

Theory into Practice: Implementing Ecosystem Management Objectives in the USDA Forest Service

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ABSTRACT / In the United States and around the world, scientists and practitioners have debated the definition and merits of ecosystem management as a new approach to natural resource management. While these debates continue, a growing number of organizations formally have adopted ecosystem management. However, adoption does not necessarily lead to successful implementation, and theories are not always put into practice. In this article, we examine how a leading natural resource agency, the United States Department of Agriculture Forest Service, has trans-

lated ecosystem management theory into concrete policy objectives and how successfully these objectives are perceived to be implemented throughout the national forest system. Through document analysis, interviews, and survey responses from 345 Forest Service managers (district rangers, forest supervisors, and regional foresters), we find that the agency has incorporated numerous ecosystem management components into its objectives. Agency managers perceive that the greatest attainment of such objectives is related to collaborative stewardship and integration of scientific information, areas in which the organization has considerable prior experience. The objectives perceived to be least attained are adaptive management and integration of social and economic information, areas requiring substantial new resources and a knowledge base not traditionally emphasized by natural resource managers. Overall, success in implementing ecosystem management objectives is linked to committed forest managers.

In June of 1992, the Chief of the United States Department of Agriculture Forest Service, Dale Robertson, announced that his agency would be moving to an “ecosystem approach” for the management of the national forests. His was the first government agency in the United States, and perhaps the world, to officially adopt an ecosystem approach to natural resource management. At the time, the popularity of ecosystem management as a resource management approach was limited to scientific and resource management communities. It was being used by many federal agencies in pilot projects and showed some success “on-the-ground” in particular locations. However, it was not generally viewed as a feasible federal initiative.

The agency’s adoption of the ecosystem management paradigm would represent not only a shift in management tools and techniques, but a reorientation of the fundamental reasons why and for whom the agency manages the forests. For example, it has been argued that ecosystem management entails managing

for what is left behind (e.g., forest conditions) after an activity rather than for what is provided by the activity (Yaffee 1999; Cortner and Moote 1999; Moseley 1999). Ecosystem management scholars have described this new approach as involving radically different decision-making processes, institutional structures, management boundaries, and knowledge (Wondolleck and Yaffee 2000; Cortner and Moote 1999; Yaffee 1999; Grumbine 1997).

Despite the enormous changes required to fully embrace the ecosystem management paradigm, it became a popular policy proposal among resource professionals, federal legislators, and even the president. Following the Forest Service’s formal adoption of ecosystem management, at least 18 US federal agencies, and numerous state agencies, adopted this new approach (Morrissey and others 1994; Malone 2000). However, policy adoption is not the same as policy implementation, and carrying out new practices on the ground can be exceedingly difficult. Given the complexities and institutional changes inherent in ecosystem management, it is important to examine the process by which it is implemented. Lessons learned from the experiences of the Forest Service might prove useful to agencies that are currently adopting an ecosystem management approach as well as those that might choose to do so in the future.

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In this article, we examine the extent of ecosystem management across the national forest system, analyzing both its operationalization into stated policy objectives and the perceived attainment of those objectives. Our aim is to describe how ecosystem management theory has been translated into practice by a leading natural resource agency.

The Ecosystem Management Concept

Although there is no universally supported, single definition of ecosystem management, numerous authors have defined similar components of this approach to managing natural resources. According to Grumbine (1994, p. 31), the main focus of ecosystem management is the integration of “scientific knowledge of ecological relationships within a complex sociopolitical and values framework toward the general goal of protecting native ecosystem integrity over the long term.” Cortner and Moote (1999) characterized ecosystem management as being comprised of four themes: (1) socially defined goals and objectives; (2) holistic, integrated science; (3) adaptable institutions, and (4) collaborative decision-making. The Ecological Society of America’s Ad Hoc Committee on Ecosystem Management crafted the following definition: “Ecosystem Management is management driven by explicit goals, executed by policies, protocols, and practices, and made adaptable by monitoring and research based on our best understanding of the ecological interactions and processes necessary to sustain ecosystem composition, structure, and function” (Christensen and others 1996, p. 665).

Perhaps the most cited statement of ecosystem management comes from Grumbine (1994). In a review of ecosystem management literature, he analyzed dozens of journal articles, books, and government documents that defined ecosystem management, to distill common themes. Grumbine identified 10 primary components of ecosystem management being discussed in the late 1980s and early 1990s (the same time the Forest Service began formulating its ecosystem management policy directives). These “dominant themes” included evaluating biodiversity at all levels of biological hierarchy, using ecological boundaries rather than administrative or political ones, and managing systems for ecological integrity. In addition, themes of increased ecological data collection and research, as well as monitoring, adaptive management, cooperation among agencies, and organizational change were prevalent. Other important themes included accepting that humans are embedded in nature and, consequently, human values are critical for generating

management goals. Grumbine observed that among these 10 dominant themes, biologists paid least attention to the ones related to social science and policy: organizational change, adaptive management, and the idea of human values as part of ecosystem management. Yet, such themes have been highlighted by other authors as essential to ecosystem management, even if they are extremely difficult to achieve (Endter-Wada and others 1998; Meidinger 1997; Slocombe 1998; Yaffee 1996).

