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Lessons from experience with ecosystem-based management

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Abstract

Pushed by recognition of the problems of fragmented management and growing interest in synthetic management goals such as sustainable development, biodiversity and ecosystem integrity, ecosystem-based management is of growing intellectual and practical significance in North America and elsewhere. Ecosystem-based management has several roots: the ecosystem approaches developed in several disciplines in the 1960s and 1970s, and earlier; more general systems approaches; and regional, bioregional, watershed and integrated resource management approaches. Although building on these, ecosystem-based management is a distinct activity that also draws on and complements ecosystem science, conservation biology, and environmental planning. Ecosystem-based management seeks to transcend arbitrary political and administrative boundaries, to achieve more effective, integrated management of resources and ecosystems at regional and landscape scales. Several key components of ecosystem-based management can be identified: defining the management unit, developing understanding, and creating planning and management frameworks. This paper draws on case studies of progress toward ecosystem-based management in Canada, the USA, and Australia to highlight lessons for implementing ecosystem-based management, and the need for new goals for it, in order to foster further, future development. © 1998 Elsevier Science B.V.

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1. Introduction

'Ecosystem management' increasingly provides the goals and framework for land, wildlife and protected area management. Broadly speaking, ecosystem management is the process of managing and understanding the interaction of the biophysical and socioeconomic environments within a self-similar, self-maintaining regional or larger system. Ecosystem management involves finding institutional and administrative, as well as scientific, ways of managing *whole* ecosystems instead of the often small, arbitrary management units that are found almost everywhere. This is not, in practice, an easy task, and certainly it is easier said than done. Moving ecosystem management beyond the rhetoric and empty adherence that have been the fate of many great new ideas in resource management is crucial.

A first step is distinguishing ecosystem-based management and ecosystem management. There is a difference, and it is important because the former emphasizes that what can be managed are the activities within the ecosystem, considered from an

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ecosystem perspective. Ecosystem management, sensu strictu, is conducted at smaller spatial scales and is the domain of ecological science (cf. Samson and Knopf, 1996). Ecosystem-based management differs from traditional regional planning and management in terms of its integrative, transdisciplinary focus.

A second basic step is recognizing that ecosystem-based management usually deals with sufficiently large spatial areas, whether they are regions, greater ecosystems or landscapes, that they are complex, interconnected, dynamic systems in which uncertainty is common and prediction difficult (cf. Grzybowski and Slocombe, 1988; Ludwig et al., 1993; Walters, 1986).

My approach to the problems of regional environmental planning and ecosystem-based management reflect a background that mixes theoretical and practical work, in ecology and in planning. Thus, the work summarized here is a synthesis of six years' effort in three areas: (1) the theory of ecosystem approaches in different disciplines, (2) the relation of ecosystem approaches to ecosystem science and environmental planning, and (3) case studies of the practice of ecosystem management from protected areas, regional planning, biosphere reserves and explicitly cooperative efforts. Case studies were most in-depth in western and northern Canada, Alaska, Australia, Russia, the Great Lakes Basin, Ontario's Grand River watershed, and the Regional Municipality of Waterloo.

My goal is briefly to link the theory of ecosystem approaches with lessons learned from several case studies of ecosystem-based management. After an introduction to the origins and principles of ecosystem-based management, lessons for implementing it are summarized with brief examples.

2. Origins

Ecosystem-based management derives in many ways from ecosystem approaches, most explicitly and immediately from environmental planning in the Great Lakes Basin and the Great Lakes Water Quality Agreement of 1978. Ecosystem approaches, from which ecosystem-based management derives conceptually, if not also practically, have been around for decades in disciplines ranging from anthropology to ecology (Golly, 1993; Moran, 1990; Slocombe, 1991, 1993b).

The view of ecosystem-based management presented here is conceptually based on ecosystem approaches. Broadly speaking, an ecosystem approach (i) describes parts, systems, environments and their interactions; (ii) is holistic, comprehensive, trans-disciplinary; (iii) includes people and their activities in the ecosystem; (iv) describes system dynamics, e.g., through concepts of stability and feedback; (v) defines the ecosystem naturally, e.g., bioregionally, instead of arbitrarily; (vi) looks at different levels /scales of system structure, process and function; (vii) recognizes goals and taking an active, management orientation; (viii) incorporates actor–system dynamics and institutional factors in the analysis; (ix) uses an anticipatory, flexible, research and planning process; (x) entails an implicit or explicit ethics of quality, well-being, and integrity; and (xi) recognizes systemic limits to action—defining and seeking sustainability (Slocombe, 1993a,b; see also Grumbine, 1990, 1994; Kay and Schneider, 1994).

