people within chemical plumes. This result however requires some careful interpretation.

Alternative Future Landscape Scenarios: A Means To Consider Conservation Policy, Loudoun County, Virginia

Deborah B. Maylie (dmaylie@umich.edu)

Loudoun County, Virginia is characterized by a rural landscape associated with numerous large agricultural lands, horse farms and vineyards. It is located just outside of the Washington, DC metro area and portions of Dulles International Airport and the Dulles toll-road are within its boundaries. For these reasons, the county is increasingly feeling development pressure from growing and moving populations in the area. Future landscape scenario studies can suggest policies that the county could use to achieve specific conservation goals. This paper compares the existing landscape with two alternative future landscape scenarios. Each alternative emphasizes different development and ecological goals. GIS maps, through spatial queries, overlay analysis and numeric calculations, will be generated to support each scenario. The final product shows potential development in the county using current zoning regulations, proposed changes to the zoning regulations, and zoning regulations based on the preservation of parcels best suited for agricultural. The final map can be used by local governments to show that by implementing conservation policies in specific areas of the county, vital agricultural lands can be preserved while still planning for increased development.

Assessing Gray Wolf Range Conversion in Northern Wisconsin and Upper Peninsula, Michigan: Determining Land Use Change Using LUDA and NLCD Datasets

Damon Hearne (dhearne@umich.edu)

Land use change analysis on a regional scale can be used in many aspects of conservation planning, endangered species population assessments and ecosystem management applications. Not only does the analysis inform us of the rate and type of historic land use change, but may be able to help predict future land use change when coupled with other data such as economic and population growth. In my masters project "Gray Wolf Range Analysis in Michigan and Wisconsin", a region wide land use change analysis will help us determine how much wolf range will exist in the future.

Two land use maps are generally available for the study region. The National Land Cover Dataset (NLCD) is a nation wide grid that is available from the USGS server. This layer was derived from early 1990's Thematic Mapper satellite images. The other layer available for the region is the 1980 LUDA (Land Use Data) polygon coverage. Because the spatial scale and mapping accuracy of these two datasets are different, the ability to compare them and produce an accurate land use change analysis may be limited. However, a scheme was developed that allowed "new development" (ie, post 1980) to be mapped and compared with original land use.

Because the gray wolf is a top carnivore and therefore does not require a specific type of habitat, and because the range sized for wolf packs are very large, I was able to lump several types of land use together in each map and resample to obtain comparable data. Using a conditional statement in ArcGRID, I was then able to map the change between each type of land use. Because the NLCD data has a higher resolution, I then dropped the small areas of development that would not have been mapped on the LUDA data. The result of this filtering allowed a map of new development to be used to obtain rates of land use change.

These land use change rates will then be used in conjunction with population growth rates and rates of housing growth to help us predict that amount of gray wolf range that will exist in 20 to 40 years.

Quantifying Balsam Fir Understory Through Remote Sensing to Determine the Black-throated Blue Warbler's Best Habitat

Laura J. Kearns (lkearns@umich.edu)

The Black-throated Blue Warbler (BTBW) *Dendroica caerulescens*, a shrub-nesting Neotropical migrant, requires a dense forest understory that can be altered by the browsing of white-tailed deer, *Odocoileus virginiana.* In the hardwood forests of Michigan's Upper Peninsula, balsam fir *Abies balsamea* persist in the understory despite deer browse, and BTBWs tend to be abundant among high densities of fir. BTBWs may also respond positively to the spatial heterogeneity of balsam fir, such as a patchwork of small dense clumps of firs scattered throughout an area (Steele 1992). If these characteristics of balsam fir provide good habitat for the BTBW, then we would expect higher numbers of BTBWs where there is more balsam fir on the plot, a greater number of patches and a smaller overall patch size. In addition, Holmes et al. (1996) found that older BTBWs had higher reproductive success, so if these fir conditions provide quality habitat, then there should also be higher proportions of older birds in addition to higher abundances of BTBWs. The objectives of this GIS analysis were to: 1) test the method of using remotely sensed data to quantify the amount of balsam fir in the understory on these plots and compare it to my field methods and 2) use the remotely sensed data to determine significant/non-significant relationships between various balsam fir and BTBWs.