Despite continuing definitional debates, ecosystem management began to be adopted in many spheres in the 1990s. By the late 1990s, in response to perceived failings of existing management approaches, new knowledge, and shifts in public values, local actors became more empowered to attempt ecosystem management efforts on the ground (Yaffee 1999). Ecological science concepts, especially those related to landscape ecology and diversity protection, began to be incorporated more into forest management practices in the United States. For example, some new forestry approaches aimed to promote forest size structures that mimicked natural regimes, work at broad scales, and emphasize interactions within forest systems (Dale 1998). A scientific advisory committee, convened in 1997 to provide recommendations for national forest resource planning, emphasized ecosystem management themes, including ecological sustainability, multiple scales, native species protection, adaptive management, and collaborative planning (Johnson and others 1999). Although increasingly prevalent in the United States, ecosystem management efforts also have been pursued in places such as Canada, Australia, Russia, and Turkey (Slocombe 1998; Ozesmi and Ozesmi 2003).

Amid the growing popularity of ecosystem management, serious concerns have been raised about its operationalizability and its implementability. For operationalization, ecosystem management has long-term goals, whereas natural resource managers need short-term indicators to guide their actions (Alpert 1995). Especially troubling to some is the possibility of codifying ecosystem management into government policy statements when its definition remains contested (Fitzsimmons 1996). For implementation, ecosystem management is not simply about changing scientific practices but is also about changing social and political practices. Traditional natural resource management, marked by centralized, hierarchical decision-making in agencies such as the Forest Service, is rather incongruent with the decentralized, adaptive, bottom-up, cooperative actions embodied in ecosystem management (Cortner and Moote 1999;

Yaffee 1996; Grumbine 1994). Additional obstacles to implementing ecosystem management include strained relationships between managers and stakeholders, multiple and often conflicting policy requirements, budgetary uncertainty, lack of interagency coordination, and agency fragmentation (Clark and others 1991; Danter and others 2000; Rigg 2001; Bissix and Rees 2001).

The ecosystem management component likely to be most difficult to implement is adaptive management. Adaptive management requires a substantial degree of organizational change, which is risky for managers because it challenges the status quo. In the past, natural resource managers have not been rewarded for experimenting, monitoring, and adapting (Grumbine 1997). To follow an adaptive management approach, however, resource managers must do so, and organizational structure will have to change so that these traits are rewarded rather than discouraged. As illustrated in a study of ecosystem management implementation in the US Fish and Wildlife Service, organizational change can be disruptive and difficult (Danter and others 2000). In addition, the monitoring and change required by adaptive management are costly (Yaffee 1996), and natural resource managers operating in a public setting are likely to encounter public and political pressure against explicitly experimenting on public lands (Lee 1993).

Where agencies have embraced ecosystem management, in name, their adoption and implementation can vary greatly. Without formal rules defining ecosystem management practices, translating concept to practice is far from uniform (Meidinger 1997). According to Yaffee (1996), for some resource managers, ecosystem management is translated to mean environmentally sensitive multiple use, where the aim is to provide multiple human uses within environmental constraints. For others, ecosystem management connotes promoting ecological integrity while allowing human uses that are sustainable. For still others, ecosystem management means managing at a landscape scale, using broad ecoregions to bound systems.

Overall, then, ecosystem management has been debated conceptually, even as many agencies have adopted their particular versions of it. The translation of theoretical approaches into practice is challenging for resource managers. For a complex and unsettled concept like ecosystem management, it is important to learn more about how a leading agency such as the Forest Service turns it into operational objectives and then implements those objectives. Such knowledge will facilitate assessing the feasibility of putting ecosystem management into practice, as well as identifying which

components are more likely to be achieved than others.

Forest Service Authority

The USDA Forest Service has long been recognized as a powerful, unified natural resources agency. It has been called a “bureaucratic superstar,” referring to its power and success in spite of the many bureaucratic quagmires that beset most government agencies (Clarke and McCool 1996). Today, the Forest Service manages 155 national forests throughout the continental United States, Alaska, Hawaii, and Puerto Rico. The agency operates through a hierarchical structure, with four organizational levels. The Chief of the Forest Service operates at the national level from the agency’s Washington, DC headquarters. The agency is divided into nine geographic regions, each overseen by a regional forester. A forest supervisor manages each national forest at the forest level. Finally, the district ranger has management responsibility for a geographic subunit of a forest.

The Chief, regional foresters, forest supervisors, and district rangers together make up the “line authority” of the Forest Service. Line officers are individuals who have formal decision-making authority over Forest Service geographic management units (Brown and Harris 2000). Each is given decision-making authority over the area of land he or she manages in a chain of command that goes from district ranger up to forest supervisor, then up to regional foresters, and, ultimately, to the Chief of the Forest Service. The line authority personnel, due to their job responsibilities, have direct experience managing the broad changes required of an ecosystem approach and are, therefore, the focus of this study.