The key is that the object of interest, whether family, ecosystem, or society is seen as a self-defining, self-maintaining unit whose parts interact both internally with each other and with their environment. Management interventions are needed due to disturbance, or to seek particular goals. More practically, ecosystem-based management derives from challenges and initiatives in protected areas, regional and environmental planning.

The lessons and links are clearest for protected areas. In the last 20 or so years, there was recognition that no park is an island, and even if it were a continent it would not be big enough: change happens, the (local) public matters, strict protection is not always best, a core and buffer zone approach may be most effective in the long term. Using good science, and fostering dissemination and acceptance of it are also important (cf. Ecological Society of America, 1995).

From experience in regional planning, watershed planning, regionalism, and bioregionalism, the lessons have been that good intentions are not enough; politics and bureaucracy can defeat almost anything; special, supernumerary government agencies do not last and usually accomplish little. People

think locally and personally; values, perceptions, and participation are important.

The lessons of environmental planning are harder to identify, which may say something in and of itself: regulatory and administrative add-ons are not enough; species-specific and site-specific approaches will only take us so far, and are undermined by the absence of wider ecosystem-based management; a diversity of approaches is good but a theory (or goal or concept) to pull it all together increases effectiveness (cf. Briassoulis, 1989).

3. Obstacles

The existence, variety and perhaps ubiquity of obstacles to ecosystem-based management and other integrative activities such as integrated resource management are well known. The following list is pretty typical; many of these problems plague most efforts at integrated or ecosystem-based, environmental management (cf. Cairns et al., 1994): (i) fragmentation and specialization in administration and research; (ii) competition within and between agencies and governments; (iii) arbitrary, politically defined management units; a structural and functional orientation; short-term, local and self-interested politics, and economic determinism; obscure terms and goals such as sustainability and integrity; top-down planning and management processes; and poor use of existing information.

It is important to distinguish between the goals ecosystem-based management is trying to achieve and the obstacles it faces. Sometimes it is tempting, or easy, to define goals in terms of what must be changed, or the obstacles that must be overcome. As discussed later, that is a mistake that confuses strategic and tactical thinking.

4. Lessons

This section draws on the experience and lessons of case studies of regions involving protected areas, land claims, conservation authorities, watersheds and river basins, and regional planning. An earlier paper identified three themes for ecosystem-based management—Defining Management Units, Developing Understanding, and Creating Planning and Management Frameworks—and provided detailed discussion of their origins, research needs and fuller case studies of several areas (Slocombe, 1993a). This section will be more selective and not focus on particular cases in detail; rather on the specific, tactical lessons of each. Table 1 provides a summary, elaborated in the text.

4.1. Defining management units

The first lesson is that the management unit must be meaningful, i.e., it should reflect distinguishing

Table 1
Practical lessons for ecosystem-based management

Defining management units	Developing understanding	Creating planning and management frameworks
· Use meaningful units	· Describing and interpreting many dimensions of the ecosystem	· Keep it simple, try not to layer new levels and organizations onto existing ones
· Be flexible; use multiple ways of defining units	· Make information available within and outside ecosystem	· Get top-level commitment and leadership
· Build on, but do not be constrained by existing units	· Use local and traditional knowledge	· Implement close to the ground and ensure there are some immediate, visible benefits and products
· Ensure, operational, in at least some way	· Be practical; when resources are limited focus on understanding that would make a difference	· Focus on management processes, information flow, and planning and target-setting
· Maintain higher administrative levels' interest in lower and newer units by communication, involvement	· When you have information, use it: analyze, map, simulate, discuss,...	· Maintain flexibility, and ensure reviews to foster adaptation

characteristics of a region that have significance to people within and outside the region. Meaningful units are often defined through comprehensive land claims, biosphere reserve, or bioregional processes. However vague some of its incarnations, the notion of a bioregion is good because of its breadth and link to local people and culture. A bioregion is more likely than most to be a region defined by its essence, including what people identify with (Aberley, 1993). The significance of place is important. Contrast this with the Canadian State of the Environment Reporting's use of biophysically defined ecozones as the basis for reporting in its 1996 national report: it is difficult to do and difficult for most to relate to. The implication is that units defined in narrowly ecological terms may not be much better as a basis for ecosystem-based management than those defined in narrowly economic or political terms.

