Spatial Analysis of Fragmentation Across Michigan's Landscape

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Analysis based upon landscape pattern metrics, demographic, social, and economic data is underway using parametric and non-parametric statistical techniques to identify significant factors driving the spatial structure of Michigan's landscape. In 2006, landscape pattern metrics from 2001 IFMAP landscape maps were developed. Data summarizing the principal spatial conditions (number of patches, patch density, perimeter:area ratio, contagion and percent built) were developed at the Minor Civil Division (MCD) spatial scale. These data hereafter, referred to as landscape pattern metrics, are being used in in statewide and substate analyses. Furthermore, these data represent dependent variables influenced by the demographic and social-economic data developed by the Land Policy Institute.

Our objective is to quantify the importance of social-economic drivers in shaping the spatial structure of Michigan's landscape. Data was developed using Minor Civil Divisions, and statewide and substate models scale from a coarse grain to medium spatial resolution. Statistical summaries including mean, variance and standard deviations for individual parameters are calculated using the SPSS statistical software package and Geographically Weighted Regression (GWR) software ((Charlton, Brundon, and Fotherington 2003). Mapped visualizations of these data summaries and predictive model results will be generated using ARC/GIS (Figures 1-3). Note: different patterns emaerge in different regions depending on the landscape metric.

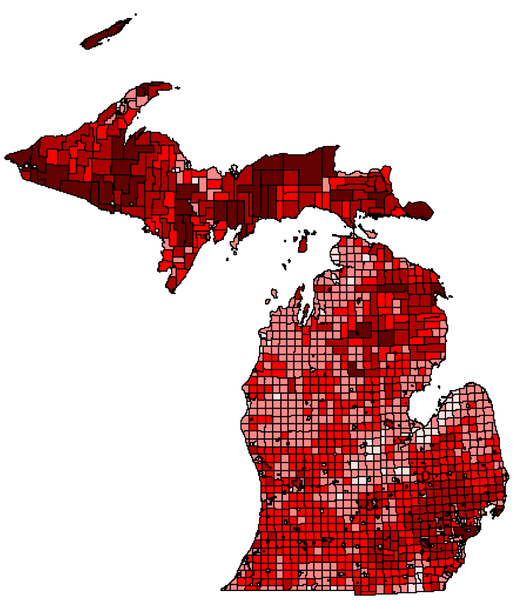

Figure 1. Number of patches by MCD (darker color associated with more patches).

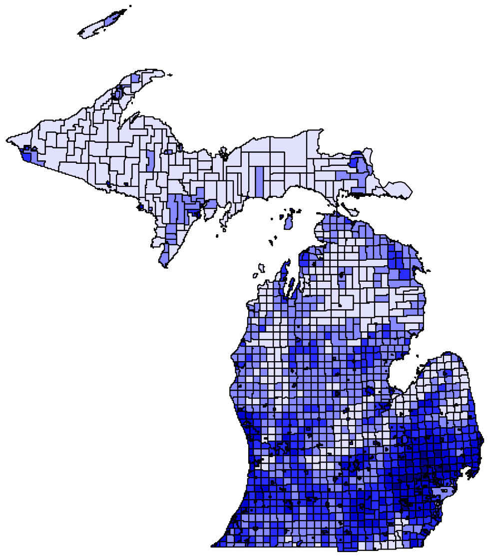

Figure 2. Patch density by MCD (darker color associated higher density).

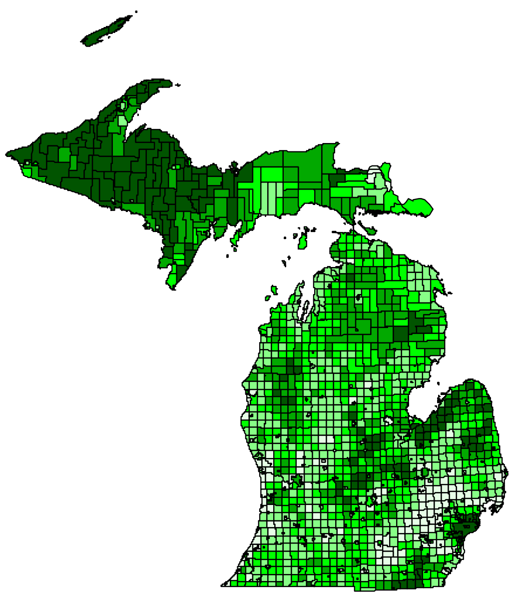

Figure 3. Contagion by MCD (darker color associated with more contagion).

Standard regression models have been developed using ordinary least squares. For the statewide model, dummy variables were used to differentiate planning regions, a process used by Friedman, Colunga and Gage (Figure 4). For number of patches as the dependent variable, most regional variables were significant. In addition, total population in 2000, population density change, farm employment in 2000, road density, and percent public land among others were significant variables that explained the number of patches. Each statewide model with different dependent variables yields different statistical relationships. The statistical significance of the regional dummy variables supports development of substate/regional models. Our findings show that for some regions there is more homogeneity (e.g., the western Upper Peninsula) and the number of significant explanatory variables declines.

