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ECOSYSTEM MANAGEMENT

The Crucial Role of "Process"

Resource management is driven primarily by legislative and judicial directives and by agency mandates. The most successful programs, however, are those driven by public values as well. These values are derived from any number of sources, including community plans, business and agricultural needs, conservationism, and personal philosophy. Incorporating public values into a management plan and building public support for it require a well defined and carefully executed process.

This article focuses on the key steps in that process. It relies most heavily on the New Jersey Pinelands management program and the Chesapeake Bay program. It also draws from the author's experience, including a watershed management study of the Great Swamp in New Jersey, the Virginia Chesapeake Bay Program, the Northwest Watershed Restoration Partnership Conference, the Barnegat Bay Estuary study, and Adirondack Park's Warren County water quality study.

BALANCING SCIENCE AND VALUES

In managing natural systems, facts discoverable by science and engineering must be balanced by social values and goals. But, our knowledge and the values underpinning resource goals are constantly evolving. The important resource management questions of our day cannot be addressed with a set of absolute answers. Rather, they must be addressed based on the best current information and current values, with full cognizance that

the policies and strategies adopted are never final.

It is quixotic to believe that we will discover simple, elegant, and universal answers to resource management questions. Complexity, variability, and diversity are hallmarks of the natural environment. At the same time, a wide spectrum of human interests extends across and intertwines within this complex milieu. Therefore, the reality of public resource management is a perpetual and open-ended process of discovery and compromise, of substantial success as well as backsliding.

Sustainability as a Vision

In the struggle to find effective strategies to maintain a stable and sustainable environment, managers, policy makers, and the public are discovering the limitations of a philosophy based on subduing the earth and making economic use of all resources. As an alternative, the concept of sustainable development is gaining widespread acceptance as a vision of how society should function. Disagreements exist on the sustainability of particular resource or land practices; people are loath to acknowledge that they engage in unsustainable behaviors. Nevertheless, there is consensus on the central objective of sustainable development: economic activity that leaves an undiminished and unimpaired stock of environmental goods—such as topsoil, clean air, potable water, forests, and diverse plant and animal species—to future generations. Resource depleting and environmentally destructive practices must be replaced with strategies designed to restore resources, establish sustainable rates of use, and foster resource stewardship.

Managing ecosystems so that multiple biological species function as part of an integrated natural community and natural characteristics are retained may be the most effective way to assure the survival of species at risk while also providing natural functions that benefit humans (e.g., retarding floods, filtering and absorbing nonpoint pollution).

Dampening the Rhetoric

In North America, resource management planning takes place amid radically conflicting views, based on a mixture of science, romanticism, personal philosophy, and economic need. Those views are strongly held and passionately argued.



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The result can be paralysis of the decision making process.

Amidst uncertainty, one reaction is to protect all resources, which quickly leads to closure of all areas. This approach discounts resource-based cultures and industries. Even the most obscure species, if not observed in significant numbers in enough places, is valued over employment or resource use.

Against a backdrop of hand wringing, contradictory claims, shrill argument, perpetually "incomplete" studies, and conflicting objectives, is it any wonder that resource managers are stymied on how to go about their jobs? It seems that whatever management tactic is proposed, it is met with a howl of protest from some quarter. Fortunately, evolving practices of public involvement and problem solving are helping to achieve consensus for some programs.

MANAGEMENT STRATEGIES

Concepts With Similar Aims

Integrated resource planning, ecosystem management, biodiversity, and watershed management are allied concepts. Arguably, these phrases describe concepts or programs that overlap in the geographic area of concern, philosophical approach, final objectives, and technical strategies. All are rooted in the following similar goals:

- minimize adverse impacts;
- understand natural, physical, and economic relationships;
- establish multi-objective goals that include ecological, community, and business needs; and
- institute management strategies to achieve those goals.

Whatever their resource focus, management programs must be flexible in responding to expanding knowledge and to the changing needs and values of society. They must be comprehensive in the scope of issues addressed and inclusive in determining who is involved in, first, debating and setting goals, and then, developing strategies to achieve them.

