Ecosystem-Based Management
Lessons from recent applications in Terrestrial and Marine Settings

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Much has been written and published on the theory and technologies supporting Ecosystem-based Management (EBM). Less information is available about the application of EBM in real world settings. While the theme of most papers in this collection is marine and/or fisheries-based, this paper uses some examples of EBM in both terrestrial and marine environments to illustrate important lessons related to socio-economic and political factors influencing implementation of EBM. The examples are drawn from the work of Sand County Foundation and its resource managing partners across North America. Each builds upon a definition of EBM that accepts imperfect information about all components and processes, that seeks to address uncertainties and dynamism through an adaptive management framework, that focuses on a limited but critical set of driving forces within the ecosystem (especially the human forces), and that incorporates research and ecosystem modeling as means to engage local resource users rather than alienate them.

Sand County Foundation

The roots of Sand County Foundation are private action inspired by the Leopold Land Ethic, using responsible voluntary means to improve habitat. Today, the role of Sand County Foundation has expanded from caretaker of the Leopold Memorial Reserve in Wisconsin to advising the managers of hundreds of thousands of acres of land in several countries. The Foundation works with private landholders to improve the quality of their lands through science, ethics, and incentives. The Foundation's objective is to learn from, encourage, and where appropriate, assist citizen-based conservation projects that incorporate multiple landowners, a commitment to ethics and incentives, monitoring, independent review and a willingness to share the social, economic and environmental outcomes with others. It is through the Foundation's own landowning experiences and those of our landowning and resource managing partners that it has developed important perspectives on ecosystem-based management. Several of those perspectives are illustrated in the case studies that follow.

Ecosystem Based Management and Endangered Species – Thunder Basin

An evolving experiment in ecosystem-based management is being played out on the eastern foot hills of the Rocky Mountains in Wyoming. This landscape, like much of the western U.S., has a significant public lands component [Thunder Basin National Grasslands administered by the U.S. Forest Service (31%), Bureau of Land Management lands (4%), state lands (6%)] and a long history of human and wildlife use.[1] On and around the Thunder Basin National Grasslands, local people, led by dozens of rugged and

[1] Betty Pellatz, *Thunder Basin Grasslands Prairie Ecosystem Association: An Introduction*, PROCEEDINGS FROM THE SECOND GRASSLANDS SYMPOSIUM OF THE THUNDER BASIN GRASSLANDS PRAIRIE ECOSYSTEM ASSOCIATION, 4-7 (May 12-13, 2004).

individualistic ranchers, have taken the initiative to adopt an ecosystem-based approach to secure the future sustainability of wildlife habitats as well as that of their ranching operations. They have been joined and supported by coal companies, conservation organizations, and ecosystem scientists, as well as federal land managers and other state and federal agencies.

What brought this disparate set of players together? What motivated them to depart from their traditional agricultural focus to embrace a foreign sounding scientific word "ecosystem?" As with most unifications of traditionally opposing forces, they were bound together in an effort to manage external threats. In this case, the local people on a remote and windswept million acre landscape spanning several counties were facing federal intervention surrounding several listed and candidate endangered species. Federal action by the U.S. Fish and Wildlife Service was sure to render ranching, already an economically marginal land use, untenable, and to greatly restrict the ability of coal companies to recover the areas' rich source of energy resources.

Initial concern arose around only a few species. Black-tailed prairie dogs and white-footed ferrets were the most visible and contentious mammals. What is notable, however, is that while Federal regulations would have led to management selectively favoring those species, the local people chose a different path.

Forming the Thunder Basin Grassland Prairie Ecosystem Association (TBGPEA), this group of ranchers and industry representatives looked beyond the urgency and political implications of single species management. Their long history on the landscape reinforced their belief that there was room enough, if implemented at a large landscape-scale, for all plant, wildlife, and human activity. The young Association had taken the rare and extraordinary leap from ranch-by-ranch, year-by-year paradigm to an ecosystem vision that incorporated change over large areas and decades. They set out for themselves the aggressive goal of sustaining a matrix of habitats and populations, across the entire landscape, which would sustain ALL native species long into the future, while also incorporating livestock grazing and other permitted uses such as mining.