Research Questions

This study is designed to address the following research questions.

1. Which specific objectives did the USDA Forest Service establish in operationalizing ecosystem management, and how well do these objectives match conceptual definitions of ecosystem management?
2. How successful do implementing officials perceive the agency has been in attaining these objectives to date? Do perceptions of implementation success vary by geographic region?
3. Which factors contribute to perceptions of implementation success?

Research Methods

Data for this study come from a three-phase research design. Document analysis, survey, and interview techniques were used to identify how the Forest Service has made operational its ecosystem management policy and to measure and explain the agency's level of perceived success in attaining its ecosystem management objectives.

In the first phase, we collected and analyzed government documents from the Forest Service and other government entities that have defined ecosystem management within the agency. To identify such documents, we searched the Forest Service publications website to find documents describing the agency's ecosystem management objectives. Although numerous documents described the merits of ecosystem management, only five were identified that provided specific ecosystem management objectives: the Forest Service statement before the House of Representatives in June of 1992 (Robertson 1992), the Forest Service report "Navigating into the Future" (USDA Forest Service 1994), the Forest Service document "The USDA Forest Service Perspective on Ecosystem Management" (Unger 1994), the "USDA Forest Service Strategic Plan (2000 Revision): Integrity and Accountability" (USDA Forest Service 2000b), and a Forest Service *Federal Register* notice (USDA Forest Service 2000a). Beyond these Forest Service publications, we discovered two additional documents that recounted what the Forest Service had described to other organizations as its primary ecosystem management objectives: the Congressional Research Service report "Ecosystem Management: Federal Agency Activities" (Morrissey and others 1994) and a report from the White House Office of Environmental Policy (Interagency Ecosystem Management Task Force 1995).

Content analysis across the seven documents yielded a list of objectives describing the agency's translation of ecosystem management concepts into operational objectives (see Miles and Huberman 1994). To corroborate the document analysis, we interviewed a high-ranking official from the Forest Service's Office of Ecosystem Management Coordination about which objectives the agency included in its ecosystem management approach (see Marshall and Rossman 1999). Analysis of government documents and the interview informed the specific questions included in the written questionnaire, the next phase of the study.

The second phase of the study involved a written questionnaire sent to all 576 line authority employees of the Forest Service at the district, forest, and regional levels. The census of that population included 9 re-

gional foresters, 109 forest supervisors, and 458 district rangers. The survey followed the "Total Design Method" of a four-wave mail survey, including a preliminary letter, a mailing of the survey, a follow-up reminder postcard, and a second survey to nonrespondents (Sallant and Dillman 1994; see also Dillman 2000) in March 2002.

The survey questions solicited information about the extent to which each of the agency's ecosystem management objectives has been attained, following Mazmanian and Sabatier (1989), by asking respondents to indicate their perceptions on a rating scale from 0 ("not at all") to 4 ("to a great extent"). Thus, we measured perceptions of attainment of these objectives by people most closely involved in the processes. Perceptual data have been used in numerous policy studies, including those in natural resources (e.g., Culhane 1981, Brudney and Hebert 1987, Elling 1992, Sabatier et al 1995, Koontz 2002a).

Perceptual data are necessarily subjective, but their reliability can be enhanced by carefully wording questions, selecting large samples, seeking the views of a wide range of the population of interest, and assuring confidentiality of responses. For this study, we worded the questions to ask about attainment of specific objectives, rather than about the more ambiguous term "ecosystem management" (see the Appendix). Our target sample was all of US Department of Agriculture (USDA) line officers at the district, forest, and regional levels, and we achieved a response rate of 60% (345 completed surveys), spread widely throughout all nine of the agency's geographic regions. We assured participants that all responses would be kept confidential, never to be identified with particular agency personnel or forests. In developing the survey, we enhanced validity by pretesting the instrument with seven Forest Service line officers (one forest supervisor and six district rangers) in national forests across Ohio, Kentucky, Indiana, and Illinois, soliciting feedback and making minor adjustments in survey format and wording based on this feedback.

We performed statistical analysis on the survey data using the software SPSS 10.0. In particular, we employed one-way analysis of variance (ANOVA) and the Kruskal-Wallis test for Normally distributed and non-parametric variables, respectively. In addition, we used the Bonferroni, Friedman, and Wilcoxon signed ranks tests to identify significantly different items within variables.

The third phase consisted of interviews with a randomly selected subsample ($n = 16$) of employees who responded to the mail survey. The interviews, each lasting approximately 20–30 minutes, were coded and

Table 1. Components of Forest Service ecosystem management policy

Objective	Definition
Collaborative stewardship	Making forest management decisions by working with people affected by and knowledgeable of the issues
Integrated scientific information sources	Integrating multiple scientific information sources in making forest management decisions
Integrated social and economic information sources	Integrating multiple social and economic information sources in making forest management decisions
Adaptive management	Monitoring forest conditions for feedback and adjusting management based on monitoring results
Interagency cooperation	Developing cooperative relationships with other agencies for forest management
Sustainability	Preserving ecological processes

analyzed following Miles and Huberman (1994). These data provided a better understanding of the factors that have contributed to the Forest Service's implementation of ecosystem management.