Integrated resource planning (IRP) is typical of such programs. Its principal concepts, borrowed from the electric utility industry, have been adapted to natural resources. The central features of IRP include:

- consider multiple options for efficiently matching resource supply to consumer demand;
- open the decision making process to new ideas and interests;
- recognize that uncertainty and change are endemic to long-range planning; and
- evaluate planning decisions from a regional and societal perspective as well as an agency perspective.

Instilling sustainable development and stewardship ethics requires reshaping the way in which Americans engage the natural world. This is not work for a few policy makers, biologists, and volunteers. It will require significant debate and agreement at many levels in government, the community, and business.



The supply and demand aspect of IRP does not suppose that resources be consumed in the traditional sense of the word. Rather, supply is what is wanted by those making the demands. Wilderness, for instance, can be a "supplied" resource, and the consumer is the public-at-large.

Basic Objectives of a Program

A sound ecosystem management program is one that can address ambiguity and uncertainty. Ambiguity comes from conflicting values and directives; uncertainty comes from the failure of a program to be definitive. Species protection offers an example. A challenge is to get away from the single-species protection approach and the "save-it-all-until-we-figure-it-out" philosophy, and develop tactics that address broad ecosystems and clearly define goals and the strategies that will be employed to achieve those goals.

Today, our forests, wetlands, headwater watersheds, and other sensitive eco-

systems often appear as islands in a sea of disturbed land. Biologists and resource managers have been aware since Darwin's work in the mid-19th century that a relationship exists between habitat size and species composition. An integrated system of connected, large natural areas is necessary to protect biological diversity. Species based strategies may only protect selected species over the short term. Species level approaches must be augmented, or even replaced, by regional level strategies that recognize broader ecosystem patterns and processes.

The patterns and sizes of ecosystems must be managed to prevent extinction of plants and animals and to maintain and enhance ecosystem functions. The interplay of nodes of "wilderness," and connecting corridors for species flow between nodes is important when designing a larger scale management plan. Adaptive use may allow areas to be managed in a dynamic pattern. The mirror image of this ecological model is the system of the built environment: the towns (nodes) and highways (corridors) of human culture that are vital to the biological and economic success of our species. Nodes and corridors for sustainable ecosystems and water quality are as important as towns and roads are for human settlement and economic growth. As a society, we must strike a balance between serving the needs of both the natural and the economic systems—a task that requires difficult choices.

Education will play a major role in achieving this balance. Instilling sustainable development and stewardship ethics requires reshaping the way in which Americans engage the natural world. This is not work for a few policy makers, biologists, and volunteers. It will require significant debate and agreement at many levels in government, the community, and business.

Laws will have to be redrafted to acknowledge the interconnections among resource and social objectives. For example, most laws regarding the natural environment do not mandate protection of biological diversity; these laws are not directed to ecosystems as a whole. Instead, they aim to protect particular resources, such as a species with a dangerously low population level or the quality of water supply sources used for drinking water. Likewise, resource oriented laws

are almost universally silent on economic and social concerns that must be incorporated into resource management.

In the past, the management choice has been cast as jobs *or* the environment. We are discovering, however, that it is possible, and desirable, to have jobs *and* the environment with multi-objective programs that many people help create and actively support.

ESTABLISHING SUCCESSFUL PROGRAMS

By their nature, management initiatives addressing broad geographic areas include a wide range of interests. They must encompass conflicting objectives and consider various approaches to solving problems. These initiatives must find ways to place values on many intangible qualities and conditions. The size of a region, the diversity and complexity of its environment, the breadth of interests, and the difficulty of having sufficient data to support decisions are major contributors to inertia.

Recent management planning efforts surrounding the northern spotted owl and other timberland issues in the Northwest illustrate what can happen when there is a complex brew of agencies, mandates, resources, and values. Some problems are institutional, such as agencies having changing, contradictory, and overlapping missions. Other problems reflect the philosophical debate over whether to permit limited use of a resource or require absolute preservation. Even apparently clear cut alternatives and policies have unintended consequences. For example, setting aside old-growth forest and suppressing fire to achieve one set of objectives has allowed fuel loads to increase and insect infestations to be largely unchecked. A fire in a heavily fueled forest causes greater damage to plants and the soil, and hence to fish and wildlife, than a fire sweeping through a managed area. As knowledge expands, policies deserve re-examination.

