WATERSHED FOREST MANAGEMENT USING DECISION SUPPORT TECHNOLOGY

Mark Twery and Robert Northrop

ABSTRACT. Using innovative partnerships and a variety of decision support tools, we identified the needs and goals of Baltimore, Maryland, for their reservoir properties containing over 17000 forested acres; developed a management plan; determined the information necessary to evaluate conditions, processes, and context; chose tools to use; collected, organized, and analyzed data; and developed alternative strategies to meet the landowner's goals. The key tools we used were the NED decision support system and ArcView. NED is a tool to gather, organize and analyze data; and compare alternative options and outcomes. Data can be exported to ArcView for spatial analysis. NED is most useful for implementation at stand and project levels. ArcView is most useful to display spatial relationships; analyze at landscape level; and show links with outside properties.

KEYWORDS. Ecosystem management, decision support system, knowledge-based system, multi-resource decisions, treatment prescription, growth simulation

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The City of Baltimore (Maryland USA) reservoir properties consist of over 17,000 forested acres surrounding three primary reservoirs that supply water to 1.8 million people in the metropolitan area. From 2000 to 2002, the Maryland Department of Natural Resources-Forest Service, with the assistance of the USDA Forest Service, developed a comprehensive forest management system for these lands. A hierarchical and exclusionary set of programmatic goals for conservation was set through a series of 20 public meetings. These explicit goals included: 1. protect and enhance water quality; 2. maintain and restore of regional biological diversity; 3. maximize forest habitat value; and 4. provide recreational opportunities. Each identified goal must be met in the order identified before subsequent goals should be addressed, and activities to meet later goals must not reduce success at meeting earlier goals.

Addressing these goals required a holistic approach to conservation management that incorporated a contemporary ecological perspective of ecosystems, recognizing the specific dynamics of the forest is contingent upon the history of the region, patterns of natural and human disturbance that led to the arrival of species on site and the relationship of the forest ecosystem to the surrounding area.

Following a review of the literature and an extensive inventory of all vegetation and physical features, we used a combination of computer-based tools, primarily the ArcView geographic information system (GIS), (ESRI, Redlands, CA) and the NED-1 system (Twery *et al.* 2000), to analyze risks to the long-term sustainability of the ecosystems and to develop and evaluate alternative scenarios for management of the lands. NED-1 was chosen as the tool to gather, organize, and analyze forest inventory data. Once summarized, NED software provided a means to compare alternative options and outcomes of forest management prescriptions. In combination with ArcView data layers that included soils, drainage, slope, and external properties, NED

allowed examination of a variety of silvicultural alternatives. The detailed, stand-level data in NED-1 provided an easily accessible form of the information necessary to design and evaluate projects at scales appropriate for implementation.

Two types of information were critical for the development of the comprehensive forest conservation plan for the protection of water quality, species, communities and ecosystems. The first type of information concerns the landscape context of the forest. Since the forest systems are open and can be regulated by outside processes, an understanding of the spatial connections to the adjoining landscape is critical in understanding the dynamics of the reservoir forestlands. The second concerns ecological processes, including dispersal, establishment, movement and interaction of organisms, the transformation and cycling of energy and materials, successional pathways that lead to changing habitat composition, structure, shape and size, and the manner in which an ecosystem responds to natural and human induced disturbance.

The broad and diverse sets of data needed to approach plan development from an ecological perspective led us to investigate the use of forest management decision support tools. Discussions with the U.S. Forest Service helped to identify the NED-1 Decision Support Software as a good match for much of the work that we envisioned. NED-1 was adopted as an integral element of our planning process, providing the database backbone for our inventories. NED-1 supported detailed forest stand-level analysis incorporating forest patches at a within-stand scale. NED-1 inventories incorporated data needed to evaluate wildlife habitat composition and structure and the quality of habitat along first and second order streams.

While providing a platform for the management and analysis of data on numerous key abiotic and biotic forest characteristics, NED-1 decision support software did not provide a mechanism for evaluating the relationships of these landscape elements. Our need to understand how landscape context and current ecological processes were shaping the forest required a synthesis of tools and often required us to step outside the decision support mechanism for critical answers to conservation problems.

Some of these concerns were addressed when ArcView GIS and NED-1 were merged to produce a hybrid tool. NED-1 provided the critical site-specific contextual data, while the geographic information system allow us to review landscape features and processes occurring within entire watershed. Analysis of local hydrology, vectors for ground water pollution, and weather patterns were used to identify risks to the long-term sustainability of the forest lands at both the local and landscape scales, and to develop and evaluate alternative management scenarios.

Important expected outcomes of adoption of the system, recommended by the Maryland DNR Forest Service as a result of the use of NED-1 in conjunction with other tools, include the development of a three-aged forest; increased structural diversity within forest and aquatic systems; deliberately patterned forest community types to match optimal sites; maintenance of an aggrading forest condition on shallow soils associated with non-point sources of pollution (80- to 90-year rotations); reduced risk of catastrophic environmental disturbance; specifically designated areas for the development of native plant seed banks and long-term monitoring (control); and a road system reduced to the minimum needed for conservation and protection.

The comprehensive forest conservation plan for the forests surrounding the City of Baltimore's reservoirs identifies the target of conservation as the ecological processes that allow the forest ecosystem to adjust to changing environmental conditions prevalent within the urbanizing northern Piedmont physiographic region. This conservation system directly addresses those human-induced changes to the landscape and associated alteration of processes that affect the ability of the City-owned forest lands to protect water quality while conserving regional biological diversity and local wildlife habitat. The goal of forest management is sustainability. Decision support tools needed by forest managers require a focus on the landscape context and the ecological processes that address the contingent structural and compositional nature of the forest system. This project succeeded because we found a combination of tools that provided the means to analyze and evaluate these characteristics.

Literature Cited

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ABOUT THE AUTHORS

Mark Twery is Supervisory Research Forester and Project Leader for the USDA Forest Service, Northeastern Research Station, Aiken Forestry Sciences Laboratory, in Burlington, Vermont. Robert Northrop is Watershed Forester for the Maryland Department of Natural Resources, Forest Service, in North East, Maryland.