Results and Discussion

Forest Service Application of Ecosystem Management Concepts

Document analysis revealed several themes in the Forest Service's ecosystem management policy objectives. These themes include an emphasis on sustainability, cooperation and collaboration with public and private entities, more efficient integration of science into management, adaptive management, improving partnerships between land managers and scientists, enhancing the protection of ecosystems, and restoring deteriorated ecosystems. Whereas each of these themes is prevalent in at least two of the seven documents analyzed, not all of the themes were found in every document, nor was there a specific listing of agreed-upon objectives.

The interview with the high-ranking Forest Service official in the office of Ecosystem Management Coordination corroborated the finding that no single policy document establishes the agency's ecosystem management objectives. However, several primary objectives of ecosystem management are emphasized in the policy directives. The first objective is to increase collaborative stewardship, which refers to increased involvement by stakeholders outside of the agency. The next two involve the integration of multiple sources of information, scientific as well as social and economic. Adaptive management is another objective, which refers to actively monitoring forest conditions for feedback and altering forest management actions based on monitoring results. The last objective is increased interagency cooperation, whereby the Forest Service develops cooperative relationships with other agencies

for forest management. Together with the Forest Service documents, which suggest an additional objective of sustainability, a set of six ecosystem management policy objectives emerges (Table 1).

Understanding how the Forest Service operationalizes ecosystem management into policy objectives yields more than just a starting point for analysis of implementation. It provides a means by which to compare the academic and theory-based ideas of ecosystem management with its actual application. Without a universally agreed-upon definition of ecosystem management and its components, it is important to discover how an agency makes this approach operational.

A comparison of Grumbine's (1994) 10 dominant ecosystem management themes to Forest Service policy objectives reveals links between theory and practice. The Forest Service's ecosystem management policy explicitly incorporates 5 of the 10 theoretical themes: *interagency cooperation*, *data collection*, *ecological integrity*, *adaptive management*, and *monitoring* (Figure 1). A common thread among most of these themes is a managerial emphasis rather than an ecological or social one. Ecological themes not listed in the Forest Service's ecosystem management objectives include using *ecological boundaries* in management rather than political ones and managing from a *hierarchical context*, which would require focusing management on more than "one level of the biodiversity hierarchy" (Grumbine 1994, p. 29). The more socially focused themes missing from the ecosystem management objectives include the acceptance that *humans are embedded in nature*, thereby affecting ecological processes, and that *human values* "play a dominant role in ecosystem management goals" (Grumbine 1994, p. 31).

These more socially and ecologically focused themes are statements of reality and abstract statements of what ought to be, rather than specific objectives to guide management. Therefore, it is not surprising that they are omitted from ecosystem

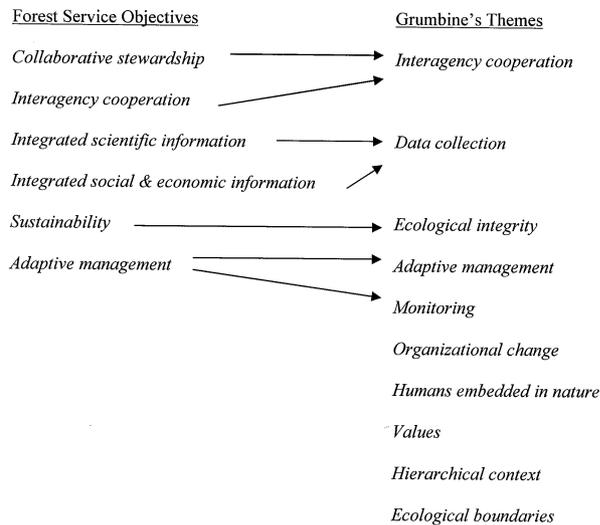


Figure 1. Forest Service objectives linked to Grumbine's ecosystem management themes.

management directives to Forest Service employees. For example, instructing line authority personnel that humans are an integral part of natural systems would do little to guide their management of national forests.

An argument can be made, however, that most of Grumbine's themes are included in Forest Service objectives, even if not explicitly stated in ecosystem management objectives. For instance, the ideas that *humans are embedded in nature* and that *human values* are dominant in generating management goals are intrinsic in the Forest Service collaborative stewardship objectives. Requiring the input of interested stakeholders outside of the Forest Service (e.g., in creating forest management plans) infers that these stakeholders and their values are important in managing forest ecosystems. Another of Grumbine's themes that is intrinsically included in the agency's objectives is the requirement of *organizational change* for the management of ecosystems. Meeting certain objectives, such as increased collaboration with stakeholders and other agencies and greater integration of social and economic information, would likely require change within the Forest Service's organizational structure, such as planning procedures and communication flows. In addition, as Forest Service management planning objectives include multiple ecological scales and boundaries (e.g., watersheds, plant communities, habitat types, and "opportunity area" landscapes), the agency already manages, to a substantial degree, in a *hierarchical context* and by *ecological boundaries* rather than political ones.

