Preface

The first production version of the Ecosystem Management Decision Support (EMDS) system was released in February 1997. As this volume is going to press, the Redlands Institute (University of Redlands, Redlands, CA) is close to releasing EMDS v 5.0. As the project lead on EMDS from the beginning, I have had a keen interest in following users of the system around the world and the scope of their applications. I have occasionally done web searches to keep tabs on EMDS applications, and in early 2008 decided to do a reasonably comprehensive compilation of published works involving EMDS, which can be found on Wikipedia (http://en.wikipedia.org/wiki/Ecosystem_Management_Decision_Support). Reflecting on this list, it occurred to me that there was a critical mass of published work, and perhaps it was time to produce a book. And that, essentially, was the impetus behind the present volume.

Origins of EMDS

If there was one watershed event to which I could point as the origin of EMDS, it would be the Forest Summit, assembled by President Clinton in Portland, OR in April 1993. The Summit was convened to resolve the gridlock over timber management that had been precipitated by the listing of the Northern Spotted Owl as an endangered species in the late 1980s. An immediate consequence of the Summit was the launching of the Northwest Forest Plan (hereafter, the Plan); an ambitious, science-based attempt to overhaul forest management on federal lands in the US Pacific Northwest. One of the pillars of the Plan was provision for an Aquatic Conservation Strategy, which, among other things, called for watershed restoration and protection based on rigorous watershed analysis. Two things were immediately clear: watershed analysis was potentially an extremely complex process requiring the simultaneous assessment of a myriad of system states and processes at multiple spatial scales, and there were no well-established procedures for implementing such an analysis at the time.

Being one of the few scientists in the USDA Forest Service Pacific Northwest Research Station with any practical experience building a decision support system (DSS), I was asked to begin development to support watershed analysis at the end of 1993, as the Plan was being finalized. I assembled a team of colleagues from around the country, representing some of the best and the brightest when it came to DSS for natural resource management. The initial work of this team proceeded on two overlapping fronts. The first was selection of core technologies and how to integrate them. The second—having settled on logic-based analysis as a practical way to tackle the size, complexity, and abstractness of the problem—initiating knowledge engineering to develop core logic-model components for a DSS to implement watershed analysis. About six months into the knowledge engineering process, the implications of designing logic models for a comprehensive watershed analysis had become painfully obvious. Even with four teams of knowledge engineers, covering the relevant subject matter would take years.

We needed a new approach if we were going to deliver something useful in a reasonable time frame. If ever I can claim to have had an epiphany, it was then. Rather than deliver the complete solution for a DSS for watershed analysis, which would take far too long, why not build a generic DSS framework that many people could use to build their own DSS for whatever problem they wished? The project abruptly changed course, and the rest, as they say, is history.

Organization and Content

This volume is divided into three parts. Part I contains three background chapters. Reynolds and Hessburg ("An Overview of the Ecosystem Management Decision Support System") give an overview of EMDS addressing underlying concepts, principles, and overall functionality. Saunders and Miller ("NetWeaver") provide an overview of NetWeaver Developer, a first core software component of EMDS that uses logic processing to interpret and synthesize ecological information, from which one may derive conclusions about ecosystem conditions. In "Criterium DecisionPlus," Murphy describes the complementary role of the second core component of EMDS, Criterium DecisionPlus, decision models of which provide software support for setting priorities on landscape elements, given results of NetWeaver evaluations.

Part II contains nine chapters that describe use of the system in specific application areas. In general, each chapter provides some background on the application domain, motivations for using EMDS in this context, a brief review of other EMDS applications in the domain, if applicable, a fuller discussion of a specific application, and aspects of analyses that worked well and didn't work well.

Gordon ("Use of EMDS in Conservation and Management Planning for Watersheds") leads off Part II with a comprehensive review of EMDS applications used to support watershed analysis. We thought it fitting to start with the topic of watershed analysis because this is one of the earliest and most common areas of EMDS application development since the late 1990s. Taking advantage of this history, Gordon nicely summarizes lessons to be gleaned from this important area of natural resource management.

Watersheds remain a central focus of analysis in "The Integrated Restoration and Protection Strategy of USDA Forest Service Region 1: A Road Map to Improved Planning" (Bourgeron et al.), but the focus shifts to decision support for forest planning in the context of the US Department of Agriculture's National Forest System. Here, an EMDS prototype application to support integrated resource restoration provided an effective proof of concept, which culminated in the subsequent design and implementation of a multilevel decision model for setting restoration and protection priorities on watersheds, taking into account 19 key resource management issues of a Forest Service Region.

