A MODEL FOR DEFINING AND PREDICTING THE URBAN-WILDLAND INTERFACE FOR THE PIEDMONT OF SOUTH CAROLINA

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Abstract- Resource managers continue to experience a deluge of management conflicts as urban population centers expand into areas that were formerly wildland settings. Traditional forest management practices, fire suppression, recreational opportunities and wildlife management are activities that have become contentious in many locales. A better understanding of the interface zones between these two types of land use is important if managers are to successfully maintain the values of such lands. A model for defining the urban-wildland interface for the Piedmont of South Carolina (Anderson, Oconee, and Pickens Counties) was developed, allowing identification of these transitional zones. Landsat TM and SPOT images provided a description of the current land cover and land use of the study area. Census data were used to obtain information on housing densities, population densities, and other social and cultural activities. Additional data (such as digital road maps) were processed and added to the ArcView-based GIS structure. On-site ground truthing was also conducted. This procedure created a snapshot view of current interface zones and provides a foundation for developing a dynamic model designed to predict future change.

INTRODUCTION

The objective of this study is to develop a process for determining the urban-wildland interface within Anderson, Oconee, and Pickens Counties in South Carolina using social, economic, and land use/land cover data through the use of a desktop geographic information system (GIS).

The idea of urban-wildland interface is a relatively new problem in natural resource management. The growth of the United States as a nation over the past two centuries is intricately tied to the concept of the conflict between urban development and pre-existing wildland. Between 1970 and 1990, the United States population increased by 22.5 percent with 21 million acres being converted to more urban land uses (Garkovich 2000).

According to a recent Sierra Club report, South Carolina lags behind the rest of the nation in terms of open space protection, ranking third to the last among the fifty states (Romain 2000). This situation has sparked valid concerns of urban sprawl in the Upstate of South Carolina. As the metropolitan areas of Greenville, SC; Atlanta, GA; and Charlotte, NC continue to expand, the counties located just outside of and between these cities will continue to provide evidence of this rural to urban transition. Concerned residents and politicians have formed groups focused on the protection of specific open spaces. Some of such groups include Upstate Forever, Friends of the Reedy River, and a Committee of Changing Land Use and Environment (CLUE). While the concept of multiple use is widely acknowledged and often practiced, the problem of externalities on the urban-wildland interface presents a particularly difficult management challenge because of the concentrated nature of the activities. These changes in land use have sparked many conflicts, making natural resource management more difficult and creating the need for identification of these urban-wildland interface areas. Management of these areas requires that one must understand the various land cover, economic, social, political, and historical factors that are involved in the make up of these zones. From this information, a definition can then be developed and the existence of these interface zones may be predicted and appropriate management concepts applied.

METHODS

A GIS database can be a vital tool within many different professions and especially in the management of natural resources because of its integral spatial component. Predictive modeling, as demonstrated in this study, is a common application of GIS technology. Within ArcView GIS, queries can easily be built and the results visually displayed. The query tool in ArcView allows an analyst to select features and records in a table that relate to attributes of the map data.

For this study, data from the 1990 United States Census (median household income, housing density, roads and municipalities) and 1992 satellite imagery (Landsat Thematic Mapper imagery of land use/land cover) were combined to get a definition of the urban-wildland interface.

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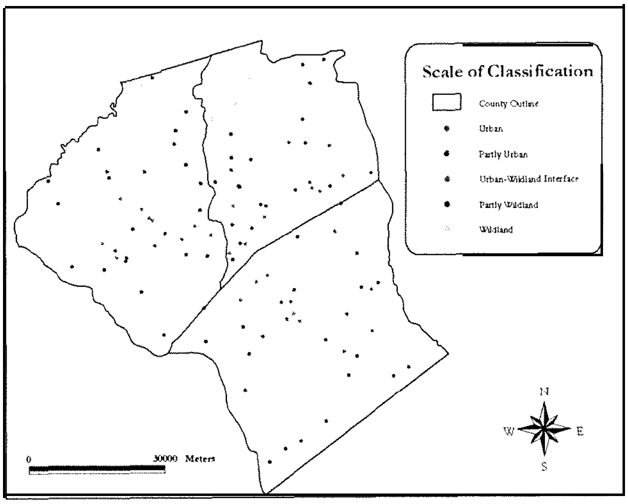