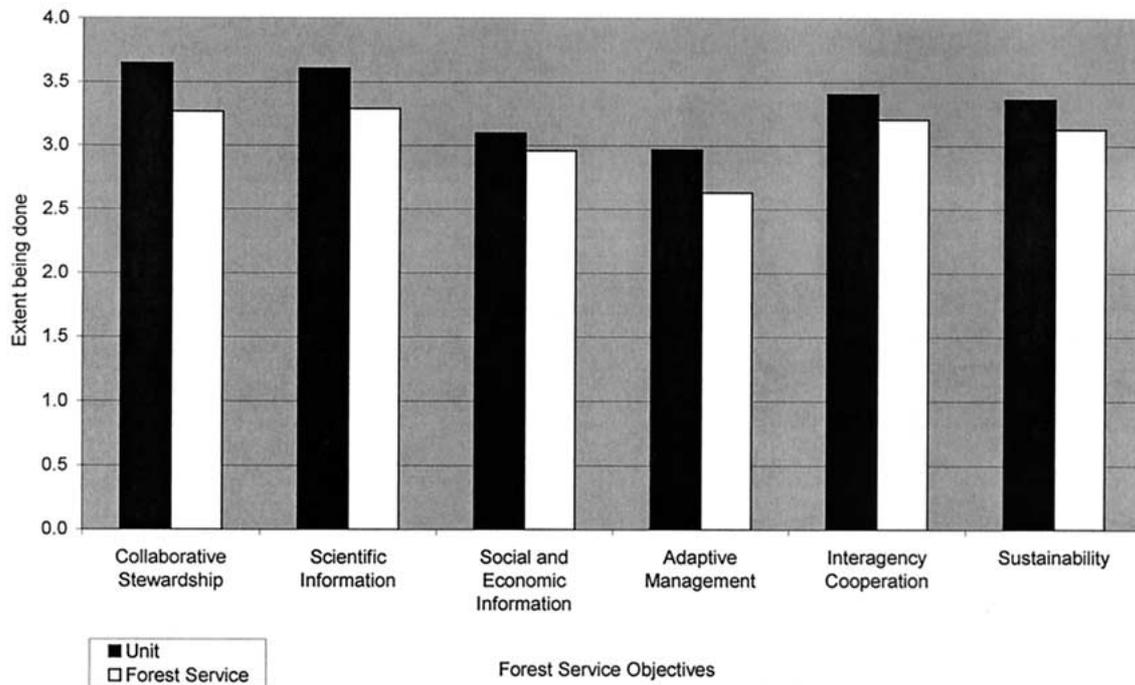
In sum, many of Grumbine's dominant ecosystem management themes are included in the Forest Service ecosystem management policy objectives: five explicitly and five implicitly. Therefore, the Forest Service's operationalization of ecosystem management matches up rather well with the theory-based concept of this approach, whereas its specific objectives are stated with a management bent, befitting a land management agency.

Levels of Perceived Implementation Success

As described earlier, survey respondents were asked the extent to which the agency is meeting each of its six ecosystem management objectives, on a scale from 0 ("not at all") to 4 ("to a great extent") (see the Appendix). The survey asked respondents about attainment in two spheres—their work unit (district, forest, or region) and the Forest Service as a whole—because respondents were likely to be more familiar with their work unit yet the researchers also were interested in perceptions of the agency as a whole. On average, respondents rated all six items as falling between being "somewhat" (score of 2 on the scale) done and done "to a great extent" (score of 4 on the scale), both by their respective work units and by the Forest Service as a whole, with mean scores for the objectives that ranged from 2.63 to 3.65 (Figure 2). Interestingly, respondents rated their unit as doing all six items to a significantly (at the 0.05 level of significance) greater extent than is done by the Forest Service as a whole. Overall, as operationalized by the Forest Service, employees perceived that ecosystem management objectives are being largely attained.

Both within specific work units and across the Forest Service as a whole, we found differences among the six objectives in the extent that each is perceived as being attained (Wilcoxon signed rank tests at the 0.05 level of significance). This allowed the objectives to be ranked meaningfully, relative to each other. According to respondents' perceptions, work units are having the greatest success in attaining collaborative stewardship and integrating scientific information sources, but are having significantly less success in attaining interagency cooperation and sustainability (Table 2). Integration of social and economic information sources and adaptive management were perceived as being least attained in the work units, with mean scores significantly less than the other objectives.

For the Forest Service as a whole, respondents perceived that the agency has had the greatest success in attaining the integration of scientific information sources, collaborative stewardship, and interagency cooperation (Table 3). In contrast, sustainability was



Note: 0 to 4 scale, where 0 = “not at all,” 2 = “somewhat,” and 4 = “to a great extent.” Each objective was defined on the survey as listed in Table 1 (see Appendix for survey wording).