Ecosystem management programs have been implemented in many parts of the country. Two well established programs are in the New Jersey Pinelands and the Chesapeake Bay. These programs are among the most informative models because of their relatively long histories. In the Northwest, issues of forestry, fisheries, and species protection are energizing moves to develop integrated resource

plans that achieve multiple objectives. The Pinelands and Chesapeake Bay experiences demonstrate the value of certain guiding principles:

- clearly expressed and understood needs;
- clearly expressed goals;
- good research;
- an open climate for discussion of issues; and
- genuine partnerships among stakeholders.

Critical Issues That a Program Must Address

Those involved in establishing and nurturing management programs must address a number of subjects that, if left unattended, can slow a program or derail it altogether.

- **Trust:** A major hurdle to implementing a program is trust in leaders and trust that there is a process that will empower people to work together to define and achieve common goals that they understand and support.
- **Leadership:** Traditional elected and appointed leaders may have less well defined roles and authority than in the past.
- **Definition of Roles:** Responsibility and authority may be unclear when there are conflicting mandates and unforeseen gaps in authority or responsibility.
- **Changing Roles:** The identity and roles of various stakeholders are difficult to determine and may change as a program evolves.
- **Lack of Clarity:** It is difficult to establish a clear vision or image of what an ecosystem is and how it directly affects or benefits people.
- **Problem Definition:** Failure to define the correct problem due to a lack of a systematic process or wrong stakeholders can waste time and resources.
- **Persistence:** Long-term planning horizons are difficult to reconcile with the short attention span of political bodies and the public. Political systems tend to throw money and resources at a problem for a few years and then migrate to a new crisis.
- **Abstraction and Size of Effort:** Large scale programs with multiple objectives and intricate interrelationships are too abstract to sustain attention. People tend to retreat to single-

issue stances where they feel they have a grasp of basics.

- **Good Data From Good Science:** Good science is important to define systems and their critical control factors, and to frame management options.
- **Separation of Science and Policy:** Distinctions between science and policy are often confused or obscured when developing alternatives and making decisions.
- **Urgency:** Management programs are difficult to implement without a crisis.
- **Measures of Success:** Success is exceedingly difficult to measure in the timeframe that most people expect to see results.

Leadership

Leaders of successful programs:

- establish and reinforce credibility;
- have clear vision and set specific and comprehensive goals;
- are willing to empower stakeholders and ensure an open climate for debate;
- ensure that funding and resources are available;
- identify the limits of a problem;
- require a systematic decision making process; and
- demonstrate their commitment to the process and to the implementation of the solutions selected.

The success of any program lies in the constituents' trust of the program's leaders. Trust is built through sustained credibility. In its simplest form, credibility is a measure of cumulative small successes forged from honest, fair, open, and even-handed pursuit of clearly articulated goals.

People expect leaders to be honest, hold to an ethic of service, and respect the intelligence and contributions of their constituents. They want leaders who will put principles ahead of politics and the interests of others before self interests.

Agency leaders as well as politicians need to empower people to take independent initiative that fits within an agreed upon framework. These actions should work toward a well defined set of goals and reinforce the actions of others.

In the Chesapeake Bay, for example, a group of twelve people, appointed by their respective governors to a panel of experts to address population growth and its impacts, included public officials,

elected politicians, academics, lawyers, and developers. All were leaders in their own right, but worked together to achieve a consensus, and then returned to their leadership roles in their own communities. The group was able to take advantage of the leadership qualities of each person. Each person was able to contribute based on his or her leadership qualities, but did not seek to dominate.