The second lesson is to remain open to alternative management unit definitions. There is no single, best for everywhere, management unit (or process). It is important to be flexible on the basis for management units. A watershed approach may work well in some places, such as southwestern Ontario; in other places dominated by strong physiography, such as mountains, a geopolitical approach may be best; while elsewhere as in the Pacific Northwest, a more systematically bioregional approach may be best. Especially large, complex regions may require a combination of management unit definitions.

Nor should the possibility of significant change be dismissed out of hand. Planners and managers are quick to say ''but of course existing management units can't be changed'', for the sake of not appearing too idealistic. But why can't they? Such change happens for political reasons (as in Ontario in the early 1970s to create regional government), why not now for ecological–economic ones?

It is possible to build on existing management units; but one should not be constrained by them. A good compromise is to modify existing local/regional boundaries to match those of a watershed or bioregion. Defining a core for the ecosystem that is strong conceptually and administratively also fosters effectiveness. A single large or a network of smaller protected areas can work well, as in biosphere reserves. On a large scale, this is the situation in the Australian Alps, which lie in southeastern Australia extending roughly from near Canberra to near Melbourne (see also Good, 1995). On a smaller scale, Ontario's Regional Municipality of Waterloo is identifying and developing a natural, forest network of regional parks, private woodlots and watercourses, and environmentally sensitive policy areas as the core of the region.

Of equal, if not greater, importance is ensuring that the ecosystem-based management unit is more than just a name, ensuring that it is an administrative, operational unit. This may start slowly, but at least some programs and, hopefully, decisions must be undertaken at the ecosystem level from the start, or the unit will be meaningless and ignored.

As ecosystem-based management develops, and more decisions and management activities take place at the ecosystem level, another challenge is to devise ways to ensure higher government levels maintain interest and attention in the small, hierarchically lower units. Options include communication directly with higher levels, and advisory or oversight committees with very high-level representatives on them as in the Australian Alps Cooperative Management Programme. Table 2 provides some brief examples

Table 2
Examples from the Greater Kluane region, Yukon, Canada of good practice in defining management units

Lesson	Example
· Use meaningful units	· Defined by a combination of physical, cultural and economic characteristics
· Use flexible, multiple ways of defining units	· Significant units in the region derive from protected areas, land claims, and comprehensive regional planning
· Build on existing units	· Protected areas and traditional aboriginal territories involved
· Ensure units are operational, effective	· Overall, this has been least well done; although the protected area and land claims related units are changing this
· Maintain administrative levels' interest	· Done through promotion and attention to tourism, mining, and wildlife issues

of actions reflecting these lessons in the Greater Kluane region.

4.2. Developing understanding

The first priority has to be to describe many dimensions of the ecosystem and interpret them for their significance, history and relationships. There are few places in dire need of ecosystem-based management for which there is not a good, existing knowledge base. It may need organizing and synthesizing, but few management exercises use all the information that is available. The Australian Alps symposia on cultural and natural heritage are good examples of developing an initial synthesis as a springboard for future research and management (Good, 1989; Scougall, 1992). An important additional part of this is to monitor baseline characteristics as a means to spot and track change. The Canadian Parks Service has recently begun this, after years of policies explicitly forbidding monitoring of environmental variables simply because they might change, i.e., do not monitor unless there is a problem.

Equally important is making information available. It needs to be interpreted and presented in a range of ways. The conservation atlas produced by Conservation International and several local groups and agencies for Prince William Sound is a fine example (Thomas et al., 1991). Finally, the results of these efforts need to be disseminated, at least some of them free, and the rest at reasonable, probably not cost-recovery, prices.

In developing understanding of an ecosystem, it is important to use local knowledge, from aboriginal and non-aboriginal residents. If nothing else, these traditionally ignored groups often have deeper understanding of processes in the region, and particularly good knowledge of spatial, temporal and cumulative variation and events. The Canadian Arctic Resources Committee's Hudson Bay Program looking at cumulative effects of hydroelectric development is a particularly innovative and comprehensive example of an approach to acquiring and integrating the best scientific and traditional knowledge about a region (Sallenave, 1994; Sly, 1994).

There is a need to be practical, particularly if resources are limited. Focus research and understanding on what could make a difference to management. In the Australian Alps that has been visitation and recreation; in the Kluane region of the Yukon it is grizzly bears, water quality, and tourism.

Finally, when you have information, use it: analyze it, map it, simulate it, scenario it, experiment. Only thus will you consider possibilities, start to anticipate change and surprise, test your assumptions, and figure out what else you most need to know.