Note: Unit varies by respondent: for district rangers it is their district, for forest supervisors it is their forest, and for regional foresters it is their region.

Figure 2. Perceived mean attainment levels of six Forest Service ecosystem management objectives.

Table 2. Respondents’ perceptions of objective attainment by work unit

Rank ^a	Objective	Mean score	Standard deviation
1	Collaborative stewardship	3.65	0.58
2	Integration of scientific information	3.61	0.60
3	Interagency cooperation	3.41	0.76
3	Sustainability	3.37	0.71
5	Integration of social/econ information	3.10	0.82
6	Adaptive management	2.97	0.84

^aWilcoxon signed rank tests were used to identify significantly different means at the 0,05 level; items sharing the same rank number are not statistically distinguishable from each other.

Note: 0 to 4 scale, where 0 = “not at all,” 2 = “somewhat,” and 4 = “to a great extent.” Each objective was defined on the survey as listed in Table 1 (see the Appendix for survey wording).

Work unit varies by respondent. For district rangers, it is their district; for forest supervisors, it is their forest; for regional foresters, it is their region.

perceived to be attained at a significantly lower level, followed by integration of social and economic information sources and, finally, adaptive management.

In order to determine whether perceptions of implementation success vary by geographic region, we used survey data to aggregate mean scores, by Forest

Table 3. Respondents' perceptions of objective attainment by the Forest Service as a whole

Rank ^a	Objective	Mean score	Standard deviation
1	Integration of scientific information	3.29	0.75
1	Collaborative stewardship	3.27	0.76
1 ^b	Interagency cooperation	3.21	0.80
4	Sustainability	3.13	0.76
5	Integration of social/econ information	2.96	0.89
6	Adaptive management	2.63	0.92

^aWilcoxon signed rank tests were used to identify significantly different means at the 0.05 level; items sharing the same rank number are not statistically distinguishable from each other.

^bAll three objectives are given the first ranking because the integration of scientific information is statistically indistinguishable from collaborative stewardship, and collaborative stewardship from interagency cooperation. It should be noted, however, that the integration of scientific information and interagency cooperation are statistically different from each other.

Note: 0 to 4 scale, where 0 = "not at all," 2 = "somewhat" and 4 = "to a great extent." Each objective was defined on the survey as listed in Table 1 (see the Appendix for survey wording).

Work unit varies by respondent. For district rangers, it is their district; forest supervisors, it is their forest; for regional foresters, it is their region.

Table 4. Ecosystem management perceived objective attainment by work unit, grouped by region

Forest Service region ^a	Sample size	Collaborative stewardship	Scientific information	Social and economic information	Adaptive managements	Interagency cooperation	Sustainability
1	33	3.61	3.59	3.19	2.84	3.34	3.34
2	33	3.75	3.59	3.19	2.84	3.48	3.30
3	33	3.75	3.38	3.00	3.06	3.38	3.13
4	49	3.67	3.54	3.02	3.00	3.29	3.38
5	44	3.53	3.63	3.14	2.84	3.44	3.31
6	45	3.55	3.65	3.12	2.91	3.37	3.42
8	55	3.77	3.72	3.09	3.11	3.66	3.62
9	45	3.58	3.69	3.13	3.09	3.20	3.32
10	8	3.75	3.75	3.25	3.00	3.75	3.63

^aThe Forest Service has no region 7.

Service region, for the extent that each of the six objectives is perceived as being attained by respondents' work units. Scores are similar across the regions; in fact, no statistically significant differences (at the 0.05 level of significance) were found for any of the six objectives across regions (Table 4). Of course, this does not mean that perceived attainment is uniform across every work unit; across all respondents, perceptions of attainment ranged from 0 to 4 on four of the six objectives and from 1 to 4 on the remaining two objectives, at the work unit level. Similarly, for the Forest Service as a whole, across all respondents, perceptions of attainment ranged from 0 to 4 on three of the six objectives and from 1 to 4 on the remaining three objectives. The mean scores, however, do not significantly vary by region.

Explaining Levels of Perceived Success

Interviews with Forest Service line officers provided insights into factors affecting implementation success of the six objectives. We spoke with 16 line officers,

randomly selected from among the survey respondents. These 16 line officers included 15 district rangers and 1 forest supervisor. Their experience ranged from 12 to 40 years of employment in the organization, and they were geographically spread across seven Forest Service regions.

The most frequently cited factor seen as supporting attainment of ecosystem management objectives is a committed and knowledgeable workforce. Some interviewees described the value of "committed people," "commitment at all levels, especially on the ground," and "the hard-working, can-do attitude of people in the organization." One emphasized the role of Forest Service employees who were "progressive, environmentally sensitive scientists using the science of ecology," whereas another described the importance of "being able to draw on a young workforce that is scientifically diverse, coming into the agency since [the enactment of] NEPA."