I sampled the abundance and ages (second year (SY) vs. after second year (ASY)) of male BTBWs in 16 (36 ha) plots varying in balsam fir density in hardwood stands throughout the Mackinac County portion of the Hiawatha National Forest. In the field, balsam fir was sampled using eighteen 4 m^2 quadrats within each plot, and plot coordinates collected using a Trimble GeoExplorer GPS unit. These coordinates were later used to map the plots in ArcView 3.3. Balsam fir understory on the plots was classified on US Forest Service digital orthoquads using Ecognition software. Total amount of balsam fir per plot, the number of fir patches and the mean patch size were calculated using ArcView 3.3 Patch Analyst and FRAGSTATS software. These results and the field data were compared and analyzed with BTBW abundance and age-ratio data using regression techniques in SPSS 10.0 software.

Patterns of Forest Use in the Central Kamchatka River Valley

Stephanie Hitztaler (shitztal@umich.edu)

Forming the heart of the Kamchatka Peninsula in the Russian Far East the 700-km long Kamchatka River valley that cuts supports the peninsula's only coniferous growth. Large-scale logging in this easternmost pocket of taiga, or boreal, forest dates to the early twentieth century. The most intensive period of logging, however, began in the early 1960s with increased mechanization of the timber industry on Kamchatka. In just three decades, nearly the entire extent of the valley had been logged, clamping the activity of timber enterprises in the late 1980s. This natural resource crisis coincided with the countrywide socio-economic crisis that befell Russia following the dissolution of the Soviet Union in 1991. As a result, the valley's timber enterprises were forced into bankruptcy, or on the verge of it. This period of transformation has left a deep mark on the logging villages dependent on these enterprises: village populations have dwindled due to steady out-migration, an increasing death rate, and a decreasing birth rate. Thus, the future of many logging communities is tenuous, especially against the backdrop of a heavily exploited resource base.

In this project I analyze patterns in forest use and factors that help shape these patterns in the central Kamchatka River Valley. This project focuses on the forested area surrounding two villages situated in the valley, Atlasovo and Lazo, where I undertook part of my research during the summers of 2001 and 2000. In conjunction with my field data collected from forest inventory plots, I use a subset of a Landsat ETM+ satellite image from the year 2000 to classify forest cover using unsupervised and supervised classification methods. This analysis aids in the identification of forest use patterns specific to this part of the valley. In addition, I use a digitized topographical map (scale 1:100,000) to quantify the distances of the villages and clear-cut areas to major transportation networks, for instance the main road leading to Petropavlosk-Kamchatsky (the peninsula's capital) and the Kamchatka River. I predict that the most intensive logging practices will be observed in areas that are in proximity to these transportation networks.

This project serves as part of my Master's thesis that examines the connections between patterns of forest use/forest cover change and demographic change during the post-Soviet period. In my thesis, I will examine two other villages in the same way I have for the villages highlighted in this project. Besides setting the analytical framework for my thesis, this project is relevant to nature conservation activities currently underway on Kamchatka as it identifies the remaining areas of intact forests that remain in the valley. I hope that this work will provide valuable knowledge for ecologists and conservationists who are engaged in implementing sustainable development initiatives on Kamchatka. This project is especially pertinent to the future growth of non-timber forest product gathering and marketing in the valley. Such activity serves as a mean to reconcile economic development in depressed logging villages with forest conservation.

Preparing Raster Data for Vector Analysis of Patch Patterns in Gunung Palung National Park, Indonesia

Aneetha Jayaraman (aneetha@umich.edu)

Converting an image from its raster to vector forms can be a challenging and important technical step in GIS analysis. It constitutes a difficulty, which is not completely solved as such a conversion inevitably leads to some amount of information loss from the original layer that has to be dealt with. A raster image of the Gunung Palung National Park in Indonesian Borneo that is part of a larger land-cover/land-use change study of the region, has been converted into a vector land-cover/land-use map that can be used in modeling and further analysis.

The establishment of appropriate decision rules that will enable the raster-vector conversion is by far the most important step in the process. The levels of classification and the nature of the analysis affect the decisions that will result in a raster to vector conversion of the image. This vector land cover/land use layer has then been used for analysis in FRAGSTATS (or patch analyst) to study the level and nature of fragmentation in the landscape. Studying the patch patterns will enable one to determine the level of deforestation that has been a result of increasing agriculture or oil palm plantations.

The outcome of the analysis depends on decisions made while answering questions like:

- What aspects of the image will be defined as a "polygon" for the land-use/land-cover layers?
- How and when isolated pixels will be removed?
- How and when one would merge the pixels (thresholding, filtering, sieving/eliminatiing and the like) with the background class, etc.

One more important aspect that influenced the conversion was the requirements and/or formats acceptable by FRAGSTATS and later the modeling software (TELSA) that use this vector layer as an input for further analysis in the larger project.

