Preface

As a graduate student in the late 1970s, I became interested in causes of diversity in birds. At that time, explanations of diversity as a function of plant community structure were almost entirely based on vertical heterogeneity or complexity, usually as measured by MacArthur's foliage height diversity (FHD). However, FHD didn't work well within a given successional stage due to variations in horizontal heterogeneity among plant communities of similar ages such as successional old-fields with woody invaders. Meanwhile, measuring horizontal heterogeneity was limited primarily to on-the-ground type measures such as the coefficient of variation (CV) of distance derived from point-quarter samples, which provided only a limited amount of information on spatial arrangement of landscape elements such as shrubs and trees. I began looking for an alternative way to measure horizontal heterogeneity and fortunately discussed this with fellow graduate student Doug Heimbuch, a wizard in statistics and thinking outside the box. Together we developed what turned out to be a hexagonal-celled (raster-based) Geographic Information System (GIS) and landscape metrics package (the terms GIS and landscape metrics didn't exist, yet) that Doug facetiously dubbed spatial distribution (SPADIST). Using SPADIST, I applied some previously unexplored explanatory variables to GIS maps derived from high-resolution stereographic aerial photographs and was able to predict with a good degree of accuracy species richness and density of bird assemblages across a range of successional stages.

Although I've worked as a restoration ecologist in the private sector since that time, I have observed from a distance the development of GIS-based habitat analysis over the last several decades and noticed that most studies I read had relatively low explanatory or predictive capability. As a result, I began to look for shared, potentially limiting attributes among such studies. This book is the result of that examination and was completed with the substantial help of Charles R. Smith, another fellow grad student, mentor, sounding board, and friend of more than 35 years.

Our interpretation of what has transpired in the field of GIS-based habitat analysis is that the phenomenal technology may sometimes lead us to overlook the underlying biology. GIS provides a powerful tool for the investigation of species-habitat relationships and the development of wildlife management and conservation programs. However, the relative ease of data manipulation and analysis using GIS, associated landscape metrics packages, and sophisticated statistical tests may sometimes cause investigators to overlook important species-habitat functional relationships. Additionally, underlying assumptions of the study design or technology may have unrecognized consequences. Here we examine how initial researcher choices of image resolution, scale(s) of analysis, response and explanatory variables, and location and area of samples can influence analysis results, interpretation, predictive capability, and study-derived management prescriptions.

We begin by reviewing several remote sensing and ecological terms and discuss two shared terms with different meanings within their respective disciplines. We also revisit several longstanding concepts in landscape ecology and in some cases offer alternate points of view on their interpretation. Hopefully, these discussions are informative, but at a minimum should provide food for thought. Our aim is to urge wildlife and conservation biologists to gain a better understanding of both the capabilities and limitations of the technologies they employ and to think critically about the assumptions that underlie some of the methods and technologies, particularly those associated with GIS, now routinely applied in both research and management within these disciplines. More predictive, easily interpreted models provide a firmer basis for conservation and management decisionmaking.

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