Interestingly, for all the headaches and conflicts that agency officials can encounter in their interac-

tions with stakeholders, most interviewees cited stakeholder involvement as helpful for implementing ecosystem management objectives. In response to the question, “Does the involvement of stakeholders have a positive or a negative effect on the implementation of the FS’s ecosystem management policy, and why?” 10 interviewees indicated positive, 1 indicated negative, and 5 indicated a balanced mix of both positive and negative effects. The positive comments emphasized the role of stakeholders in bringing information that can help the Forest Service make better decisions that are more acceptable to the public. For example, one respondent said, “Part of ecosystem management is taking a broad look; the Forest Service has [certain] perspectives with its specialists, but to get an idea of a complex system and all that might be effected, you have to involve others.” The negative aspects, included slowing down management decision-making and opening further avenues for those opposed to complain and obstruct actions. As one interviewee explained, “It slows down the process—some groups have an agenda with a specific objective they are not willing to compromise.”

As described earlier, both the survey respondents’ work units and the Forest Service as a whole have had the greatest perceived success attaining the objectives of collaborative stewardship and integration of scientific information sources. As indicated by one interviewee, the level of success achieved with collaborative stewardship is tied to the enactment of laws that required stakeholder involvement prior to the adoption of ecosystem management, especially the National Environmental Policy Act (NEPA) of 1970. Seeking citizen input—a component of collaborative stewardship—was already part of forest management, although the quality and nature of the input has changed dramatically since then. In addition, several interviewees noted that the Forest Service has always had to integrate scientific knowledge for the purposes of forest management, even when it used to be a more timber-oriented agency. Consequently, integrating scientific information sources is a task in which the Forest Service is already experienced, even as more holistic types of scientific information become available.

In contrast, the adaptive management component of ecosystem management is perceived to be least attained by respondents’ particular work units, as well as the Forest Service as a whole. As described earlier, scholars have argued that adaptive management is very difficult to implement due to the significant changes it requires, the immense costs of monitoring, and lack of public and political support required for sustaining

efforts over time. These challenges are very real in Forest Service implementation of ecosystem management, as indicated by interview data. For instance, one interviewee said, “Adaptive management happens, but it is a reach for the agency. We don’t have all the mechanisms in place to do it well, and there are legal, logistical, contractual, and social constraints.” In addition, to the extent that adaptive management requires long-term data to draw meaningful conclusions for use in adjusting management, it might still be too early to do.

Comparison with Other Studies

Data analyzed for this study suggest high levels of perceived attainment, in most locations, of ecosystem management policy objectives defined by the Forest Service. These results stand in contrast with other empirical studies that conclude ecosystem management is not being conducted in land management agencies, even in those agencies that claim to do so. For example, Rigg (2001) examined ecosystem management efforts on Sequoia National Forest relating to management of giant sequoias. In her case study, she concludes that Forest Service officials in that forest have largely failed to achieve success in each of four dominant themes of ecosystem management: ecological and integrated systems management, adaptive scientific management, cooperation and collaboration, and integrating social values. Barriers to success include inadequate funding, lack of political support, a history of antagonistic relationships with local stakeholders, and conflicting agendas.

It is hard to know whether the experience of the Sequoia National Forest documented in Rigg’s study (2001) is representative of national forest management in other locations. Data from the study at hand do include responses indicating low perceived levels of attainment by line officers in some locations. However, most responses in this study are more positive. Moreover, research by Wondolleck and Yaffee (2000) pointed to numerous examples of the Forest Service, in a variety of locations, successfully attaining many ecosystem management objectives, especially those relating to collaboration, interagency cooperation, and integrating information.

Data from a study of multistakeholder resource management groups can help us to estimate the potential perceptual bias of agency managers. According to Leach (2002), when surveying such groups in the United States, state and federal agency officials are likely to overreport success in achieving goals, compared with other stakeholders. For exam-

ple, on a 7-point Likert-type scale of perceptions about success in achieving goals, state and federal agency officials averaged 4.2, compared to 3.8 for local agency officials and 3.6 each for environmental advocates and resource users (Leach 2002, p. 645). Thus, the Forest Service officials surveyed in the study at hand might exhibit a similar perceptual bias about attainment of objectives, on the order of 10–15% more positive than other stakeholders would report. After subtracting for this amount of positive bias, the attainment scores for all six objectives remain above the midpoint of the scale. (There is no reason to believe that such positive bias would differ from objective to objective, so the reported differences among the six ecosystem objectives likely provide unbiased data about which objectives the agency is most attaining, relative to other objectives.)

Studies of ecosystem management in other agencies have yielded somewhat less positive results. Prior research has suggested that federal agencies with a history of decentralized policy-making and responsiveness to local communities, such as the Bureau of Land Management, might be more likely to embrace ecosystem management components (Thomas 1999). However, in a comprehensive study of another federal agency, the US Fish and Wildlife Service, researchers concluded that ecosystem management was not well integrated into agency activities, owing largely to inadequate guidance, leadership, and accountability (Mullins and others 1998). At the state level, state forest management agencies have shown relatively little adoption of ecosystem management principles (Koonz 2002b). Also, across the country, only a handful of state environmental programs include a substantial number of ecosystem management elements (Malone 2000).