The analysis of the level of fragmentation and habitat loss was done both at the landscape level and at the class level for the primary forest class. The seven kinds of metrics were used to study the structure, composition and function of the Gunung Palung National Park. These metrics were chosen based on their ability to provide the maximum information on the landscape of this region, particularly with respect to primary forests while eliminating redundancy.

The metrics used in this analysis were:

- Patch density and Mean Patch size (patch size, density and variability metrics)
- Area-weighted mean edge contrast index (edge metrics)
- Area-weighted mean patch fractal dimension (shape metrics)
- Total core area and Class core area as a percent of landscape (core area metrics)
- Nearest neighbor distances (nearest neighbor metrics)
- Shannon's diversity index and Patch richness density (diversity metrics)
- Interspersion and Juxtaposition Index (contagion and interspersion metrics)

The analysis of this landscape shows fragmentation in the primary forests especially around the edges. This is especially of concern since the region is a protected forest. Oil palm plantations and agriculture seem to be important reasons for fragmentation at the edges. However, within the forest the fragmentation seems to be the result of illegal logging.

Land-cover Change in Siberian Forest: A Case Study Site in Krasnoyarsk, Russia

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The Siberian Russia, home to world's largest boreal forests, has experienced great changes in social-economics and environment after its economical transition. This project focuses specifically on land-cover changes at one of the case study sites in Krasnoyarsk Oblast, Russia since mid-1970s. The highlight will be given to forest succession in regard with disturbances (such as logging, fire and agriculture activities), which to some extent are closely associated with economic regulations.

Satellite-derived remote sensing data from Landsat vehicle 2, 5, and 7 are used to explore changes over the past thirty years. These geo-rectified data were degraded to the same scale (60m resolution) for the purpose of sequential change detection. Cloud and haze were eliminated to provide clear views for change analysis. Ancillary data, such as land-cover type labels from map surveys, were used as "ground truth" for the supervised classification. Categorical changes were finally derived based on 3-date land-cover classified images.

Precisely ten identical classes (excluding water) were created for each of the 3-date images. These classes can be designated to four broader land-cover types, i.e., (1) coniferous, deciduous, and mixed forest, (2) logging, fire and insect, (3) forest re-growth, and (4) wetland, agriculture and settlement. Image statistics show that severe changes took place in all of the forest types and logging activity. Total forest cover increased from 57-8% (in 1974 and 1990) to 68% in (2000). Forest re-growth increased from 17% to 24% during the first 16 years, and then decreased to 9% afterwards. Meanwhile, logging areas reduced from 10% to 4% in the first 16 years, and remained constant afterwards. Agriculture reduced from 14% to 8% gradually over the study period.

I drew the conclusion that forest restoration after transition was relatively fast due mainly to abandon of logging/agriculture activities and success of forest re-growth. Most of the cut areas were able to regenerate into young deciduous and finally developed into mature forest. Meanwhile, large areas of farming land were turning into deciduous or mixed forest. Therefore, though severe insect damage occurred in many coniferous and mixed forest stands in 2000, the total forested area did not shrink over the 1974-2000 period.

Effects of Surrounding Vegetation on Pine Warbler (*Dendroica pinus*) and Red-eyed Vireo (*Vireo olivaceus*) Presence in the Hiawatha National Forest: A Comparison Between Field Data, the Northwoods Database, and a Classified Landsat Image

Amy Gilboy (agilboy@umich.edu)

Vegetation and plant composition are important determinants of suitable habitat for animal species. The spatial arrangement of different habitat types also has an effect on the quality of habitat (Imhoff et al. 1997). Fragmentation of the landscape leads to a loss of suitable habitat and causes edges, which have been shown to alter landscape processes and be detrimental to some species. Because of the importance of habitat types, classified remote-sensing maps (like the Landsat Thematic Mapper) have aided the prediction of suitable habitat for wildlife.

The Northwoods Database is a table listing species of animals found in the Upper Peninsula that describes their habitat types. The objective of this project was to compare field data collected this summer in certain homogenous patches of vegetation and compare it to the Northwoods Database to find any incongruencies between the two. The Pine Warbler (*Dendroica pinus*) is a bird that is listed on the Northwoods Database only in mature pine forests. Data collected this past summer found them in young pine as well as mature pine. The Red-eyed Vireo is typically a hardwood species, yet they were spotted consistently in mature pine forests. With the aid of ArcView, RADAR biomass imagery, and knowledge of the survey areas gained while in the field, an attempt will be made to explain why these birds are appearing in this kind of habitat.