In ecosystem management programs, leadership can come from any quarter. In both the Chesapeake Bay and the Pinelands, leaders include fishermen, businessmen, developers, farmers, environmentalists, and citizens, as well as public officials. Those who were empowered to implement specific activities showed leadership as well. They listened well. They ensured an open climate for transfer of insights and opinions and were not overly directive of the process. They were patient in the definition of problems and in the selection and use of data. They were open to the opinions of others. They were willing to deal with uncertainty and look at alternative outcomes.

The leadership pool can include agency personnel, retired professionals, dedicated self-trained citizens, and others. One often overlooked source of leadership is the business community. By tradition, we ascribe to business managers a streak of almost pure self-interest. In fact, this group is no less heterogenous than the public-at-large when it comes to values, vision, and ideals. But, they have talent and experience needed in consensus building including negotiation skills, compromise identification, logical thinking, and a "cost-benefit" outlook.

From our experience, the most successful leaders are able to describe the need for specific projects or activities in ways that everyone involved can understand. During implementation, the description of need is continually reiterated so people always understand why the project is being undertaken.

Successful leaders also have the authority and ability to bring the necessary resources to bear when they are needed. Once momentum has developed in a program, leaders provide the resources needed to maintain it.

In order to implement a decision a leader must:

- map a clear decision pathway that includes the project team, the public, and the decision making body;
- participate at key points in the decision process;
- help the project team break tasks into manageable short-term and long-term elements; and
- demonstrate and publicize success.

- understand the functioning and critical control points of their ecosystems;
- maintain state-of-the-art research efforts;
- make policy decisions based on the best science available at the time;
- monitor and reassess policy decisions; and
- demonstrate expertise.

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In programs that cross jurisdictions and authorities, lines of authority are ill-defined. As agencies increasingly work cooperatively and jointly, their roles become based more on a "natural" authority and are less defined by agency traditions. Setting goals and objectives that are broader than their mandate will be difficult for individual agencies; they will need to rely on the good offices and efforts of others to achieve their aims. Leaders within these agencies will need to find new ways to empower groups to work together. This will increase the pressure on leaders to have a coherent vision, explain it well, and motivate people to achieve it.

Balance of Science and Policy

Successful program managers:

Ecosystem management must build on observational, analytical, and experimental science. Policy decisions have little chance of being sustained without a good scientific foundation. Scientific study is needed to define system boundaries and describe a system's functions. These findings lead to the identification of critical elements for management and control. The process is seldom simple; information is always incomplete and rarely points to an obvious management strategy. One risk is that ecosystem analysis and understanding can become an end in itself, a sort of refuge from confronting tough management choices.

There is a flow of personnel between the scientific and policy communities. Over time, those not formally trained as scientists gain substantial scientific knowledge. Conversely, a scientist is not unaware of the policy debates that are taking place. The difference between the role of science and the role of policy can get blurred and confused. Because science is so important in understanding a system and the consequences of different actions, scientific arguments often appear to take the place of public policy. Policy must be based upon the best scientific information, but must be clearly separated from scientific judgment. Policy weighs scientific information along with social objectives, ethics issues, and philosophical concepts.

Demonstration of scientific and management expertise are important. Both the Pinelands and the Chesapeake Bay programs have maintained extensive research and monitoring programs. The Pinelands also became a laboratory for land use management techniques. Transfer of development rights, infrastructure boundaries, and a wide range of performance and incentive approaches have been used over the past 12 years.

Both programs were also willing to make the policy decisions needed in or-

der to begin to meet their goals. Just as important is their willingness to reexamine earlier policy decisions in light of new information.

Public Policy and Public Involvement

Successful programs:

- have goals that are embraced by leaders at all levels of government, the community, and business;
- ensure that diverse participants are brought into the process early, have a generous opportunity to participate, and are afforded a productive long-term role;
- maintain continual public and institutional education programs; and
- create icons or symbols as part of the education process.

Leaders and managers cannot develop, monitor, revise, and implement a program alone. No single group of landowners, organizations, or communities can implement a broad-based program. Everyone shares responsibility for getting extraordinary things done through ordinary means.

Pinelands, the Chesapeake Bay, and similar programs everywhere, undergo continual examination as a normal part of political processes. Some interests, generally those not extensively involved in building a program, are continually pressing for their particular objective or view. Because of their broad support and extensive public involvement, both the Chesapeake and Pinelands have met these challenges with success.