Keane et al. ("Evaluating Wildfire Hazard and Risk for Fire Management Applications") suggest that DSSs like EMDS will find increasing use in fire management because evaluations of fire hazard and risk need a general context in which to assess possible fire management decisions. Past fire hazard and risk projects often lacked a decision support platform in which to couch major fire management concerns. This chapter summarizes and evaluates various methods of computing fire hazard and risk for decision support. A current project using EMDS to prioritize resources for fire management is presented as an example.

Hessburg et al. ("Landscape Evaluation and Restoration Planning") review published landscape evaluation and planning applications designed in EMDS. They show EMDS's utility for designing transparent local landscape evaluations, and summarize a variety of approaches that have been used thus far. They also highlight a current US Forest Service project to evaluate wildfire, insect, and disease outbreak vulnerabilities, a variety of wildlife habitat conditions, and vegetation changes in a contemporary forest landscape, comparing the current vegetation, disturbance vulnerability, and habitat patterns with both historical and future ranges of variability (under climatic warming). They used a climate change analog approach to estimate the future range of variability. The project shows how EMDS may be used to evaluate the linked facets of any landscape, and which linkages can explicitly inform managers about trade-offs associated with spatial allocation, intensity, and prescriptions for management of any single or multiple facets.

Stoms ("Ecological Research Reserve Planning") describes guidelines for assessing sites as potential reserves for scientific study. Translating these imprecise qualities inherent to reserve siting into measurable suitability criteria for ranking sites in a large landscape can be particularly challenging. EMDS was used to provide a formal framework for assessing suitability for a new reserve to serve the University of California, Merced campus. The assessment was performed iteratively at three geographic scales, narrowing the scope and increasing the detail of the criteria, at each subsequent iteration. The products of the assessment were the identification of a small number of high suitability parcels to be field inspected, and a flexible, transparent framework for future applications.

White and Stritholt ("Forest Conservation Planning") describe an EMDS application for spatially explicit conservation planning in forested landscapes. Its application is illustrated in two case studies: a conservation assessment of 1.5 million acres of the northern California Sierra Nevada region that was used to prioritize and expand land protection, and an 18 million acre conservation value assessment of the Alberta Foothills region that was used in multiuse forest planning. These case studies demonstrate how EMDS can be used to model diverse and complex landscape characteristics, using information about mixed precision, to inform conservation decision making across large regions.

Gordon et al. ("Wildlife Habitat Management") describe how the Washington State Department of Natural Resources is using EMDS to assess the impacts of alternative state forest management plans on dispersal habitat for the Northern Spotted Owl, as required under their Habitat Conservation Plan. Expert workshops defined three separate models to assess foraging, roosting, and dispersal habitat. The scores developed from the three models are then used in a spatial dispersal model, which uses graph theory and a variable resistance landscape to assess the connectivity of suitable habitat with respect to the owl's dispersal capabilities.

Puente ("Planning for Urban Growth and Sustainable Industrial Development") presents a model for locating industrial areas based on defined sustainability criteria. As a result, a creative methodology and a new tool have been developed to facilitate decision making for urban and regional planning. Through a multicriteria analysis methodology, spatial suitability for locating industrial areas is represented by cartographic outputs. The same methodology can also be used to evaluate other industrial areas.

Wainwright et al. ("Measuring Biological Sustainability via a Decision Support System: Experiences with Oregon Coast Coho Salmon") round out Part II with a look at decision support for sustaining the viability of Coho salmon populations on the Oregon coast. The finest scale of analysis begins with watersheds, but this application is particularly interesting as an example of integrated analyzes that span a range of spatial scales. The authors describe the range of spatial scales needed to address Coho population viability, the nature of the questions that need to be addressed at each scale, and how all of the scales and associated questions fit together within a decision support framework that provides a cohesive understanding of viability.

Part III contains two chapters outlining the road ahead for EMDS. Paplanus et al. ("EMDS 5.0 and Beyond") describe already developed and planned features for the forthcoming EMDS version 5.0. EMDS applications have been developed for an array of problems related to spatial decision support for natural resource management over the past 15 years. Along the way, the development team received many suggestions for how the system could be enhanced, improved, or redesigned. Many of these suggestions are documented in the chapters in Part II. Driven largely by user feedback, "EMDS 5.0 and Beyond" describes a radically reengineered DSS that will be more powerful, flexible, and extensible.

Finally, Reynolds et al. ("Synthesis and New Directions") offer some final thoughts by way of summary and synthesis. They conclude with additional thoughts about key next steps in DSS extensibility to meet the emerging needs of land planners and managers.

Acknowledgments

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