Table 3 provides some brief examples of actions reflecting these lessons in the Australian Alps region.

4.3. Creating planning and management frameworks

Planning and management frameworks should be kept simple where possible, as in the Australian Alps Liaison Committee, or Ontario's Conservation Authorities. Simple means characteristics like shallow hierarchies, clear chains of responsibility and decision-making, and specific goals and objectives providing criteria for decision-making. Sometimes frameworks can't be kept simple, as with many comprehensive land claims regimes. They can still work, but it is harder (e.g., Slocombe and den Ouden, 1993). A corollary to this is don't try to add on,

Table 3
Examples from the Australian Alps region of good practice in developing understanding

Lesson	Example
· Describe ecosystem dimensions	· Multidisciplinary symposia on the cultural and heritage of the Alps region
· Make information available	· From proceedings volumes to conference presentations, to computerized information systems
· Use local and traditional knowledge	· Perhaps least significant here, but increasing through local consultation
· Be practical	· Early focus on small, useful research projects related to key management issues across whole region
· When you have information, use it	· Research has supported management changes in, for example, grazing and recreational use

Table 4
Examples from the Australian Alps region of good practice in creating planning and management frameworks

Lessons	Examples
· Keep organizational structure simple	· A small coordinating (liaison) committee with stakeholder representatives, small working advisory committees, and a small central secretariat
· Get top-level commitment and leadership	· Done at the start, and continued through top-level membership of the liaison committee
· Implement close to the ground	· Early standardization and simplification of some regulations across parks in the Alps region
· Emphasize improving processes, informatiom flow, and target-setting	· Standard regulations, communication programs, and annual program goals and targets
· Maintain flexibility, and ensure reviews to foster adaptation	· Annual, and triennial reviews of progress, budget and structure

layering new agencies and structures on top of existing ones. This has failed in many places. Examples from my case studies include comprehensive regional land use planning in the Kluane and North Yukon areas (the southwest and northwest corners of Yukon, respectively); and, in fact, conservation authorities in southwestern Ontario (Mitchell and Shrubsole, 1992; Slocombe, 1992a).

Top-level commitment, as was achieved in the Australian Alps and in Kluane land claims (but not land-use planning), is critical. Without it, those from the top on down won't take anything new seriously. And without senior commitment it will be much harder to give the new framework and those working within it the power to make a difference, to deal with a real unit and manage it better. Leadership is an allied need; so is what the business management literature calls champions. Someone has to take the lead, and make the case for the new, ecosystem-based, management.

Part of managing ecosystems better, and making people see and appreciate the change, is implementing ecosystem-based management and the new framework close to the ground. This can include many activities and Hartig and Law (1995) provide examples in the Great Lakes context. The Australian Alps program did it well, starting simply with such activities as exchanges of agency staff across the ecosystem, standardization of practices and regulations, and information posters and pamphlets. Practical, rather than financial, incentives seem to have been most effective in generating support for ecosystem-based management. Incentives such as simpler processes, clearer regulations, new professional opportunities, and better access to information, all helped to make the Australian Alps program a success.

Starting simply often has the added benefit of helping to ensure immediate short-term results or benefits, e.g., clarifying processes for approvals; solving some simple administrative problems, and increasing tourism or support for it.

Ultimately, creating planning and management frameworks for ecosystem-based management needs to be concerned with processes of management, information flow, and planning and target-setting. Some fundamental redesign and reengineering may be needed. There are few places, however, where this will be feasible to a significant degree initially. Florida may be one exception, thanks in part to high-level government leadership (Florida Dept. of Environmental Protection, 1994). Hammer and Champy (1993) give many suggestions for fundamental process redesign that are transferable from business to the environmental management context.

Finally, it is necessary to maintain flexibility, and ensure reviews, to foster adaptation. Ecosystem-based management must be allowed to evolve and develop; it can no more be created, complete, from scratch than could regional planning. Be patient, and give it time.

Table 4 provides some brief examples of actions reflecting these lessons in the Australian Alps region.