To accomplish this monumental task, the Association recognized some key needs. First they needed the buy-in of a sufficiently large number of ranchers. This was no small accomplishment. Second, they needed a compelling and credible ecosystem assessment of range condition, habitats, and species populations. And lastly, they needed the resources to sustain and grow their young organization and science effort.

The Association initiated an ecological assessment of the planning landscape, with a significant field effort in 2003. This assessment is characterizing the landscape in terms of ecosystem diversity that will be a major focus of their ecosystem management plan. The ecological assessment and ecosystem management plan will use an historical reference approach to address the ecological objectives. This approach will identify and quantify the array of ecosystems in the landscape that occurred under historical disturbance regimes, and subsequently will identify threshold levels for amounts of each ecosystem that must be represented and distributed within the landscape to meet the

ecological objectives. The appropriate distributions and amounts of each ecosystem are checked using an assessment of the viability of selected species to assure that adequate threshold levels have been identified. This approach should provide the required habitat conditions for all native species within the landscape.

The overall process being undertaken by the Association is being conducted in three parts. The first part of the plan is the on-going ecological assessment of the landscape. The second part is the development of an ecosystem management plan and conservation strategies for selected species. The third part is the implementation of this plan and establishment of conservation agreements. The ecosystem management plan will provide the basis for either individual landowners or for a group of landowners to enter into appropriate conservation agreements with federal and state regulatory agencies.

Western U.S. landscapes or other places with significant public land ownership represent both opportunities and obstacles to ecosystem-based management. Opportunities abound because the semi-arid nature of the lands means that management units are by necessity quite large and relatively intact. Additionally, human population tends to be low and dispersed. However, the internal and external demands for multiple use and nature protection on public lands are high. These factors result in administrative and regulatory obstacles to ecosystem-based planning. Groups like TBGPEA are overcoming these obstacles by creating a citizen-led initiative spanning public and private ownerships that address the multiple use mandates of western landscapes.

Co-management of state regulated wildlife species – Kinzua Quality Deer Cooperative

Context and scale have been recognized as important elements of ecosystem-based management. Ecosystem processes operate over a wide range of spatial and temporal scales, and their behavior at any given location is greatly affected by surrounding systems. Thus, there is no single appropriate scale or time frame for management.

Many state wildlife management regimes operate on spatial scales that do not allow for sustainability at the level of land ownership or resource user groups. One example of this disconnect has emerged in the Lake States and Northeastern U.S. in relation to state management of white-tailed deer. Deer population targets and management strategies (primarily regulated through hunting season and bag-limit restrictions) are often established at spatial scales driven by coarse data availability and which do not accommodate localized deer impacts to farms, forests, and other species' habitats. In these circumstances, local coalitions devoted to monitoring and managing at a finer scale and in response to local objectives can be advantageous.

The Kinzua Quality Deer Cooperative, which formed in 2001, is one such attempt. Private industrial forest land owners (Kane Hardwood/Collins Company, Forest Investment Associates, and RAM Forest Products), together with the Allegheny National

Forest, and a Municipal watershed (Bradford Municipal Water Authority), entered into a 10 year agreement to manage deer in an ecosystem-based framework. They worked closely with local landowners and deer hunters who utilized the area to collect wildlife and forest condition data across a 75,000 acre unit of McKean County, Pennsylvania. Extensive baseline data on forest vegetation and deer population indices was established in the first several years. Subsequently, the Cooperative (KQDC) worked with other interest groups to develop some devolved authority for deer management. In response to these efforts, the Pennsylvania Game Commission developed the DMAP (Deer Management Assistance Program) in 2002 which allowed groups who had developed credible, place-based deer management plans to request allocations of special antlerless deer hunting permits to be distributed among hunters. Utilizing these permits, KQDC and public deer hunters, have reduced the average over-winter deer population by 50% (approximately 31 deer per square mile to approximately 16 deer per square mile) in just a few years, while measurably improving the quality of deer, as measured by body weight, age, and antler development. This, in turn, has resulted in detectable improvements in forest habitat diversity and commercial tree reproduction and growth.

