Appendix 4.1

The following material is Appendix 4.1 for Chapter 4 of: Fowler, C.W. 2009. Systemic Management: Sustainable Human Interactions with Ecosystems and the Biosphere. Oxford University Press

1 What should management applied to ecosystems include?

This appendix is a brief consideration of the who, what, how, and why of “ecosystem management” as described in the literature. It demonstrates complexity and conflict when definitions are attempted on the basis of conventional science and perception of ecosystems. Conflict is experienced, often in lack of consensus. Although there are a number of common elements, surveys of the literature show that, there is no commonly accepted definition of “ecosystem management” or “ecosystem-based management” (Agee and Johnson 1988, Arkema et al. 2006, Christensen et al. 1996, Clark et al. 1991, Costanza et al. 2000, Francis 1993, Francis et al. 2007, Grumbine 1994, Kay 1993, Keddy et al. 1993, Malone 1995, McCormick 1999, Moote et al. 1994, Pikitch et al. 2004, Schaeffer and Cox 1992, Stanley 1995, Toman 1993). More often than many are comfortable with, the claim is made that we are already doing ecosystem management; clearly, we are influencing ecosystems, but is our influence sustainable?

Most of the literature describes or suggests desirable components of management or adds to the list of factors, elements, processes, and other things that should be taken into account (pieces of complexity, or fragments of reality stakeholders and managers are supposed to think about, consider, or discuss; top row Fig. 1.1). The desirable components of management fall into the categories of who should do “ecosystem management”, how it should be done, what should be managed, and why. Each publication places different emphasis on each of these components and a sense of indecision emerges stemming from the complexity of “ecosystem management” as an extension of conventional management with emphasis on the transitive. There is a clear lack of consensus on how a balance can be struck in view of the diversity of opinion regarding a variety of often opposing points of view. There is frequent call for something different to deal with the impasse (e.g., Salwasser 1993).

In the existing literature there is frequent mention of the need to consider the genetic effects of human activities or concern about the coevolutionary reactions among species to human influence (e.g., Brown and Parman 1993, Kendall 2007, Law 2001, Law et al. 1993, Mangel et al. 1996, NRC 2006, Orians 1990, Sutherland 1990, Thompson 2005). In actual management, however, these issues are considered less in management at all levels of biological organization than are matters of products, goods, and services and their economic value. Evolutionary/genetic effects are of even less concern in the literature when we consider ecosystems (even rejected scientifically, e.g., Golley 1993). Scientists appear to be more concerned than are managers and their concerns seem to relate more to loss of genetic diversity than change in species-level characteristics and their consequences.

The literature identifies a wide variety of people who should be involved in “ecosystem management”. Among those are scientists from various disciplines, especially those involved in integrating and synthesizing information. Included are elected officials, their constituents, staff, executives and administrators, government agencies, international bodies and organizations, representatives of various communities (including local private interests and landowners) and people, institutions,
and businesses that use resources. The breadth of involvement suggested above is intended to encompass the widely differing (often opposing) objectives of the groups represented. Collectively these are the stakeholders identified as important to the process of setting policy, establishing goals, and making decisions in their position represented in the top row of Figure 1.1.

The qualities brought to management by people identified above are also deemed important. A variety of experiences, professional qualifications, and skills have been emphasized, whether for individuals or collective management groups. It has been suggested that management personnel work independently, be interdisciplinary, and show interagency, political, and economic expertise through integrated coordination. Responsibility for decisions is often emphasized. Mixes of appointed and elected participation have been suggested. The institutional inadequacy of existing management (e.g., Clark et al. 1991) is recognized and results in emphasizing inclusiveness, breadth, and commitment to abide by decisions made. The reaching of consensus and resolution of conflict is left to human design. To improve on this, special training is advocated to bridge the gap between science and management (Brosnan and Groom 2006).

The variety of suggestions for what should be managed to constitute “ecosystem management” reflects the history of ecosystem science. More importantly, it reflects the prevailing concept that management is largely a matter of transitive manipulation. Such approaches often seem to be in opposition to means of ensuring long-term sustainability for future generations of humans in ecosystems exhibiting natural states and processes capable of supporting humans. This often emerges as conflict between what are called the biocentric (that value forms of life at the ecosystem level, future options and natural states) and the anthropocentric camps (that place more value on meeting human needs for the short term, Stanley 1995).

Based on conventional approaches, components of ecosystems, populations, and species are often seen as options for management. Some publications emphasize control over ecosystems and their elements as an option; others focus on regulation of human activities as the approach that emerges as the only viable option in this chapter. Processes and functions identified as subject to management include flows of nutrients and energy, and interactions and relationships among species, especially human resources. The need for holistic approaches is expressed in words such as landscape, systems, network, community, array, total, and global. Abiotic components of ecosystems are included in management of habitat (including soils) and there is concern about global warming and pollution.

Although manipulation to meet human need is seen as part of “ecosystem management” (Allen and Hoekstra 1992), it is recognized that limits to such activities must exist. Although there is no agreement on how to go about establishing such limits (or find a balance, Stanley 1995), management with humans as the subject of management has been suggested as one alternative. The limitation and regulation of human activities and influence is often considered part of “ecosystem management”, and is often recognized as the only part of the system that can be controlled.