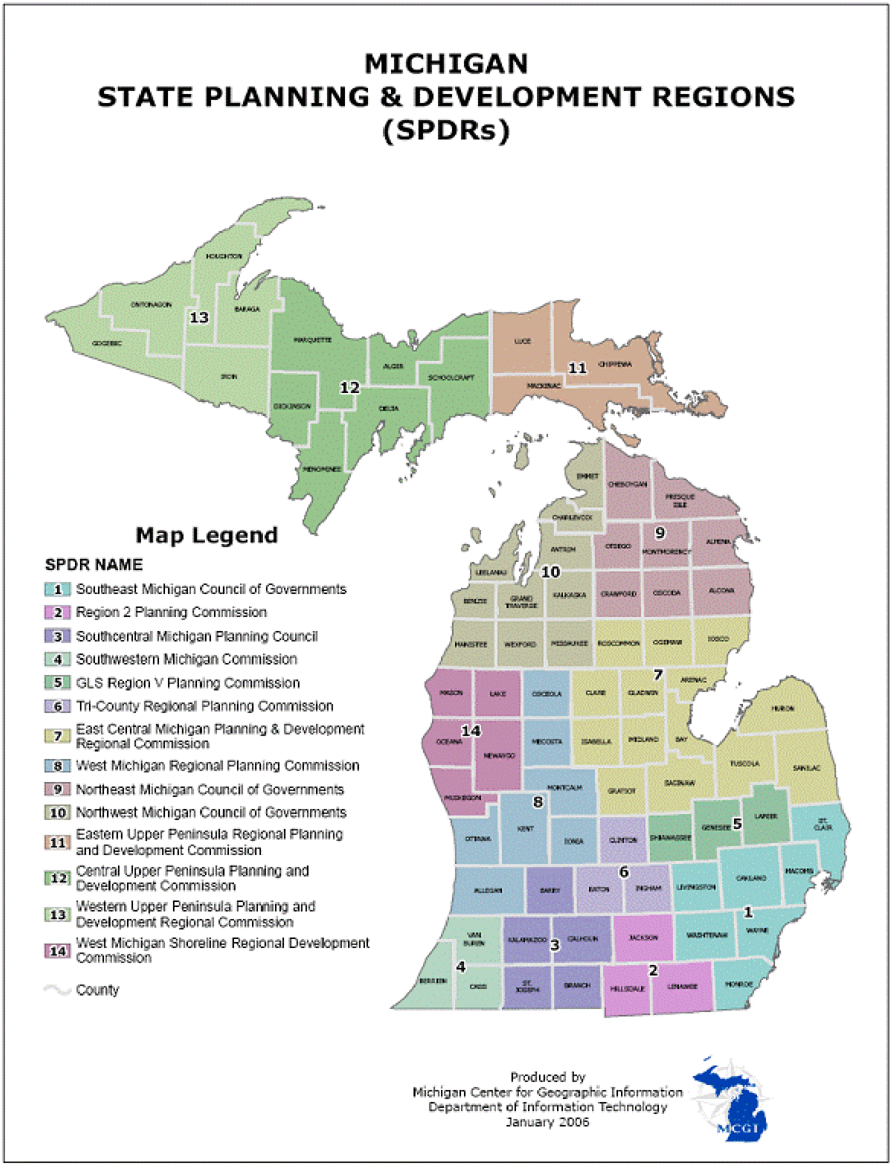

Figure 4. State planning and Development Regions

A second approach used to examine spatial variability is through the use of GWR. In this approach, each MCD is recognized for its location within the modeling framework. The approach uses the existence of spatial correlation to enhance model performance (Figure 5). For the statewide model, most explanatory variables have significant spatial variability, and GWR is warranted. For some substate/regional models, this is not the case and standard regression approaches are most useful.

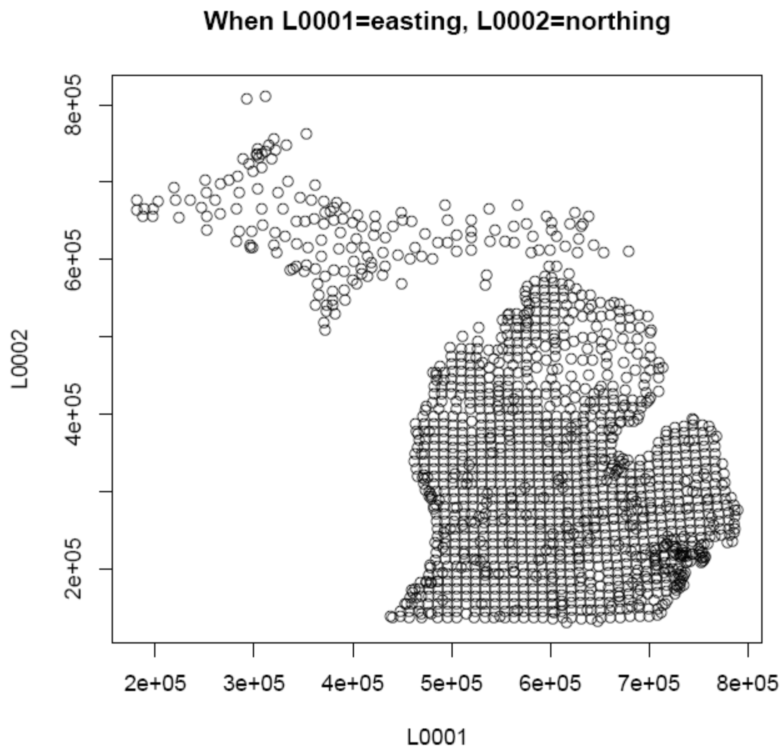

Figure 5. Representation of spatial location via MCD midpoints in GWR.

Social-economic factors governing the spatial structure of land use/land cover patterns vary geographically across the state. A number of statistical results have been developed and others are underway. In the end, statewide results and results from a subset of regions will be reported. This will provide a more holistic view of drivers of landscape fragmentation across the state.

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