5. Discussion and conclusions

It is difficult to sum up what is necessary to implement ecosystem-based management or, more importantly, what is necessary to make it work. On

Table 5
Comparison of substantive, knowledge-oriented tools and process, planning-oriented tools for ecosystem-based management (after Slocombe, 1993b)

Substantive methods	Process methods
· Multidisciplinary studies with integrative simulation and GIS methods	· Facilitated, representative, scoping workshops and ongoing consultation
· Comprehensive studies; using theory and detailed knowledge	· Incentives and methods for institutional cooperation
· Innovative approaches to evaluation, definition of criteria	· Consensus goal definition and related planning for their achievement
· Ongoing, multilevel monitoring	· Newsletters, consultation, to disseminate information
· Use expert and public knowledge to develop hypotheses and models	· Use to test, revise results, process
· Incorporate backcasting, scenarios	· Use visioning, scenario development exercises

the one hand, it is so many things, and on the other, it varies so much from place to place. Environment Canada (1995) identified five broad principles for ecosystem initiatives that nicely complement the framework developed here: ecosystem approach, partnerships, environmental citizenship, science and leadership. Many examples of all five of these can be seen in the examples discussed above, and elsewhere in the ecosystem management literature.

Perhaps the single best approach is to suggest that ecosystem-based management is a matter of using the right mix of new, and old, and appropriate tools (Slocombe, 1992b) Table 5. Most fundamentally, one must consider the goals and character of tools in choosing them. For example, an appropriate mix of prescriptive and descriptive tools and activities, and substance- and process-oriented tools is necessary. The latter distinction is highlighted in Table 2.

There are several points that deserve emphasizing. First is that ecosystem-based management is much more than simply a better form of ecosystem protection. It is not preservation; it is adaptive management (Walters, 1986) or conservation in the old, original sense of the word. Ecosystem-based management should lead to better protection of natural systems, but the rationale is jointly scientific, ethical, and economic. And preservation from all change is not usually the main goal.

Spatial and temporal interactions and patterns are at the center of ecosystem-based management (cf. Sample, 1994). Understanding them is a prerequisite for implementation, and a key goal of the 'developing understanding' component of ecosystem-based management. There is growing interest and expertise in spatial and temporal patterns, in fields as diverse as geography, economics, and ecology, and this will assist ecosystem-based management in the long run. The less quantitative side of this is the links between ecosystem-based management and the sense and management of place (cf. Kemmis, 1990). That link is one reason why I think ecosystem-based management should and will have more effect than sustainable development. It is inherently more tied to particular places and problems. Indeed, ecosystem-based management may be a critical means of implementing sustainable development.

Perhaps the greatest and most important challenge in ecosystem-based management, increasingly recognized, is identifying goals. Ecosystem-based management needs goals, but we are still struggling with what they should be. We often confuse goals and objectives with obstacles. 'Avoid fragmentation' is a weak goal, based as it is in the negation of something existent; 'developing coherent management of the greater such-and-such ecosystem' is stronger. Detailed and comparative studies of goals are still rare, but necessary (see Angermeier and Karr, 1994).

We need new goals for at least two reasons: (1) because at a fundamental level, ecosystem-based management cannot be either science or planning process alone, lest it maintain the status quo of priorities and problems within a new framework, and (2) because existing planning and management goals have not been good enough.

What is the best goal, or goals, for ecosystem-based management? There are strong contenders such as ecological health, integrity, sustainability, but they have not yet had much effect. Perhaps they have been used inherently wrongly, or perhaps they are not understood. Current research has identified a set

of criteria for ecosystem-based management goals (Slocombe, 1998). The criteria derive from the theory and experience presented here and elsewhere. Goals for ecosystem-based management need to reinforce its core characteristics and needs. For example, ecosystem-based management goals should: imply and reflect specific values and limits (normative), reflect 'higher' values and ethical principles and rules (principled), reflect the wide range of interests, goals and objectives that exist (integrative), work with, not artificially reduce, complexity (complex), accept and recognize the inevitability of change (dynamic), synthesize a wide range of information and knowledge (transdisciplinary), be applicable to a wide range of ecosystem types and conditions (applicable), involve people and actors (participatory), be explainable and operationalizable in a consistent way to different people and groups (understandable), and be inherently tentative and evolving as conditions and knowledge change (adaptive).

Most fundamentally, there need to be many goals, or one such as sustainability that can and must be broken down into others to be operationalized. The five goals of Grumbine (1994) are a good example of such a set: maintaining viable populations, ecosystem representation, ecological processes and evolutionary processes, and accommodating human use in light of the first four. Suites of goals are needed because ecosystem-based management is not simple, or quick, or the same everywhere.

As I commented at the end of the last section, ecosystem-based management must last and evolve: good practice can almost never be invented quickly, from scratch. What is critical, as for any great project or journey, is beginning. This paper has tried to synthesize some lessons for beginning, and to identify some directions for continuing.

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