Implementation of ecosystem management programs requires strong support from political, community, and business leaders. Because of political pressures, diverse and broad based support are critical to sustainable programs.

Unfortunately, it is difficult to energize a program without a crisis. A major challenge with ecosystem management will be to continually educate people about why certain practices and activities are necessary, especially those that affect people's livelihoods, recreation, or freedom to do what they want with the land.

Successful programs create educational and public awareness campaigns that establish and promote symbols or icons that are identified with the program or the resource. In the Pinelands these include the pine tree, tree frog, and the traditional Piney culture. In the Ches-

apeake Bay they are skipjack sailing craft and the blue crab. Folk culture is also stressed. Each symbol had a purpose: to be a readily identified image or rallying point. These add a sense of romance and nostalgia that develop "connections" to the resource at a personal level.

Both the Pinelands and the Chesapeake Bay programs found ways to get ecosystem management accepted into the social and institutional fabric of their respective areas. While there is no set formula, successful programs appear to have several common characteristics, including patience to allow the programs to mature and constant involvement of people at all stages.

From the start, the public should be involved in the process of developing a program, and its role should be maintained throughout the decision making process. This is a key element in most successful programs. It is difficult to include all interests and a diversity of viewpoints, but doing so is necessary for a program to be credible and to be adopted as a way of behaving and thinking about the managed resources.

Decision Process

Successful programs:

- work to frame the problem correctly;
- look for integrated solutions;
- develop balanced, comprehensive alternative approaches from which to choose;
- use a full set of implementation and land use tools;
- involve the broader community and businesses; and
- demonstrate success.

The quality and openness of a decision making process are nearly as important as the quality of the results. Even with a host of decision tools and a stack of scientific reports, decision making remains fundamentally a human process subject to human error, bias, and folly.

Few people are trained in decision making. Most rely heavily on old habits or simplifications, which can lead to adversarial processes rather than genuine problem solving and decision making processes.

Success is highly unlikely in the absence of a systematic decision making process that frames problems well and identifies a comprehensive set of alternative actions. In both the Pinelands and the

Chesapeake Bay projects, framing problems correctly was difficult. It required more time and effort than people had anticipated.

A good decision making process:

- details goals, objectives, and values;
- distinguishes the roles of science and policy making;
- emphasizes which data are important to problem solving and decision making;
- establishes a traceable and open record;
- achieves credible results; and
- makes the best use of limited resources.

Clear goals and a structured process for decision making provide all parties with a forum for exploring issues, conducting analyses, and integrating ideas and concerns. It is also a useful forum for linking policy to technical assessments, so that the analysis is directed by and informs policy.

Measuring success is difficult in natural resource management. Both the Pinelands and Chesapeake Bay staff have been working on research to show progress. This is difficult because most objectives are long-term, with results in the future. Rapid, dramatic results are infrequent. Whenever there is progress it needs to be celebrated. For example, the rebound of the striped-bass population in the Chesapeake Bay over a relatively short period is seen as real progress. Efforts to develop and publicize environmental "score cards" are helpful in maintaining the public's attention and interest. It is important to have a mix of both short-term and long-term goals to allow for early demonstration of progress.

IMPLEMENTATION

Implementation requires money, and funding is always a problem. Support must come from all levels of government and the public. Most "programs" are not single programs, but clusters of strategies and independent programs and plans, worked out over time among a host of groups, within a generally accepted policy and goal framework. Funding for these individual efforts ebbs and flows. At the same time, the voluntary efforts of many individuals and groups play a significant role both in developing a public consciousness and in dealing directly

with problems that are amenable to volunteer action.