Figure 1—GPS Data from Preliminary Sample

In order to develop a reasonable query for urban-wildland interface, a preliminary sample of global positioning system (GPS) data was taken using a Trimble GeoExplorer II. Points were collected randomly along roadsides within the tri-county area. Each point was classified along a scale of urban to wildland based on observation. Although this appears to be a subjective task, much of the process was based on the Anderson Level II Land Use Classification System (Anderson 1976). The map in figure 1 depicts the scale of classification used and the preliminary sample of GPS data.

The "GPSed" points were examined to determine statistical trends in each classification. Queries were then conducted to identify where urban-wildland interface areas were located. Once the queries were completed, a verification sample of 125 points was collected, again using GPS technology, to compare the queried data with on-site observations (ground-truthing).

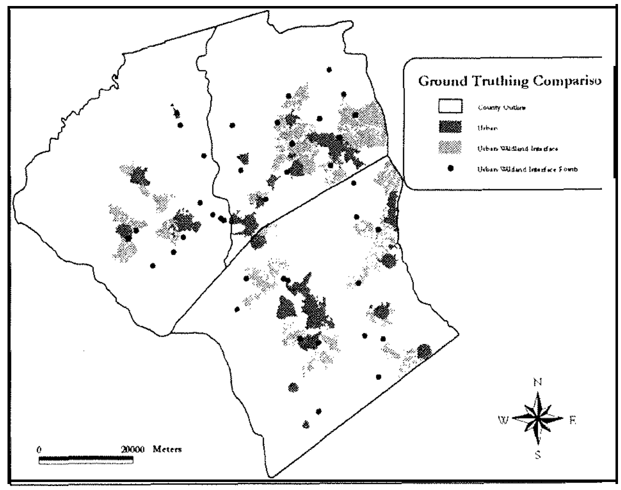

Figure 3—Urban-Wildland Interface Verification Sample Compared with 99 Percent Confidence Interval Query.

RESULTS

The initial map queries of each classification included 90 percent, 95 percent, 99 percent confidence intervals based on median household income and housing density because these were the quantitative variables used in the study. These queries also specified land use/land cover types which occurred 30 percent or more of the time in each urban to wildland classification. Figure 2 depicts the results from the 99 percent confidence interval query.

Figure 3 focuses on the query results for urban-wildland interface, comparing those areas with urban-wildland interface points collected in the verification sample. Local municipalities were displayed for location reference. Here, a total land area of 635 square kilometers meets the criteria from the query for urban-wildland interface. Points from the verification sample allow one to examine the veracity of the query results. Some points lay directly on urban-wildland interface, indicating agreement between the query criteria and on-site observations. Other points lay just

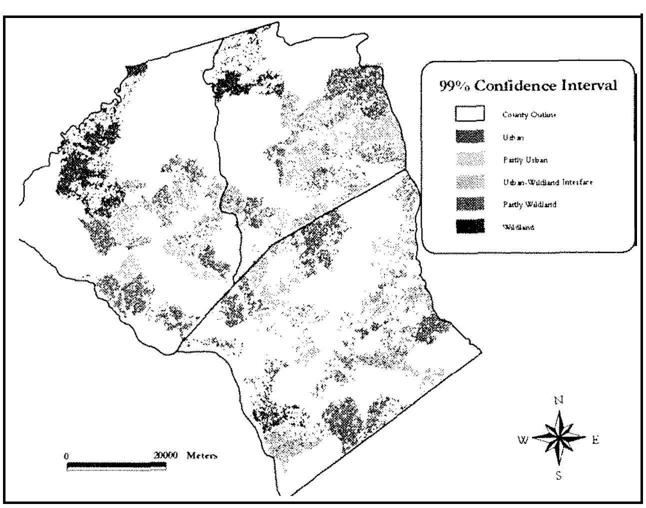

Figure 2-Query Results from 99 Percent Confidence Interval on Housing Density and Median Household Income.

