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Integrated decision support for sustainable forest management in the United States: Fact or fiction?

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Abstract

Decision support systems have played a prominent role in the implementation of forest management since the early 1980s. However, whereas early systems were typically designed to address relatively simple management questions, more modern systems are increasingly being called upon to address the challenges posed by issues surrounding forest ecosystem management, sustainable forest management, and adaptive management. This paper considers some of the key requirements as they apply to forestry in the United States, and reviews recent decision support system designs in the United States, considering the extent to which they are satisfying the requirements, and opportunities for their continued evolution. The three systems discussed, NED, LMS, and EMDS, are typical of recent approaches to system design insofar as each has taken an evolutionary approach to system implementation in order to develop effective, integrated decision support for forest management in this new, complex problem domain. On considering the current state of system development for the three systems, it is concluded that significant progress has, in fact, been made in the last few years in providing support for evaluation and planning, although it is equally true that substantial opportunities remain for continued development to support plan implementation and forest ecosystem monitoring.
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Keywords: Decision support; Sustainability; Forest management; Ecosystem management; Adaptive management; NED; LMS; EMDS

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1. Introduction

The early to mid-1980s saw the rise to prominence of decision support systems in forest management in the United States (U.S.). Numerous expert systems were developed to assist with forest pest management, silvicultural prescriptions, and timber harvesting, among other things (Durkin, 1993). By the end of the decade, the value of decision support in forest management was well established, and decision support system developers had become relatively adept at delivering effective expertise for these small, well-defined problems. By the late 1980s, however, the scope of forest management began to expand dramatically as agencies, universities, and industry began to embrace new concepts like the hierarchical organization of ecosystems (Allen and Starr, 1982) and forest ecosystem management (Holling, 1978; Walters, 1986). With its emphasis on broad, holistic, integrated perspectives, the concept of forest ecosystem management posed serious new challenges to the delivery of effective decision support (Rauscher, 1999; Schmoldt and Rauscher, 1996). The challenge was further exacerbated by the still newer concept of sustainable forest management (SFM) that had risen to prominence, following the Earth Summit in Rio de Janeiro, Brazil in 1992, and by introduction of the adaptive management concept.

Twenty years after the initial appearance of decision support applications for forest management, it is appropriate to ask, "How are we doing?" or more specifically, "Has decision support been able to meet the challenges posed by forest ecosystem management, SFM and adaptive management?" In this paper, I consider some of the key requirements of ecosystem management, adaptive management, and SFM as they apply to forestry in the U.S., and review recent decision support system designs in the U.S., considering the extent to which they are satisfying the requirements, and opportunities for their continued evolution. Rauscher (1999) recently presented an excellent overview of the state of decision support for ecosystem management. Rather than present another broad overview, this paper discusses three major systems in some detail. The three systems are relatively mature in their development, relatively advanced in integrated decision support features, and representative of the state of the art in the U.S. The first two systems, the Landscape Management System (LMS, McCarter et al., 1998) and NED[1] (Nute et al., 2000, 2003; Twery et al., 2000, 2003), primarily provide decision support at the project level; that is, at the level management areas encompassing 10 s to 100 s of stands. LMS and NED are similar in that both use vegetation simulation components to project future landscape conditions. The third system, the Ecosystem Management Decision Support System (EMDS, Reynolds et al., 2003c), is a decision support framework for environmental evaluation and planning at any spatial scale.

2. What is a decision support system?

There is a natural human tendency to generalize the meaning of terms until they are no longer useful. For example, the term, knowledge base, originally meant a formal, typically logical, specification for the interpretation of information (Walters and Nielsen, 1988).

[1] Author's note: The name, NED, originally derived from Northeast Decision Model. The acronym has been retained, but the application is no longer referred to as the Northeast Decision Model.