On the other hand, the characteristics of managed units are often seen as available for manipulation or control. At the ecosystem level, such characteristics include variability, productivity, mean trophic level, species numbers or diversity, organization, integrity, health, homeostasis, structure, processes, patterns, composition, heterogeneity, boundaries, and equilibrium. The holistic nature of ecosystems is evidenced by the use of words such as integrity, bioregional, entirety, viability, order, dimensions, irreducible wholes (and whole systems), geographic, complexity, and interdependence.

More than anything else, the literature on management has identified “what should be taken into account” in “ecosystem management”. This includes uncertainty, instability, unpredictably, evolution, dynamics, change and variability, time, area and space (including parks and preserves), flows of materials and energy, cycles, physical components and environment, extinctions (natural and human caused), aggregation, species-level issues, ecosystem responses to stress, complexity and levels of organization, nonlinear nature of interactions, interconnectedness, whole system properties (e.g., ecosystem attributes, including the fact that they are open systems and exhibit emergence), history,
spatial heterogeneity and fragmentation, carrying capacities, responses of ecosystems to stress, limits, overpopulation, rarity, naturalness, and extinction. Although this is only a partial list of factors that various authors have listed as important to account for in “ecosystem management”, it exemplifies the complexity of biotic systems in general (and scratches the surface of the complexity of reality, Appendix 1.1). It also illustrates the guaranteed conflict when various people or organizations support one element over another. In the end, collective consideration of such lists emphasizes that we must account for reality/complexity.

Much of the existing literature recognizes that to be operational, a definition of “ecosystem management” must include specified activities. These include what managers are often asked to do: assess options, consider and integrate information, apply standards and reference points (normative information, often seen as lacking), plan, establish policy, evaluate, cooperate and coordinate, assess risks, identify and define problems, implement legislation, establish programs, educate and communicate (including journalism), authorize specific actions, and implement programs and decisions. The activities of scientists in providing information is also included: application of technologies, information integration and synthesis, measurement, analysis, experimentation, inventory, monitoring, providing data and information on natural principles (contribute to perspective, paradigms, ideas, concepts), recommending actions, educate, assess (resources, risks, benefits), interpret, identify and define problems, and conduct studies and research. In carrying out management to achieve ecosystem states, control and manipulation are frequently mentioned. Often the components of ecosystems are to be manipulated. But the main subject of effective control is the human element. Human activities should be restricted in order to protect or promote certain characteristics for resources and ecosystems. Other activities are promoted in support of humans as elements of ecosystems. These include subsidizing and mitigation for ecosystem responses, undertaking captive breeding, and directed exploitation, or alteration of environment.

It is often proposed that management activities should be conducted with democratic, collaborative, and consensual approaches with emphasis on integration (combined or collective approaches), and holistic or global breadth. There is clear desire for predictive capacity, and the difficulty or impossibility of ever achieving it is recognized. The utility of modeling in such cases is often emphasized and in other contexts the limits of such approaches are recognized. Flexible, experimental, adaptive approaches are often emphasized (Holling 1978, Walters 1986, 1992). The magnitude of risk involved in failed trials arises in conflict with this suggestion.

Motivation for developing a clear definition of “ecosystem management” stems from recognition of clearly important objectives, goals, and desired outcomes. The conflicting nature of many of the goals is clearly emphasized. Minimizing risk is often in opposition to yields, services, products, commodities, and the multiple uses of various elements of ecosystems. Preventing extinctions, maintaining biodiversity, conservation, care, and sensitivity to environmental issues are in conflict with human needs in the realms of the economy, health, and resources. Sustainability is recognized as a step toward finding a balance among these conflicting forces and is often presented with the word “development” to emphasize the need to avoid disregard for human needs. Long-term objectives are suggested to be necessary to account for the longer time scales of ecosystem dynamics. Preservation (especially of biodiversity) is seen as important but often in conflict with meeting human need. Undisturbed ecosystems are valued for their contribution to knowledge of natural baseline ecosystem characteristics.

The preservation of nature is recognized as relevant to the future of humans as a species and is part of the concept of sustainability and intergenerational need. This is emphasized in the goals of renewability, continual availability, preserving options for the future, and the need for resources lasting into perpetuity as long-term objectives. These, however, are in conflict with the short-term goals of socioeconomic and political forces in meeting day-to-day utilitarian needs. Optima are seen as balance (Fuentes 1993) wherein maintaining healthy ecosystems includes long-term human goals such as avoiding extinction. Harmony,
altruistic, therapeutic, spiritual, ethical, and aesthetic issues arise when trying to balance use and protection, or short- and long-term objectives.

To understand these conflicts as natural, one must understand the human species from biological, ecological, and evolutionary perspectives. Evolutionary forces behind the need to consume, survive, and reproduce, for example, are in opposition to the forces of ecosystems that both set limits and provide resources. Finding a balance is one of the challenges in defining an operational form of management.


A strong pattern in most of the literature listed above is the theme of expressed support for involving stakeholders, scientists and managers in decision-making in regard to setting objectives and policy as depicted in the top row of Figure 1.1. This is in contrast to the roles to which people are confined in systemic management (bottom row of Fig. 1.1) wherein posing questions, empirically observing things consonant with management questions, and carrying out management to avoid abnormality are the responsibility of all stakeholders.

References


Ecological integrity and the management of ecosystems. pp. 61–79. St. Lucie Press, Delray Beach, FL.