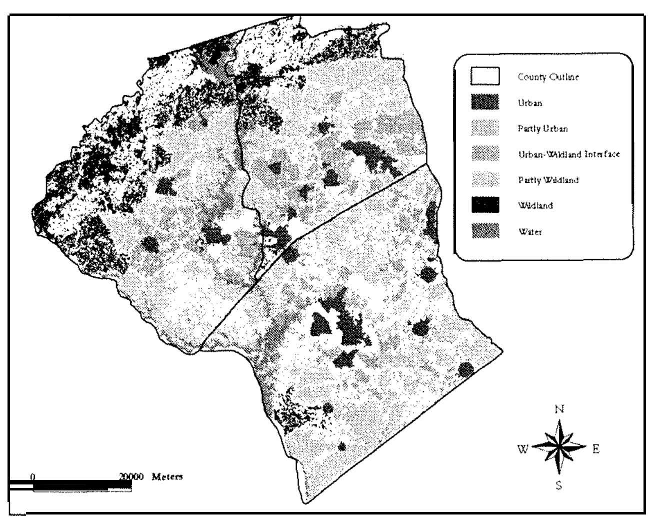

Figure 4-Extended Query Results.

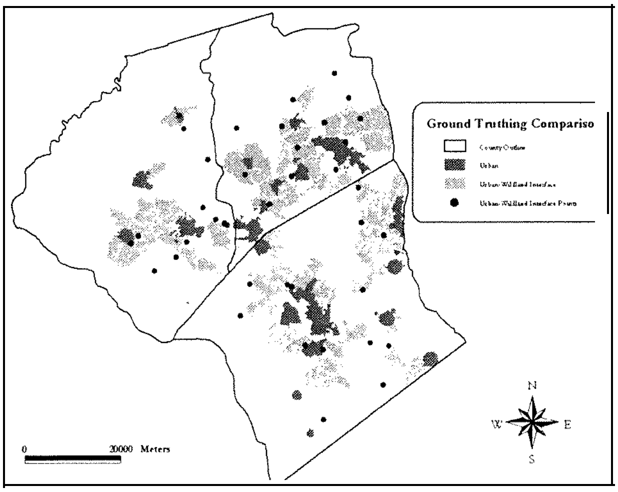

Figure 5—Urban-Wildland Interface Verification Sample Compared with Extended Query.

outside of or along the outskirts of urban-wildland interface, indicating partial agreement between the query data and on-site observations. Still other points remain in question, lying on areas for which census data were not available, and therefore, not answered by the urban-wildland interface query.

Because of overlapping data from the initial queries, each classification was separated based on housing, with higher densities depicting more urban areas. The queries were further refined by extending the ranges within each classification and by requesting urban areas to reflect municipality boundaries. Figure 4 depicts the results from this extended query. This map shows a more logical pattern for locations of each classification, where urban areas blend into interface areas, which in turn, blend into wildland areas.

Figure 5 focuses on the results from the extended query for urban-wildland interface, as compared with the verification points for urban-wildland interface. This query indicates that a total area of 1061 square kilometers meet the criteria for urban-wildland interface, nearly 1/5th of the entire tri-county area. This map shows more agreement between the verification points and the query results. That agreement reflects accuracy within the queries, and depicts the locations of urban-wildland interface. However, points of partial agreement and points of question still exist. It is yet to be determined what may be occurring in these areas. Perhaps they have outlying values in the housing density or median household income variables, which would prevent these regions from meeting the query criteria for urban-wildland interface. A revisit to these points may answer some of these questions.

CONCLUSION

This study reveals that using social, economic, land use/ land cover data may define urban-wildland interface locations. Maps like these could be used as a tool for development and land management planning, especially where conflicts exist or may arise. These maps allow land managers to easily identify and focus on regions of concern. They provide information for not only land managers and developers, but also for interested community members and local residents within areas experiencing land use changes.

This study could be further expanded to examine interface in larger regions using additional social and economic variables. The added information would provide an even more detailed definition, applicable to more communities. The model could also be adjusted to depict future change, by including a variable representing time.

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