On-going monitoring is aimed at understanding the pace and pathways of forest recovery from decades of over-browsing by white-tailed deer. Additional work is being done to evaluate the response of other forest species, such as ruffed-grouse and neotropical songbirds, to improving forest structure and diversity. Additionally, longitudinal studies of hunter participation in the KQDC experiment are assessing hunter recruitment, attrition, and hunting effort under lower deer density conditions. The leaders of KQDC believe that continued success in management at a finer spatial scale than is practical through traditional state regulations is achievable and that KQDC offers one model of how to accomplish this.

The KQDC highlights the limitations of traditional scales of regulated wildlife management and opens the possibility of a more flexible approach to geographic scale. Scales that are tailored to local ecosystem function offer advantages. It engages local landowners and helps them form a shared vision for habitat, wildlife, and other economic and recreational uses with sportsmen and others. This, in turn, tends to reduce social conflict and improve economic sustainability of forest ecosystems. Shifting the geographic scale of wildlife management and devolving authority to regional cooperatives also offer the advantage of moving the temporal scale of planning out of the state political realm (which tend to operate on short electoral cycles) and into the forest resource planning scale (which in hardwood forests spans 50 to 80 years). Overall, the finer geographic scales permit adaptive management in response to a more detailed understanding of ecosystem behavior.

Area-based management by Sea Urchin Harvestors – San Diego Watermen's Association

Application of ecosystem-based management to fisheries has been a controversial and complex undertaking. One effort, led by a group of fishermen in southern California,

offers promise in overcoming the controversy and reducing complexity. A small but growing group, The San Diego Watermen's Association (SDWA), was formed initially among local sea urchin harvesters, but is expanding to include lobstermen and a local seafood processor. It has also been open to the input and involvement by wharf owners, California Fish and Game, regional and national conservation groups, and Sea Grant and University scientists. A handful of urchin divers began with the objective of improving their sustainability and profitability by sharing data about location and timing of harvests, as well as some key attributes of the size and abundance of urchins collected in the course of their commercial diving. These steps were motivated by the fishermen's mistrust of the California Department of Fish and Game's sampling data which forms the basis for regulation. Some divers also worried about the implications of California's implementation of marine protected areas (MPAs) and/or closed areas. These divers recognized the importance of developing proactive management proposals for where and when to fish so that regulations and the siting of MPAs would enhance stocks and not render the fishery uneconomical. Finally, early leaders of SDWA recognized the disincentives in the current permit system that discouraged the participation of divers in data sharing, planning, and habitat enhancement.

Once data sharing and mapping was underway, SDWA objectives quickly expanded as initial data suggested: (1) the information could lead to more efficient and profitable harvesting; (2) aggregated data provided a more complete and credible picture of resource condition; and (3) systematic and cooperative management among the historically competitive harvesters offered new opportunities to invest in habitat (kelp bed) enhancements that would boost productivity of the ecosystem.

Working with California Sea Grant marine scientists at UD Santa Barbara and Dr. Ray Hilborn from the University of Washington, the SDWA created their own on-board data collection systems and developed predictive models of how various harvesting strategies would affect total landings. Some divers began, with support from SDWA, to collect data outside of seasons and traditional fishing areas. The group began to investigate how their harvesting might be impacting the reproductive rates of urchins. They cooperated in studies to identify key spawning areas and patterns of spawn dispersal. A whole new world has begun to open from this small set of fishermen, who no longer see their state permits as merely a license to fish, but rather as a valuable asset that invites their full commitment and creativity to devising plans to enhance that asset's long-term value. A clear indication of buy-in by harvesters is their imposition of a tax on themselves to help underwrite monitoring, planning, and research.

This new paradigm has led to a proposal for an area-based management pilot program in the San Diego fishery. Such fisheries, sometimes called Territorial Use Rights Fisheries (or TURFs), have been successfully used in small scale settings around the world, in some cases for centuries. These area-based approaches assign rights to resource users over a specific geographic area. The rights holders cooperatively define the rules by which rights holders will operate, oversee monitoring, invest in research, and adaptively manage the coastal area.

