URBAN SPRAWL AND ATMOSPHERIC POLLUTION EFFECTS ON FORESTS IN THE GEORGIA PIEDMONT

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DISSERTATION ABSTRACT

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Current and projected population pressures on natural lands in the South have resulted in extensive amounts of rural forests being converted to human-modified urban uses. Such substantial loss of forest land and wildlife habitat to urbanization renders the health of those remaining forests critical. The overall goal of this project was to examine the effects of urbanization on forest health by investigating forest stand structure, condition, and bioindicators of ecosystem health along an urban-to-rural gradient, as well as assessing landscape-scale indicators of ecosystem health across the region. The specific objectives of this project included: 1) examination of forest stand structure and condition across different land-use types through the measurement of various biotic, abiotic, and anthropogenic variables 2) determining concentrations of selected air-borne contaminants (N, S, and heavy metals) over space and time and relating these to land-use

changes, 3) development of a methodology for a land management and planning tool using a land-cover classification to select regional landscape indicators and to correlate these with plot-level bioindicators of forest ecosystem health, and 4) examination of the utility of a regional ecological assessment tool using landscape indicators of ecosystem health. The study area (hereafter referred to as 'West Georgia') includes Muscogee, Harris, Meriwether, and Troup counties in west Georgia and represents an urban-to-rural gradient in terms of land development. Thirty-six permanent 0.05-ha circular plots (three plots per site; four sites per land-use type – urban, developing and rural) were established along the gradient using criteria adapted from the USDA Forest Service Forest Inventory and Analysis National Program guidelines. No differences were observed in forest stand structure and species composition from groundcover to upper canopy in any of the sites, except the total number of hardwood trees and tree species richness, which were greatest in developing areas. The percentage of trees with lichens, lichen species richness, and lichen abundance, were least and injury to trees was greatest in urban areas. Of the bioindicator variables measured, lichen tissue collected *in situ* appeared to be the best indicator of urbanization regarding differences in elemental concentrations among land-use types, and Cu, N, Pb, S, and Zn concentrations were all greatest at urban sites. There were significant inverse correlations between forest land-cover and population, housing, and road densities; tree species richness and forest patch density; urban land-cover and lichen species richness; and lichen incidence and forest perimeter-area fractal dimension. The measured regional landscape indicator variables supported the field-based forest condition results for urban and rural but not for developing areas. Overall, these studies were useful for examining human impacts to forest ecosystems at a variety of scales.