Conclusion

As an approach to managing natural resources, ecosystem management has generated much interest and discussion among scholars and conservation professionals. Numerous state and federal agencies have formally adopted an ecosystem management approach. Yet, it is not clear whether, or how, ecosystem management concepts might be translated into practice. To address this knowledge gap, we analyzed efforts by the USDA Forest Service to operationalize and implement ecosystem management across the United States.

Our results show that the Forest Service has operationalized ecosystem management policy into six objectives and, according to the perceptions of line

officers, the agency has been relatively successful in attaining all six. In addition, the level at which the objectives are being attained does not seem to vary systematically by geographic region—no small feat for a far-flung agency. It appears that the Forest Service has not only created ecosystem management policy objectives that correspond well to theoretical frameworks of ecosystem management, but that these objectives are perceived to be applied relatively successfully across regions. These findings bode well for the possibility of conducting ecosystem management across diverse settings. Despite the geographic separation that exists in the agency and the variety of unique ecosystems its professionals manage, the implementation of ecosystem management objectives is perceived as being achieved similarly across Forest Service regions.

Based on the perceptions of Forest Service line officers, agencies currently adopting an ecosystem management approach as well as those hoping to do so in the future should know that ecosystem management can be practically applied. To successfully implement the approach, however, the commitment and “buy-in” of the policy by employees who work “on-the-ground” should be of the utmost importance. In addition, it is evident that ecosystem management components linked to what an agency already has experience in are likely to see higher levels of attainment.

In contrast, components such as adaptive management that require a great deal of organizational change, funding, and political support are more challenging to implement. Moreover, the ecosystem management component of integrating social and economic sources is perceived to be less successfully attained. Advances in this arena will likely continue to be challenged by the fact that natural resource managers are most often educated or trained in natural science, rather than social science. More work to generate understanding of social and economic aspects of natural resource management and to transmit this understanding to natural resource professionals can play a vital role in successfully implementing ecosystem management.

In light of prior studies of agency adoption and implementation of ecosystem management, this study suggests the Forest Service is at the forefront of attaining ecosystem management objectives, at least as perceived by agency line officers. However, these results contrast sharply with Rigg’s (2001) case study of the Sequoia National Forest, which included perceptions of a variety of stakeholders, in a setting characterized by high levels of conflict over a unique resource

(giant sequoia groves). It remains to be seen whether Rigg's case is broadly representative of efforts in other national forests. If it is, then this points to a substantial rift between agency officials' perceptions of their attainment of ecosystem management objectives and others' assessments of attainment. This possibility should be investigated across multiple national forests, examining the experiences of both agency personnel and external stakeholders and drawing on nonperceptual data such as planning documents, meetings, and project reports.

It is worth noting that since these data were collected in early 2002, significant changes have been made in Forest Service operations. The Bush administration's emphasis on reducing litigation and streamlining planning processes are manifest in the Healthy Forests Restoration Act of 2003, as well as in changes to agency rules that reduce opportunities for citizen appeals. Although some argue that these changes reduce citizen input and meaningful dialogue—a key component of ecosystem management—others claim that the new procedures encourage greater predecisional interactions among stakeholders. This policy development merits careful study, especially in light of the fact that agency line officers in 2002 viewed collaborative stewardship as one of the most fully attained ecosystem management objectives. A follow-up study could examine the degree to which this attainment of collaborative stewardship has changed, if at all, since the new Forest Services policies have taken effect.

The most recent Forest Service changes serve to remind us that all organizations experience changes over time. It has been over a decade since the agency formally adopted an ecosystem management approach, and numerous other land managing agencies have done so since then. The dynamic nature of ecosystem management, combined with variation across and within the organizations charged with implementing it, poses a substantial challenge to our understanding. Continued attention and inquiry is needed to generate insights for academics and professionals involved in ecosystem management, from theory to practice.

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Appendix: Survey Question for Measuring Perceived Attainment of Objectives at the Work Unit Level

Q9: Please indicate, on a scale from "0" (*not at all*) to "4" (*to a great extent*), the extent to which your work unit does the following items:

(Circle one number for each item)

	not at all	some what	2	3	to a great extent
1. Makes forest management decisions by working with people affected by and knowledgeable of the issues	0	1	2	3	4
2. Integrates multiple scientific information sources in making forest management decisions	0	1	2	3	4
3. Integrates multiple social and economic information sources in making forest management decisions	0	1	2	3	4
4. Monitors forest conditions for feedback and adjusts management based on monitoring results	0	1	2	3	4
5. Develops cooperative relationships with other agencies for forest management	0	1	2	3	4
6. Preserves ecological processes	0	1	2	3	4

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