While current anti-trust court opinions have shown greater receptivity to such cooperative harvesting arrangements, there remains a strict legal prohibition of marketing agreements that could be considered anti-competitive. This distinction between harvesting and marketing cooperatives may be open to reconsideration as the environmental benefits that accrue from better management and the increasing fungibility of global markets outweigh the strict enforcement of local commodity cartels.

The emerging model of ecosystem-based management in the San Diego near-shore fishery enjoys several advantages. The first centers on scale. It is a relatively small area, which allows for pilot project status as the state works through the policy implications associated with devolving some regulatory authority to a local association of fishers. The limited geographic extent of the initiative also limits the cost and complexity of collecting data and developing management models. The San Diego ports are also home to a small number of commercial participants. While coalition building is still a major focus of SDWA, the number of active permit holders is small enough to hold down the transaction costs among participants. Communication and education (e.g. training in the urchin monitoring protocol and software) are conducted among people who know each other and done mainly face-to-face. The second advantage centers on the nature of the resources themselves. Near-shore and off-shore fishing fleets are fairly distinct, and thus are not competing in their fishing activities and gear. The initiative has started with sea urchins, abalone and lobsters as natural allies. Some of the fishermen hold permits in multiple fisheries. Lobster trapping benefits from control of the urchin population as those species compete for some aspects of habitat. These species are also relatively sedentary, spending most or all of their life cycles within the management area. This simplifies the modeling and management planning. Lastly, stocks are considered healthy. The primary impacts to stock abundance and quality come not from overall fishing effort, but rather from terrestrial pollution and other external environmental impacts. All of these factors tend to reduce the complexity and controversy surrounding implementation of experimental management regimes.

Conclusions

Ecosystem-based management does not spring into existence in complete and final form. Each of the examples above demonstrates a different course and trajectory toward understanding and managing increasing sets of components and functions within ecosystems. And each also highlights the incremental development of such enterprises.

Generally, willingness to step beyond a traditional single resource approach emerges as a response to economic and regulatory hardships. A shared vision of how to move beyond traditional modes of conflict must be developed and this is often aided by the intervention and facilitation of groups like the Sand County Foundation. Individuals and groups in the role of facilitator must have credibility and independence.

Early stages of EBM initiatives are typically marked by assessments of resource condition and abundance, identification of threats, and enumeration of management

options. These processes can be enhanced through relationships with scientists, agencies, and conservation organizations. External funding is usually critical in these stages.

Early stage EBM practitioners often view the ecosystem, including the resource users, through the prism of one or more ecosystem components. It might be livestock, white-tailed deer, or kelp. It is rarely, if ever, an abstract, dispassionate and objective concern for "the ecosystem" that will motivate human action. What is important to observe from these examples is that each group's expanding ecosystem perspective emerged from a shared understanding of others' resource priorities and their commitment to understanding how various resources relate to one another within the context of a single ecosystem.

The abovementioned examples underscore that ecosystem-based management, indeed ecosystems themselves, incorporate and depend upon ecosystem service users. Ranchers, foresters, farmers, and fishermen need to recognize and exercise more responsibility for ecosystem performance. Regulatory agencies need to accept that careful devolution of resource management authority to local individuals is essential for catalyzing better resource stewardship. Ecosystem-based management will only succeed in those instances where responsibility is rewarded with stronger rights.

This co-dependent equation is most famously encapsulated by Aldo Leopold:

> Conservation means harmony between men and land. When land does well for its owner, and the owner does well by his land; when both end up better by reason of their partnership, we have conservation. When one or the other grows poorer, we do not.[2]

If EBM is to become a more successful resource management paradigm, advocates and practitioners must be realistic and flexible about how EBM is implemented in the real world. There is no blueprint for such processes. This paper suggests the importance of documenting the myriad examples of EBM playing out on land and at sea in order to inform future efforts.

[2] ALDO LEOPOLD, *The Farmer as a Conservationist*, *in* 45 AMERICAN FORESTS 6, 294-299, 316, 323 (1939).