Administrative barriers often cause natural resources and public lands to be administered differently by different agencies. Resource management is so complex and undergoes so much scrutiny that agencies are compelled to work together to address mutual problems. This need to work together is bringing down the barriers. Multiple objectives are replacing single or limited sets of objectives. For example, the federal Endangered Species Act (16 USC §§1531-1544) requires protection for listed species. Initially, implementation of this law focused on preservation of the species. This has evolved to a focus on protecting critical habitat for the organism, and not just the organism alone. In turn, there is now an understanding that multi-species systems or landscapes are vital for achieving a sustained population of a species and its related natural community. Thus, entire ecosystems need to be evaluated and have management strategies developed for them to successfully protect target species.

In a similar way, water is being looked at as part of a broader set of integrated resources. In nature, water shapes and is affected by environmental conditions. Its seasonal availability, volume, quality, and other characteristics are important to maintaining aquatic and terrestrial systems in a healthy state. Public water supply resources are now recognized as being related to other natural resources and resource values. Because diversity also exists within the water resource itself; the need for an integrated strategy for supply development, storage, use, treatment, reclamation, reuse, and conservation is a common concern for water suppliers and managers.

Separate environmental laws designed to protect either natural conditions or human health are merging at the program implementation phase. Rather than waiting for a species to achieve endangered status, we are looking at entire ecosystems as natural reserves of biological material to sustain a web of relationships. To reduce the need for filtration and chemical treatment to prepare water for human

consumption, we are looking at water supply watersheds as assets to be managed so as to reduce or eliminate the need for treatment, which itself can generate undesirable byproducts.

Combining the thrust of natural resource and public health laws with the requirements of the National Environmental Policy Act (42 USC §§4321-4370(d)) and its state-level counterparts, it is clear that integrated management of resources based on public involvement and analysis of alternatives is becoming the norm. Adversarial clashes in which champions compete to "win" a battle over how to manage a particular resource are anachronistic. Integrated planning will be a basic method of addressing a host of issues simultaneously. Public participation in decision making, calculating risks, monitoring program results, and replanning will be common to all resource management programs.

The watershed restoration and forest management planning being undertaken in the Northwest illustrates many of these points. Concern and energy to undertake programs reaches to the grass roots in communities hard hit by the collapse of local resource-based economies. There is a need for partnerships among landowners and regulators to develop long-term strategies for land use and land protection. Incentives are needed, too, for private land managers to protect publicly valued goods in the land. Such incentives are beginning to emerge from discussions. Jobs increasingly include working on restoration projects and other management programs as well as traditional resource-based employment.

CONCLUSION

For the resource owner expecting to get a yield or product from his or her property, predictability in the administrative management of key resources is a critical factor. To avoid a continual "revolving door" in which landowners are never sure what the next issue or species will be that will prevent their economic use of the land, multi-species habitat protection plans are rapidly becoming the norm. Under such plans, land managers will have a predictable, sustainable yield

of resources, while the publicly valued goods in the land remain protected.

This type of thinking goes beyond "interagency coordination." Resource agencies are themselves members of a larger resource team and must begin to bring their special knowledge to bear as members of the team. For instance, the EPA is now organizing to regulate impacts on a watershed basis. Rather than segregating various pollutants by the medium they pollute, the EPA is looking at integrated land-water-air solutions. Neighboring land owners, environmental groups, county agencies, and state and federal resource agencies are seeking voluntary collaborations to create plans for watersheds in both rural and urban areas.

A clear example of bringing diverse parties together to review and explore options was the Northwest Watershed Restoration Conference held in Tacoma, Washington in early 1994. Central messages coming from the conference are applicable elsewhere:

- Watershed restoration activity will not be controlled by a central authority; it will be the result of a number of public-private programs.
- Local political and opinion leaders must be involved in a coordination strategy.
- Public agencies must share resources, experience, and data.
- Agencies have an opportunity to develop new project delivery systems to ensure that work is accomplished in a timely manner and that local skills are developed and used in practical management solutions.

Resource decisions are shaped by both technical considerations and individual or collective values. Balancing technical and social input is central to resource management. For instance, knowledge of technical issues, such as development cost, risk, environmental impact, quality, and reliability is essential to the development of a well-informed water supply plan. But this technical knowledge alone does not determine the plan's final shape. The most viable alternatives are those that have successfully balanced technical and economic criteria with local, regional, and national values.